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.

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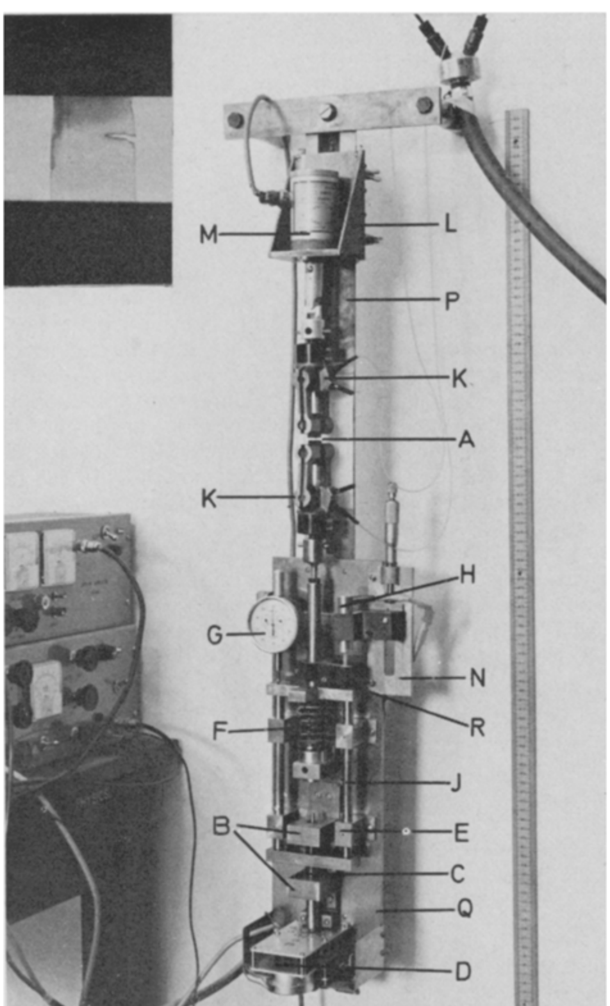
PRO EXPERIMENTIS

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

[1] G. A. M. Butterworth and N. J. Abbott, J. Materials *2*, 3 (1967) 487–518.

perturbations when switching. The rate of extension is adjustable from 7 μm/min to 3500 μm/min and calibration is effected by means of a built in dial-gauge (G) with a range of 5 mm and a resolution of 1 μm (Tenso, Huggenberger, Zürich). The construction of the system is sufficiently accurate to ensure smooth movement at the micron level, and a compressed automobile valve-spring (F) (c. 5 kg/cm, BMC, Coventry, U.K.) is used to eliminate backlash in the screw system.

The force transducer (4.5 kg max., type UF2, Pye-Ether, Stevenage, U.K.) is rigidly mounted on a brass plate attached perpendicularly to the sliding saddle. The mounting holes in this plate are slotted so that accurate alignment of the system is possible. The compliance of the transducer is such as to produce an error of only 0.04 mm at maximum loading.

Two types of specimen grips are used, depending upon the nature of the specimen. For horizontal operation with very fragile specimens, the specimen ends are cemented to 2 flattened rods which screw into the force transducer and sliding frame respectively. For routine measurements on less fragile samples, Instron pneumatic grips (K) (type 2710-002, Instron Ltd., High Wycombe, U.K.) are used, and the device is operated in the vertical mode. The upper grip is suspended on gimbals.

Each measuring system, for force and displacement, utilizes a coherent amplifier designed and described by GERARD[2]. The transducers are activated by stable audio-frequency oscillators, which also supply the reference signals for the coherent amplifiers. The output from each transducer is fed into a coherent amplifier and a D.C. voltage is obtained which is accurately proportional to the property being measured. These rectified outputs drive the appropriate channels of an X-Y recorder. In this way, accurate measurements of force versus extension are recorded continuously over wide ranges of sensitivity and with a linearity of better than 1%[3].

Zusammenfassung. Es wird eine einfache und ökonomische Vorrichtung zur kontinuierlichen Aufzeichnung von Druckbelastungs- und Spannungs-Kurven biologischer Baustoffe beschrieben.

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[2] V. B. GERARD, J. scient. Instrum. (J. Phys. E) *1* ser. 2, 552 (1968).

[3] Acknowledgment. The authors are grateful to Mr. T. B. DOYLE for his assistance with the electronics.

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A Microtube Oscillation Method for Cellular Reaggregation

Cell aggregation has been used to study both histotypic rearrangement (MOSCONA[1]) and the strength of cellular adhesion (EDWARDS[2]). A comparison is made in the Table, between various methods, contrasting numbers of cells needed, the interference of a solid surface, and the facility for observing the formation of individual aggregates. (CURTIS and GREAVES[3], CUNNINGHAM and HIRST[4], JONES and KEMP[5], OPPENHEIMER and OLDENKRANTZ[6], HENKART and HUMPHREYS[7], ROUX[8] and HERBST[9]).

This paper describes the use of an acoustic pump for studying aggregation of very small numbers of cells in suspension, under direct observation.

Materials and methods. HeLa cells, CBM17 cells, (FRANKS and HENZELL[10]) or primary mouse embryo cells were suspended, at a density of between 10^4 and 10^5 per ml in culture medium with Hepes buffer and calf serum. Aggregation chambers were made from the fine ends of disposable Pasteur pipettes. These were bent through 90° about 1 cm from the end, and again in a plane perpendicular to the first bend a further 3 cm along the tube. They were cut 3 cm beyond that and were flame polished. Each tube was fitted with a minute, centrally bored, silicone rubber bung, and was sterilized by dry heat.

The bungs fitted into a short plastic tube connected to the ear mould connection of a Madresco OL 575 hearing aid earpiece. The latter served as a pressure transducer, driven by an oscillator operating at low audio frequencies (20 to 200 Hz).

The open end of the tube was submerged in liquid paraffin in a Petri dish; the entire apparatus being held with Plasticene upon an aluminium plate with a central hole. A second tube, not connected to a transducer was

Method	Direct observation of aggregation	Cell numbers needed	Third phase attachment	Principle	References
Shakerflask	None	High	None	Cell collision	1
Turbidimetric	None	High	None	Cell collision	3–5
Miniature shaker	None	Moderate	None	Cell collision	6, 7
Settling	Satisfactory	Low	Dominant	Cell rearrangement	8, 9
Microtube oscillation	Satisfactory	Low	None	Cell collision and clustering	