our current knowledge. There seems, then, to be a need for a measure of discriminability which does not imply commitment to a particular model. Such a non-parametric measure should have the properties of being quick and simple to use, and should be monotonically related to d', so that the rank ordering of results may be unaffected whichever measure is used.

For recognition experiments, Brown[5] proposed just such an index. Pleasing though it was, however, it had originally the limitation that a number of examples of "noise" and of "signal and noise" had to be presented simultaneously. It is often desirable, and sometimes unavoidable, to present items sequentially. Brown has therefore modified his index (personal communication, 1971) for this condition. It is, however, computationally a trifle laborious, and there is clearly a need for a measure which is consistent and which can be derived as simply as possible from the data for the ROC curve. The following alternative is therefore suggested.

Let subjects be presented with a sequence of samples of As and Bs. They are asked to give confidence ratings from 1 = certainly A to r = certainly B. Compute the mean rating for As ($=N$, say) and for Bs ($=n$, say). For perfect discrimination, $N=1$, $n=r$; for random responses $N=n$, clearly. Let C be the index, defined as

$$C = \frac{n - N}{r - 1}$$

It can be shown that C is monotonically related to d', and it is obvious that $C=1$ for perfect discriminability, 0 for random response, and lies between 0 and -1 for consistent error.

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Wishful Thinking of Turgor

Reviewing work by Rayle et al.[1] a correspondent has written[2] that plant cell growth is a simple process, and continues, "There is a strong osmotic tendency for water to enter a . . . growing cell, but this is prevented by the rigidity of the cellulose walls". (Hydroxyproline bridges in the wall limiting growth are located in the amorphous matrix; hence a unique role of cellulose as resistance in the wall is questionable[3].) The first sentence is dubious. Cleland[4], however, has expounded the matter: "This potential for extension can . . . be converted by turgor pressure into . . . wall extension". This adds to the doubts because the rigidity of the walls preventing the entry of water is the cause of the turgor pressure, which arises as a consequence of the resistance of the wall to an expansion. How then can the turgor pressure cause expansion? A simple answer is given by Green et al.[5]: "Plant cell growth is . . . believed to be the result of a driving force, turgor pressure,

acting on a yielding cell wall". Many authors prior to them have written the same for 40 years, usually without the cautious "believed to be".

The conditions conducive to expansion are expressed in the following universally accepted way: $\psi_c = P - \pi$ . . ., in which ψ_c means the water potential of the cell, P, turgor pressure, π, osmotic potential, and other terms have been left out in this context[6].

If the tissue is in equilibrium with the ambient medium $\psi_m = \psi_c$, where ψ_m denotes the water potential of the medium. Actually the water permeability is usually so high that these two are always equal. That is why the first quoted phrase of Nature's correspondent is ambiguous. The origin of P is, as mentioned, the resistance of the cell wall to expansion. A cell ceases to take up water when $\psi_m = \psi_c$ and P reaches a maximum. Turgor is built up because there is an expansion. Thus turgor does not cause expansion and is not the driving force. What this is I shall show later.

First I shall consider growth. It begins with a loosening of the wall, demonstrated by Cleland and many others. It can certainly take place in different ways[7]. It implies that the resistance to an expansion decreases, P would attain a value P_x with $P > P_x$. Thus $\psi_m > \psi_{cx} = P_x - \pi$ . . . . This causes an immediate expansion. The driving force is the difference $\psi_m - \psi_{cx}$. After expansion $\psi_m = \psi_c = P' - \pi'$: . . ., with P' and π' lower than P and π. This is elementary and was formulated in 1920 with other symbols. The driving force of any expansion is a difference in water potentials. Expansion is due to water uptake. Volume changes during growth should best be expressed in terms of water fluxes[8]. Unfortunately, the phrase "turgor expands the cell" was coined in 1931 and has been copied dogmatically in untold articles, although the mistake has been pointed out repeatedly[9,10].

What the erroneous opening "turgor expands the cell" may lead to is shown by Green et al.[5] who assume as an axiom or a corollary that growth (r) is proportional to P: $r=mP$. Since experiment fails to submit to the assumption, they introduce a correction factor, Y, called yielding threshold: $r=m(P-Y)$. This does not suffice because growth is practically independent of turgor. Thus they assume that Y shifts with P, otherwise $P-Y$ will not remain constant. It seems to me that little is left of the proportionality between P and growth in this instance.

The mistake made since 1931 is to regard the cell as something existing in an empty space, disregarding the ambient medium and external hydraulic pressures[5].

The literature on plant cell growth would certainly improve if the notion of turgor expanding the cell was abandoned and replaced by accepted equations for water balance or fluxes. They must be valid in growing as well as non-growing cells, perhaps with the addition of terms denoting cell wall changes[11] in growing cells.

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