

human beings)³, it is quite conceivable that the endogenous piperidine may be influencing behaviour. Von Euler³ had speculated that, because of its nicotinic property, piperidine may be regarded as an endogenous 'synaptotropic substance'. An important problem is to determine whether piperidine is synthesized within the body or arises from some exogenous source. In plants, piperidine and other cycloalkylamines are derived from amino-acids such as lysine, ornithine and proline⁶; but there is no evidence that such biosynthetic pathways can occur in mammalian systems. The presence of piperidine and other volatile amines in the central nervous system⁴ nevertheless suggests the existence of many endogenous agents capable of influencing or regulating neural function. One exogenous source of piperidine is directly through the intestinal flora which can decarboxylate lysine to cadaverine, while the latter product is de-aminated and cyclized to form piperidine.

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STATISTICS

Nodal Analysis of Associated Populations

A METHOD of subdividing an associated population the individuals of which are specified by the presence or absence of a number of attributes has been described previously¹; the process is ultimately derived from the *R*-techniques of factor analysis, and the groups of individuals so obtained will be called *R*-groups. The attributes may similarly be subdivided into *Q*-groups by the corresponding *Q*-techniques. There results a 2-way table in which every attribute-individual record is referred to one of each kind of group. The requirement is to extract from this table the most concentrated groups of records, the attribute-individual noda around which the population may be regarded as varying. The problem is essentially that of establishing coincidences between *R* and *Q* factors; even in normal factor analysis the coincidences are impaired in the formation of the correlation matrix^{2,3}, and in a subdivision process involving successive correlation matrices the divergence may well be considerable.

Despite many attempts, we have found no way of operating directly on the 2-way table, and have therefore devised a method which involves finding the

best possible coincidences with each direction taken as reference direction in turn, followed by collation of the two sets of results so obtained. The population is first *R*-divided, producing a group of individuals defined by the possession of the attribute *a* with the highest loading on the first centroid *R*-axis. The same population is then *Q*-divided; that individual (*i'*) which, of those possessing *a*, has the highest loading on the first centroid *Q*-axis is used to delimit the group in the other direction. The residual group is similarly delimited by the individual with the highest loading among those not possessing *a*. Each resulting group we call an *RQ*-group. The division is continued to the significance-level required, resulting in a series of *R*-groups, with each of which is associated its corresponding *RQ*-group. It will normally be desirable to set a lowest acceptable limit for the loading of *i'*; if no individual attains this level, *RQ* is set $\equiv R$. The transpose of the entire process similarly gives a series of *Q*-groups together with their corresponding *QR*-groups.

Collation consists in taking one group from each side and subjecting the pair to a logical 'and' operation, whereby only those records common to both tables are retained. The conditions for collation are obtained from the singly defined (*Q*- and *R*-) tables. If any *R*-individual possesses all the *Q*-attributes and any *Q*-attribute occurs in all the *R*-individuals, *QR* is collated with *RQ*; the result is a nodum. If any *R*-individual possesses all the *Q*-attributes, but no *Q*-attribute occurs in all the *R*-individuals, *QR* is collated with *R*; the result is an *R*-subnodum. The transposed situation will give a *Q*-subnodum. If neither condition is fulfilled, all records common to *Q* and *R* are discarded. In the unlikely, but perhaps not impossible, case where collation is permissible but the nodum vanishes, the coincidence may be treated as intersecting subnoda.

The noda are extremely concentrated, and contain all the genuinely central information at the significance-level in use. They are not, however, necessarily all the same type. All are defined in the form (*a'i'*); but a nodum may also contain *a* and/or *i* (the attributes and individuals which define the non-residual *R* and *Q* groups), and the presence of these may be regarded as conferring a rise in status on the nodum. The subnoda constitute a penumbra of diffuse groups, some at least of which would become noda were the subdivision to be carried further on one side or the other by lowering the significance-level; they are always defined as (*a'*) or (*i'*), but their status can rise to (*a' i*) or (*i' a*).

Our existing *Pegasus* subdivision-programme limits the analysis to a 76 × 76 population matrix. As yet, we have applied the method only to ecological data, but with very promising results. Whereas our earlier *R*-subdivisions^{4,5} gave only groupings of quadrats on species-attributes, the 2-way tables provide a double abstraction in terms of both plant and habitat: the doubly defined noda thus represent true 'vegetation-units' in the widest sense.

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