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## SHORT COMMUNICATION

# REVIEWING THE CHROMOSOME NOMENCLATURE OF LEVAN *et al.*

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The nomenclature for chromosome morphology on the basis of centromeric position was reviewed by Levan *et al.* (1964) in an almost definitive way. For these authors the chromosome should be denominated as *M, T, m, sm, st* and *t.* The first two types would be utilized for chromosomes whose centromeres are located exactly on the median and terminal *points,* respectively, whereas the other four types designate chromosomes whose centromeres are located in median, submedian, subterminal and terminal *regions* respectively.

Although the above article has been cited by many authors, only some of them have rigorously followed this nomenclature. Most of the authors use the terms metacentric, submetacentric, acrocentric and telocentric, terms which are not recommended by Levan *et al.* Thus we have two nomenclature systems: one with six chromosome types and the other with four types.

This confusion is obvious when we observe the nomenclature used by the authors of some cytogenetics textbooks. John and Lewis (1966) classify chromosomes as meta-, acro- and telocentric, whereas Brown (1972), Stebbins (1971) and Swanson *et al.* (1981) use the four types, i.e, meta-, submeta-, acro- and telocentric. Saez (1978) and Schulz-Schaeffer (1980) use these four types as well as the term subtelocentric which they use as synonymous for acrocentric. White (1977) uses the terms meta-, acro- and telocentric and suggests the terms subacrocentric, heterobrachial metacentric, and isobrachial metacentric. Bostock and Sumner (1978) explicitly avoid a discussion about this terminology.

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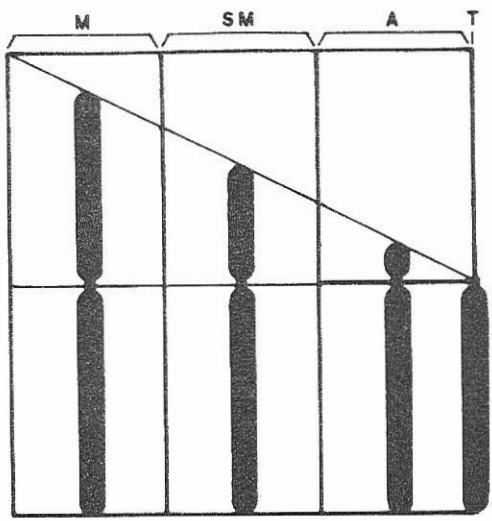
The term telocentric (*T* in the nomenclature of Levan *et al.*) is classically used for chromosomes with the centromere situated exactly at the terminal position and only in this sense is the existence of natural telocentrics discussed. But the *t* chromosome of Levan *et al.* corresponds to the acrocentric in the four-type system, whereas the *st* has no correspondence in this system. Furthermore the term sub-telocentric is not recommended by these authors. On the other hand, the designations *M* and *m* should both correspond to metacentric, and *sm* to sub-metacentric. However, they do not correspond because Levan *et al.* have divided the interval between the extreme types (*M* and *T* points) into four equal regions (*m, sm, st,* and *t*) whereas if we admit only four types with the telocentric as an extreme situation, without variation, we should divide this interval into only three regions – the metacentric, the sub-metacentric and the acrocentric.

Although the tendency to reduce the six types of Levan *et al.*'s nomenclature to only four types might seem to diminish the precision, in fact it will facilitate the definition of each one. We know that chromosomes are very small objects whose exact measurement is subject to error due to differential arm contraction, mechanical distortion, inadequate staining as well as some other difficulties (see Sybenga, 1959; Egozcue, 1971). So, for most species it is almost impossible to assert that a chromosome with 1 $\mu$m length is really an *st* and not a *t* one.

Although the predominant nomenclature used is the four-type system, a




| | | | | |
|---|---|---|---|---|
| ar | 1.00 to 1.49 | 1.50 to 2.99 | 3.00 to ∞ | ∞ |
| ci | 50.0 to 40.1 | 40.0 to 25.1 | 25.0 to 0.01 | 0 |

Figure 1 - Limit values for each morphological chromosome type. M, metacentric SM, submetacentric; A, acrocentric; T, telocentric; a.r., arm ratio; c.i., centromeric index.

determination of the limits for each type has not yet been proposed. Using the scheme of Levan *et al.* we can easily determine these values. Taking a telocentric as a chromosome whose centromere is strictly terminal we can only divide the regions between the two opposite extremes into three equal intervals whose ranges of variation are represented in Figure 1. The arm ratio was calculated as done by Levan *et al.* (length of long arm divided by length of short arm) and the centromeric index by dividing the short arm by total length x 100 as commonly used for human chromosomes (Paris Conference, 1971). In this way we believe we can associate the great advantage of a numerical definition of the chromosomes types, as proposed by Levan *et al.*, with the commonest nomenclature currently accepted by most authors.

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