GENERAL NOTION OF RELATIVE VOLUME OF STEM AND ITS GROWTH

(Summary)

Let us consider a stem which has the total height of h and the diameter of $d_{0.9}$ at nine-tenths of the total height from the top. $d_{0.9}$ should be called the normal diameter in this report. Now, we generally express the stem curve by the function Y = F(X), where Y is radius at distance of X from the top. If we put x = X/h and y = $Y/d_{0.9}$ in the above formula, we have the relative stem curve. Revolving the relative stem curve around its x-axis, we obtain a solid, in which both the height and the diameter at distance of nine-tenths are equal to 1. We will call such a solid the "fundamental body", and its volume the relative volume, which is given by

$$\theta_{0.9} = \pi \int_0^1 \{f(x)\}^2 \, dx$$

As the actual stem can be regarded as the fundamental body expanded by h times for the height and $d_{0.9}$ times for the diameter, its volume can be expressed by the formula (6).

The form of the vertical profile containing the axis of the fundamental body means the relative stem form. Therefore, the relative volume is useful as an index of the relative stem form, and the actual form of the stem is given by the relative stem form and the ratio of the height to the normal diameter, as shown in Fig.1.

From its determination, the relative volume is independent of the height or the normal diameter. Therefore, the volume of a stand which is composed of the number of trees of N is given by the formula (14). This is advantageous for analysing the stand structure.

In order to make clear the process of growth of the relative volume, we chose 5 sample trees from each of two artficial and even aged stands of Cryptomeria japonica (Tables 1 and 2), and for each of them, calculated the relative volumes by age class, applying the method of the stem analysis. The results are shown in Tables 3 and 4. Using the mean values of relative volumes by age class, we obtained the growth curves as presented in Fig. 4. From the results, it may be recognized that the relative volume of stem increases with age, approaching a upper limit. But it may be possible that the relative volume first increases with age, and then, after reaching its maximum at a relatively higher age, decreases gradually.

Examples of developement of relative stem form are shown in Fig. 5 and 6.

As shown in Fig. 7, the relation between $\theta_{0.9}$ and the relative middle diameter $\eta_{0.5}$ is so close that we may estimate the value of $\theta_{0.9}$ by measuring $\eta_{0.5}$.

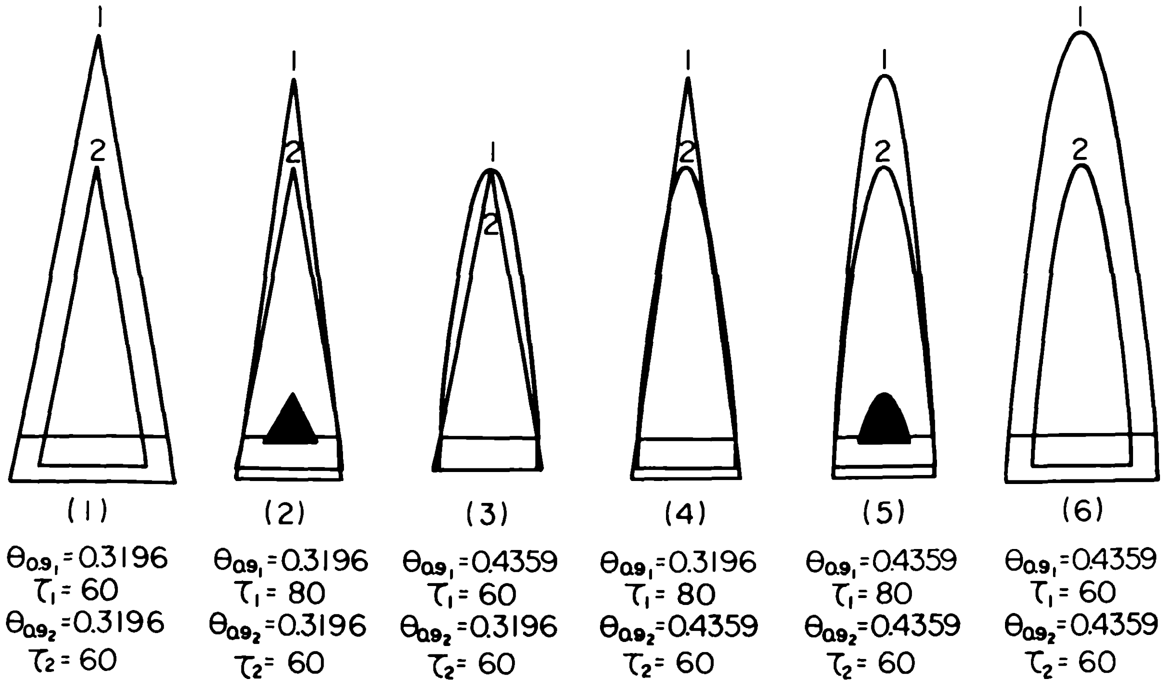

Fig. 1 Diverses formes des tiges provenant de deux formes géométriques Cône et paraboloïde.
Various stem forms derived from the two geometric forms: Cone and paraboloid.

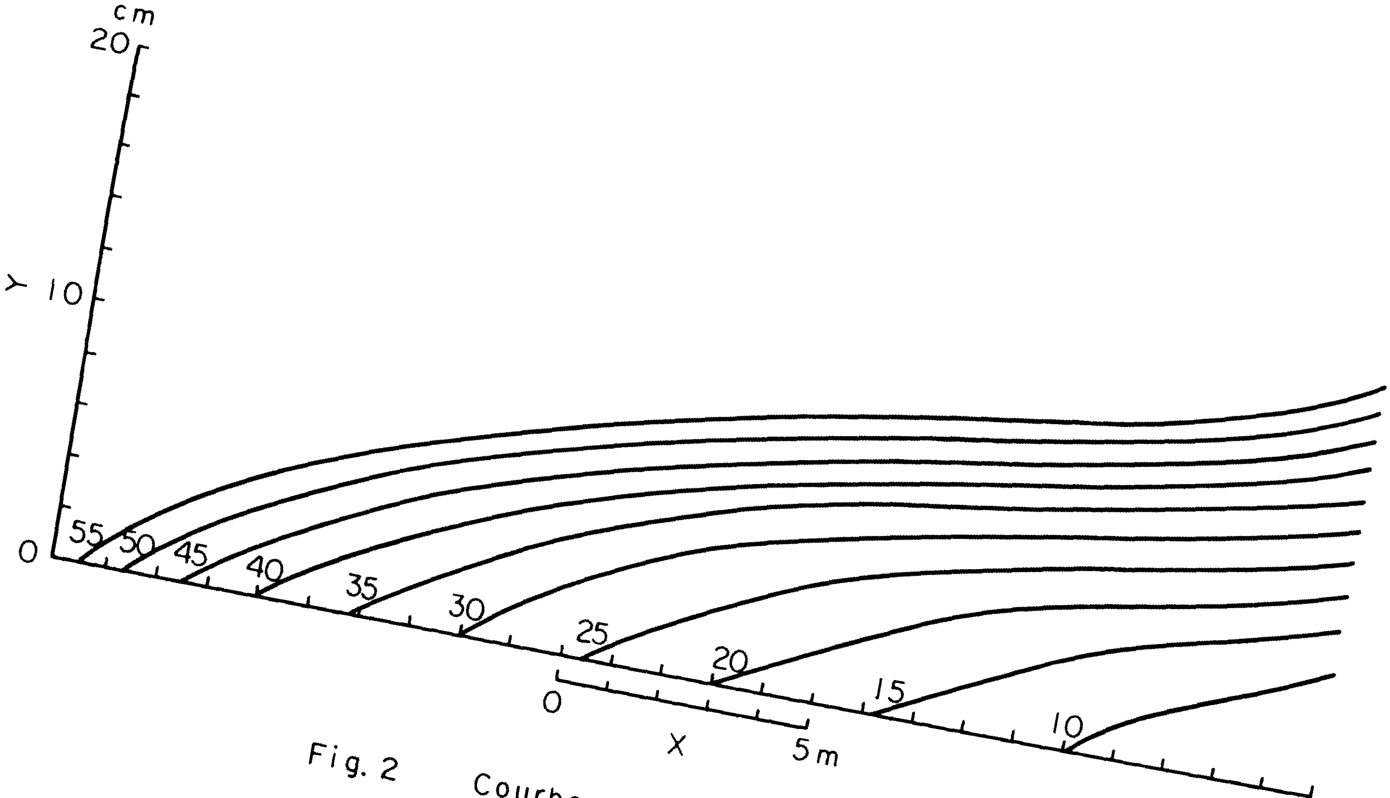

Fig. 2 Courbe actuelle de tige (I-N°1)
Actual stem curve (I-No.1)

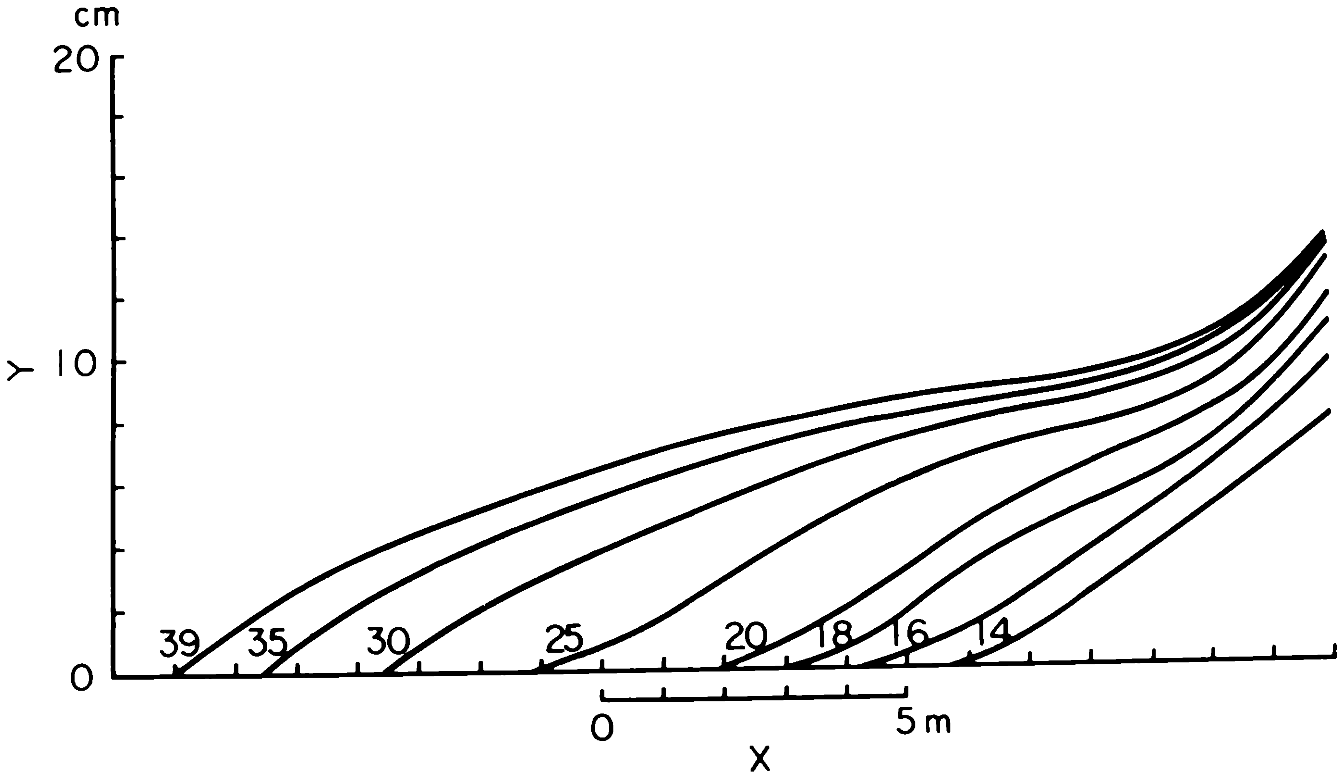

Fig. 3 Courbe actuelle de tige (II – N°1)
Actual stem curve (II – No. 1)

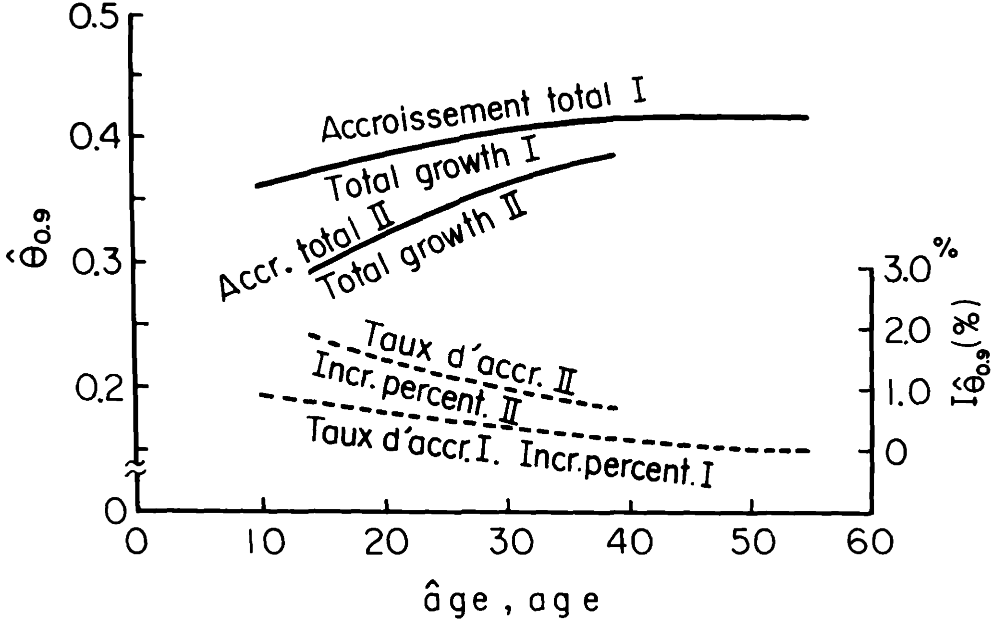

Fig. 4 Accroissement de $\hat{\Theta}_{0.9}$, Growth of $\hat{\Theta}_{0.9}$

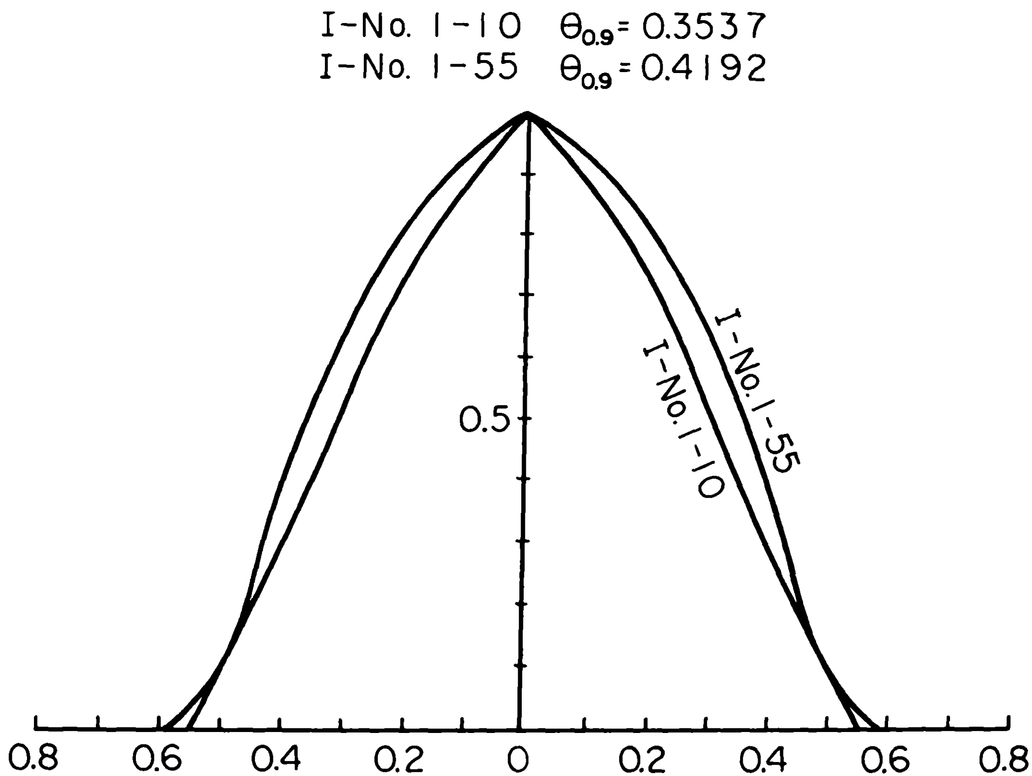

Fig.5 Développement de forme relative de tige (I-N°1)
Development of relative stem form (I-No.1)

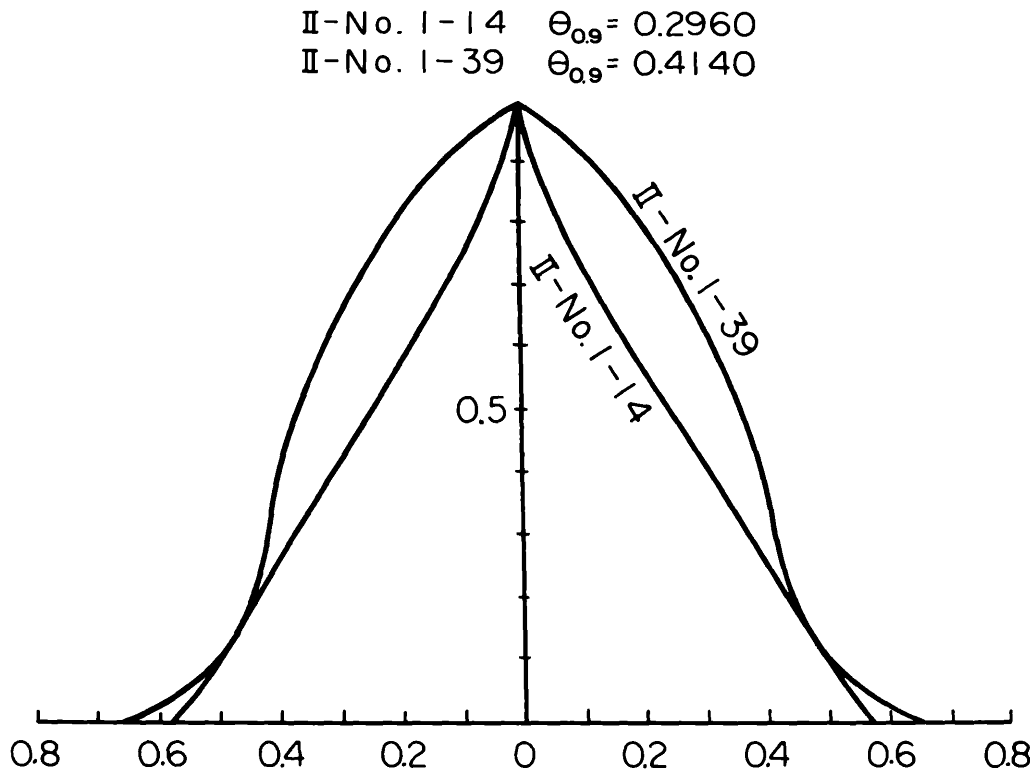

Fig. 6 Développement de forme relative de tige (II-N°1)
Development of relative stem form (II-No. 1)

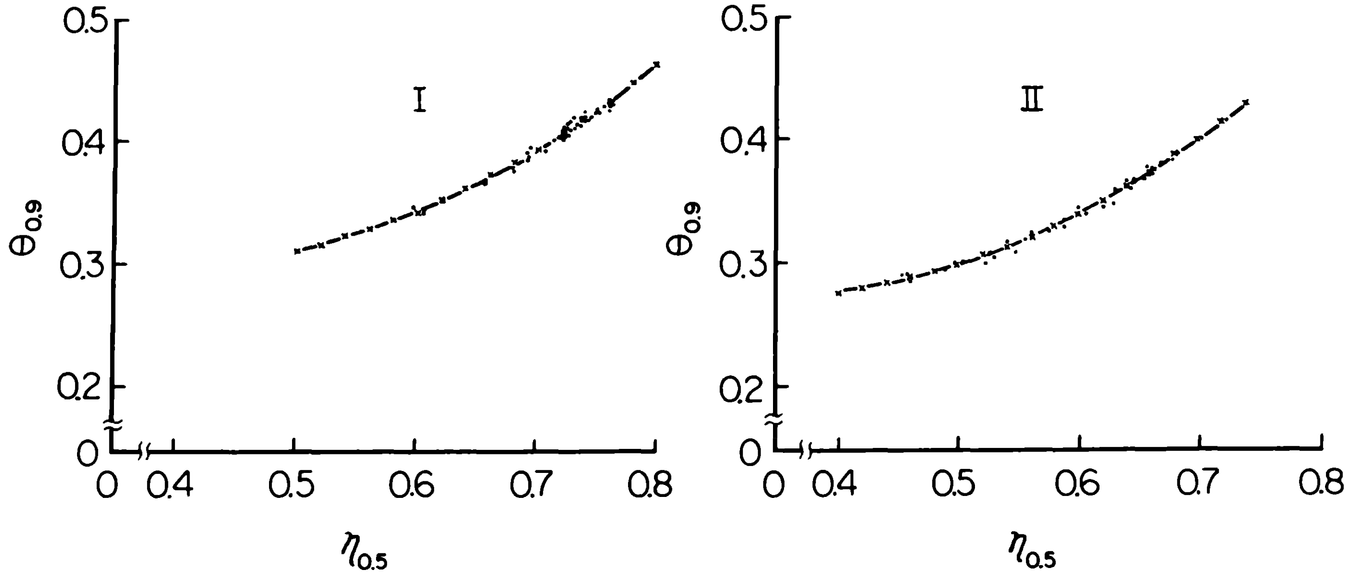

Fig. 7 Relation entre $\Theta_{0.9}$ et $\eta_{0.5}$

Relation between $\Theta_{0.9}$ and $\eta_{0.5}$