the secondary growth of the stems and there are indications that the so-called sliding growth of the tracheids in conifers may be intimately connected with the development of an increasingly inclined slant to the grain of the wood. Further knowledge on the growth of wood elements from the cambial initials is required to enable us to understand exactly what happens, knowledge to which Prof. Priestley's studies in Leeds are making important contributions.

Unless Dr. Copisarow can develop his suggestion so that it will account for twist predominantly in one direction or another irrespective of soil, and for a change over in direction with time, it does not take us much further than my own made in 1925, that such a detail as the prevalent direction of circulation of the cell contents (if they do circulate at all) might decide the initial direction, and sliding growth might accumulate small inclinations (if the tracheids do slide or anything like it).

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Dec. 1.

[1] NATURE, 130, 541, Oct. 8, 1932.

Spectrum of γ Cassiopeiæ

SINCE photography was first applied for recording the spectrum of this bright star, its spectrum has always been considered to be of a constant character. In 1928, I announced that a slight change had taken place, and since then I have made numerous observations which completely corroborate its variability. The relative intensities of the bright components of the hydrogen lines in the latter half of 1931 were such that the red components were a little brighter than the violet components. Since then, the violet components have been steadily increasing in intensity, and now (January) they are very much stronger than the red components, so much so that, in the case of $H\epsilon$ and $H\zeta$, the red components are scarcely visible while the violet components are quite strong.

A detailed discussion of all my observations since 1921, which include more than sixty photographs, will be published at a later date.

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Jan. 15.

Heterogony and the Chemical Ground-Plan of Animal Growth

IN his letter in NATURE of December 3, Dr. J. Needham suggested that "the chemical ground-plan [of development] must be thought of as deformable in space-time". In this connexion, the deformations which are obtained by a change in the unit of time measurement seem to be particularly interesting. Needham showed that if we have two animals a and b and measure in each of them several chemical magnitudes M_a, M_b, N_a, N_b, etc., such as fat content, dry weight, etc., we find relations of the type $\log M_a/M_{a_0}=k \log N_a$ and $\log M_b/M_{b_0}=k \log N_b$ where M_{a_0}, M_{b_0} are specific constants and k is a general constant relating M and N for all animals. Now M and N are also functions of the time t. If we have $\log M_a/M_{a_0}=F(t)$ and $\log M_b/M_{b_0}=F(t)$ we can clearly choose another variable p such that $F(p)=f(t)$. That is to say, by choosing a suitable unit for the measurement of time, we can convert the growth curve of M_b into that of M_a : and further, the same system of time measurement will convert all the growth curves of chemical magnitudes of animal b into those of animal a, provided only that in each case there is the linear relation between the logarithms, with the general constant k which Needham discovered. Thus we could regard the two systems of time measurement defined by t and p as the relative time scales of chemical development of the two animals.

Such relative time scales may become very interesting when data are available for comparing them with relative developmental time scales derived in other ways. The relative time scales of morphological development can be obtained fairly easily. Now it has been shown in various cases that the morphological stage at which an organ becomes embryologically determined may vary widely in nearly related species. These two criteria, namely, stages of morphological development and times of determination of different organs, should provide two other systems of relative time measurements. It would be very interesting to know how these two are related to one another and to the time scales of chemical development.

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The Constant of Gravitation, G.

IT appears that before the advent of the theory of relativity the constant of gravitation was purely empirical. No theoretical estimate or discussion of it has at any rate come to my notice. It is perhaps worth while to obtain a theoretical explanation of the constant, even from the point of view of Newtonian gravitation, in view of the remarkable success of the latter in the regions of space that have already been explored. Following Mach, one expects that the constant G should be dependent upon the distribution of matter in the entire universe : it may be explained in terms of the other universal constants of relativistic cosmology.

Suppose that the total matter in the universe is distributed at random in a sphere of radius R where the boundary condition is furnished by corpuscular radiation going round with the velocity C. Then, according to Newton,

$$MG/R^2 = C^2/R \text{ or } MG/C^2 = R,$$

where M is the total mass in the universe. We may compare with this the relativistic formula

$$M^+ G/C^2 = (\pi/4)R \text{ for the Einstein world.}$$

There are two reasons why M and M^+ should differ slightly as they do ; first, in estimating M^+ the entire mass is supposed to be at rest, which is far from the truth, and secondly, there is the mathematical difficulty of measurement pointed out by Painlevé[1].

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Dec. 7.

[1] C. R. Acad. Sci., 173, 873.

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