As has frequently, though not always, been recognized in discussions of organic selection, the guidance of evolution, through plastic modifications of the individual, is not exact. The frequently used illustration of the forced adoption of an arboreal habit by individuals of a monkey-like species, when environmental conditions became unsuitable for their persistence upon the ground, recognizes that this ontogenetic change of habit will not guide to the evolution of an innate tree-climbing instinct. For example, in Conn's use of this illustration, the tree-climbing habit leads to the survival of individuals which show entirely different congenital adaptation, modifications in foot and hand structure. Here a change to a tree-climbing habit has had a general influence, making all adaptation for life in the trees advantageous. The effect is general and the effect upon evolution is general, not preserving congenital adaptations similar to the first ontogenetic adaptation, but preserving entirely different sorts of adaptations. The effect is vague and general. It is, however, no less real.

In a species whose members are slightly plastic, or slowly responsive to modifying influences, innate characters, similar to those ontogenetically acquired, may be evolved, but in a species whose members are highly plastic and rapidly responsive, the adaptive innate characters which may later be produced, will probably be of a type different from that of those ontogenetically acquired. In other words, the greater the plasticity, the less intimate will be its guidance of the course of evolution, for a rapidly acquired and highly developed ontogenetic adaptation is almost as beneficial as an innate adaptation of the same type.

There is another possible influence of plasticity, which is worth considering. There is some paleontological evidence in favor of a belief that there are definite trends in evolution, due to conditions within the organism, rather than to external factors. I have, in this journal, pointed out[1] that the appearance, generation after generation, of the same mutants of *Œnothera lamarckiana*, in numbers far greater than could be explained by purely fortuitous variation, is a further indication of some internal control over variation, making it somewhat determinate, instead of purely indeterminate. Weismann's theory of germinal selection is an ingenious explanation of a possible way in which such trends in evolution may arise and persist. I believe there is evidence that well-defined trends in evolution have existed (paleontological evidence) and do exist (evidence from *Œnothera lamarckiana*). This question could be settled by sufficiently prolonged and sufficiently extensive observations in breeding, to see if variations and mutations do tend to be grouped in particular directions rather than to be equally distributed in all directions from the mean.

If it be true that trends in variation (or in evolution, the same thing) do exist, it suggests an interesting consideration in connection with plasticity. If such trends do exist, it is probable that they will appear in a species, persist for a time and ultimately die out. It is, therefore, possible that the adaptability of the individual members of a species might tide the species over a period of disadvantageous environmental conditions, giving time for some new and advantageous trend to appear. Such an effect is not only conceivable; it seems not unlikely that in numerous instances it may have been important.

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A SIMPLE FORMULA FOR MIXING ANY GRADE OF ALCOHOL DESIRED.

THIS problem of mixing different grades of alcohol recurs almost periodically to the worker in biology, but at sufficiently long intervals for him to forget his method. I do not recall, on the other hand, that I have ever seen any wholly satisfactory rule or formula that was simple, easy to remember, and with which one could, at a glance, mix any desired quantity, or having given a certain volume of any grade of alcohol, that one could with readiness change the whole volume into the required percentage. Nearly all rules and tables that have come to my notice limit the starting point either to 100 c.c. of the alcohol on hand or to some other quantity which may not be a mathematical factor of the volume that one desires to change. Just one possible exception to this statement has come to my notice. Professor John H. Schaffner in his book ('Laboratory Outlines for General Botany') gives the general pharmaceutical rule which works out very well: 'Take of the grade at hand as many volumes as the number of the per cent. you wish to make, then add to this enough volumes of pure water to make the total number of volumes agree with the number of the per cent. at hand.' This is quite simple and is really a special case of what I have to offer. While recently wrestling with this problem I determined to work it out algebraically, and I believe with success, evolving a formula that is simple and which gives results in an abstract number, or multiplier, with which one can find the amount of water to be added to any given volume of the alcohol at hand, to obtain the per cent. desired. This simple formula is, $v = (P - P') \div P'$ and is translated into words at the end of this article.

To get at the starting point of my formula I took a special case: Make 25 per cent. alcohol from 95 per cent. alcohol. Take 100 c.c. of 95 per cent. alcohol. This contains 95 per cent. of pure alcohol and 5 per cent. of water, or there are 19 parts of pure alcohol and one of water. To make 25 per cent. alcohol from one part of *pure alcohol* requires 3 parts of water. In order then to make 25 per cent. alcohol from the 19 parts of pure alcohol (in the 100 c.c. of 95 per cent. alcohol) we must multiply each part of pure alcohol by 3, excepting the nineteenth part, which must be multiplied by 2, since there is already one part of water, namely the twentieth part present. In figures this gives $18 \times 3 + 1 \times (3 - 1) = 56$ parts of water to be added. But we began with 19 parts (or 95 per cent.) of pure alcohol and 1 part (5 per cent.) of water, so that our total number of parts will be $56 + 19 + 1 = 76$ parts of 25 per cent. alcohol. Proof: $19 \div 76 = 25$ per cent. as required. Or, using per cent., we have 90 per cent. $\times$ 3 + 5 per cent. $\times (3 - 1) +$ 5 per cent. + 95 per cent. = 380 per cent. $95 \div 380 = 25$ per cent. as required. Now it is quite evident that a similar course of reasoning can with more or less difficulty be applied to any case imaginable. Therefore, let P represent the per cent. of the alcohol on hand, P' the per cent. required, v the multiplier with which to multiply any volume of the alcohol on hand to obtain the volumes of water to be added, y the number of volumes of water to be added to a volume of *pure alcohol* to obtain the per cent. required, z the per cent. of water in the alcohol on hand, and 100 per cent. the volume taken of the alcohol on hand. Then, following our original course of reasoning we have: $(P - z)y + z(y - 1) = v$ 100 per cent. (by definition), or $Py - z = v$ 100 per cent. But $z =$ 100 per cent. $- P$; $y =$ (100 per cent. $- P') \div P'$; substituting and simplifying we get $P'v = P - P'$. This formula is clearly the pharmaceutical rule above quoted. Simplifying this we have, $v = (P - P') \div P'$, a simple formula, independent of any volume of alcohol that we choose to take, and easy to keep in mind, in which v represents the multiplier with which to multiply any volume of the alcohol P that we choose to take, to obtain the volumes of water necessary for making alcohol P'. Or we may regard v as representing the number of volumes of water to be added to one volume of P in order to make P'. Thus, if we desire to make 40 per cent. alcohol from 95 per cent. alcohol, $(95 - 40) \div 40 = v = 1\frac{3}{8}$ volumes of water to be added to one volume of 95 per cent. alcohol.

Rule: *To find the number of volumes* (v) *of water to be added to one volume of alcohol of the grade per cent.* (P) *on hand, divide the difference between the number* (P) *denoting the grade per cent. on hand and the number* (P') *denoting the grade per cent. required by the latter number* (P'). Or, which is simpler, $v = (P - P') \div P'$.

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