ferent growth intensities . . . while the disposition and orientation of the follicle in relation to the general growth gradients would affect the direction and magnitude of the forces at play."

It will be admitted that much yet remains to be gained before a complete understanding of the spiral habit is forthcoming, in both its general and particular manifestations. That the crimping of wool represents a periodicity of reversals of rotation, due to a like succession of twists on a fundamental spirality, by no means suggests a simplicity in nature's methods.

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THE TIME CONSTANT

SERIOUS misinformation regarding inductive circuits, contained in a recently published text-book on college physics, appears to justify my calling attention to the facts of the case.

In a circuit containing electromotive force, resistance and inductance the fundamental equation

$$e = ri + l\frac{di}{dt}$$

leads to the Helmholtz equation

$$i = \frac{e}{r}\left(1 - \epsilon^{-\frac{r}{l}t}\right) = i_o\left(1 - \epsilon^{-\frac{r}{l}t}\right)$$

i being the value of the current at the end of t seconds, and i_o the final value. From this it follows that the rate of rise of the current,

$$\frac{di}{dt} = \frac{r}{l}i_o\epsilon^{-\frac{r}{l}t} = \frac{r}{l}\left(i_o - i\right)$$

At the very start, at the moment the circuit is closed, and before the current has an assignable value, we may say $i = o$, and hence at the start

$$\frac{di}{dt} = \frac{r}{l}i_o.$$

Evidently, if this rate of increase should be maintained for $\frac{l}{r}$ seconds the current would reach its final value i_o. This ratio $\frac{l}{r}$, generally called the time constant, is therefore numerically equal to the number of seconds required for the current in reaching its final value if the initial rate of rise should be maintained. This way of regarding the time constant I do not find in any of my books, but I have found it helpful in my teaching experience. Obviously, with a fixed inductance and a fixed ratio between e and r so that i_o is fixed, the rate of rise of current increases as r increases. The curves in the text-book referred to teach exactly the reverse of this truth.

Similarly, in a circuit containing electromotive force, resistance and capacity the fundamental equation

$$e = ri + \frac{q}{c},$$

q being the charge in the condenser of capacity c, leads to the charge q at the end of t seconds

$$q = q_o\left(1 - \epsilon^{-\frac{t}{cr}}\right),$$

q_o being the final charge.

The rate of increase of q, in other words the current flowing into the condenser, is

$$\frac{dq}{dt} = \frac{q_o}{cr}\epsilon^{-\frac{t}{cr}}$$

which becomes $\frac{q_o}{cr}$ at the very start when $t = o$. Obviously, this rate of charging, if continued for cr seconds, would give the condenser its final maximum charge q_o. So here the time constant cr may be defined numerically as the number of seconds in which the condenser would receive its final charge, in case the initial rate of charging should be maintained.

The accurate calculation and plotting of the growth of current in an inductive circuit is rather laborious, but an approximate graph may be easily and rapidly plotted by a method given by C. V. Drysdale in his "Foundations of Alternating Current Theory."

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"'GUNS' OF SENECA LAKE"

"SILENCING the 'Guns' of Seneca Lake" was the title of a discussion which appeared in SCIENCE for April 13, (page 340), having been communicated by Professor Herman L. Fairchild, of the University of Rochester. In it Professor Fairchild offered an explanation of a mystery of sound which, as he states, "has hovered over Seneca Lake, in central New York, for more than a century." This is what is known by the local residents as the "lake guns," an occasional low, dull boom suggesting a distant muffled explosion.

The explanation offered in Professor Fairchild's communication was that Seneca Lake occupies the upper part of a glacially deepened valley which cuts the Oriskany Sandstone at a depth of about 1,450 feet below the surface of the lake, and that the "lake guns" are caused by volumes of natural gas which escape from that porous gas-bearing stratum, find their way upward through the 450 feet of superincumbent glacial drift and ascend rapidly through the

600 feet of lake water above it, exploding at the surface. He states that these "guns" have now suddenly ceased, "with no sound reported for the last summer," and that they are probably silenced forever. The interpretation given is that the many gas wells which have recently been drilled in the Wayne-Dundee field not far from Seneca Lake have diminished the gas pressure in the Oriskany, so that the gas no longer escapes into the lake.

This hypothesis is ingenious and at least plausible on the evidence presented, but the purpose of the present communication is to state that Professor Fairchild's obituary of the "guns" comes before their demise, for the writer heard these sounds as recently as last October.

During many years the lake "guns" were heard on innumerable occasions when the writer lived adjacent to Seneca Lake and, as a youth, spent month in and month out on it and in it, camping, swimming, sailing, boating and fishing. Each autumn at the present time he returns to the same scene for a vacation, and this is spent in a way which should bring to notice most of the audible lake sounds; that is, in working alone from morning till night laying stone masonry on a rock cabin situated actually in the lake waters, at the base of a cliff (which may incidentally be instrumental in concentrating sounds which proceed across the lake). This is at Glenora, close to the Dundee gas field, and it was from there that the "guns" were heard last October. The previous absence of reported observations of lake "guns" in 1934 may have been due to the fact that it is the fishermen who most frequently report them, and that last autumn the bass fishing was so poor that relatively few fished.

In itself the hypothesis of escaping gas bubbles is not new, having been commonly current among the native residents of Seneca's shores for many decades, but its association with the depletion of the nearby gas fields, credited by Professor Fairchild to Mr. A. M. Beebee, geologist of the Rochester Gas and Electric Corporation, is a new and ingenious hypothesis which probably will acquire standing if the lake "guns" actually become silent later on.

Interested readers will find in Davison's "Manual of Seismology" a discussion of phenomena of a similar description, under the section "brontides." "Guns" are evidently heard in several localities—Italy, the Philippines, Africa, Haiti, Belgium—though their cause is unknown. Those heard at Seneca Lake seem to be most frequent in the autumn and in the daytime —in fact, the writer has never heard them after dark. Their direction is vague, and like the foot of a rainbow, they are always "somewhere else" when the observer moves to the locality from which they first seemed to come. No large bubbles or volumes of gas have actually been observed broaching on the surface of the lake, but is it not probable that a large single volume of gas, starting from the bottom of the waters 600 feet below, would be broken up into very many small bubbles during its upward passage through that amount of water? Theoretically, this should not occur, but actually, due to some form of instability, it possibly would.

Finally, is it not likely that gas from the Oriskany, seeping upward through the 450 feet of drift between that horizon and the top of the drift filling, would be stopped and held temporarily by the layers of fine compact lake-bottom clay which have accumulated there since the recession of the Wisconsin ice; and then, when a sufficient volume of gas had thus become pocketed under the clay (perhaps in a large "blister"), the latter would suddenly give way and cause the explosion, not at the surface, but at the bottom of the lake. The sound would then be transmitted upward from the bottom by the water, emerging with the vague non-directional origin so often noted in connection with the phenomenon heard.

Since the above was written, Mr. E. R. Dobbin, of Geneva, N. Y., has stated in *The Syracuse Herald* (April 25) that at Kashong, near Dresden, N. Y., the Seneca Lake guns "were quite as distinct last summer as formerly, perhaps not so frequent. They have also been heard quite distinctly this spring . . . the Seneca Lake guns," he adds, "are still in existence."

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NUTRIENT MEDIA WITH STABLE HYDROGEN-ION CONCENTRATION

PROFESSOR SAM F. TRELEASE and Helen M. Trelease in a recent issue of SCIENCE[1] emphasized the fact that one of the important problems in the culture of higher plants in artificial media is that of maintaining the hydrogen-ion concentration of the culture solution within limits favorable to growth. They propose for this purpose the use of physiologically balanced solutions. It is not possible to judge their very interesting idea from the contents of their short note.

In writing this note I should like to draw attention to my work, covering a period of over ten years, which has dealt with this question. The results of this work have appeared in several publications and have been fully described in recent papers.[2]

I take this opportunity to give a very brief summary of my studies. These investigations showed that the slightly soluble phosphates plus NH_4NO_3 are

[1] SCIENCE, 78: 438–439, 1933.

[2] "Nutrition artificielle des plantes cultivées. I. Mélanges nutritifs à pH stable," *Annales Agron.*, Paris, 2: 809–853, 1932; 3: 53–72, 1933.