century, say from fifty to seventy-five generations—presumably a quite inadequate period for the evolution *and fixing* of the form by the selection of small chance variations. Certainly, if the analogy of language in the human race is permissible, the number of generations is far short of what would be required to impress any character on the heredity of a species *by the inheritance of acquired characters,* even if we could find any reasonable connection between soot-stained bark and darkened wings for the purposes of the theory.

But gradual adaptation during the present epoch does not fit the facts for another reason. The darkening, if gradual, would have been noticed by entomologists, as is the case with *Aplecta nebulosa* in Delamere Forest and *Hybernia leucophaearia* in Epping Forest. The species would be a beautiful example of a mutation if it were not for the fact that intermediates, though rare, have a puzzling habit of turning up; and, what is more serious, a careful examination of the melanic forms reveals the fact that on the upper margin of the hind wings, where they are covered by the fore wings when the moth assumes its normal resting position, there is an area of the original pale coloration. As in the reverse case of the exposed tip of the underside of the fore wings of many butterflies being coloured quite differently from the rest of the wing area, in order that it may match the cryptic pattern on the underside of the hind wings, the retention of the pale area in var. Doubledayaria can only be accounted for by the supposition that the variability is the work of natural selection.

If the above reasoning be correct, the black variety must either be regarded as the recurrence of a pattern slowly evolved in some previous epoch, or we must consider it as an example of the working of Weismann's germinal selection. The needs of cryptic adjustment to environment having put a premium upon darker, but not necessarily black forms, the determinants of the darkened characters tend by the operation of selection within the germ to increase progressively to a point where they are cut off by the operation of natural selection upon the individual. As a consequence, a few rare examples will always be thrown having such a progressive character in excess, and should any rare and sudden chance such as is afforded to melanism by our smoky civilisation occur, an enormous premium is placed upon the survival of their offspring.

A. BACOT.

154 Lower Clapton Road, London, N.E.

Inductance in Parallel Wires.

A PROBLEM of some considerable importance to the practical engineer or physicist is that of calculating the effective self-induction of a circuit consisting of two parallel wires, the one being the return of the other. When the wires are not very close together, and their current is either steady or only very slowly alternating, satisfactory results are known to be given by the formula

$$\frac{L}{l}=2\log\frac{c^2}{ab}+\tfrac{1}{2}(\mu_1+\mu_2),$$

where L is the self-induction of a length l, c the distance between the wires, which have radii a, b, and μ_1, μ_2 the permeabilities of their materials. But if the current oscillates rapidly, this formula fails to give even approximately correct results. Now in many practical problems, such, for example, as the measurement of small inductances not greater than 1000 microhenries, it is necessary to employ long leads to keep them at some considerable distance from bridge and other circuits. A knowledge of the self-induction of such leads is very desirable. Some results which I have recently obtained are capable of finding this quantity in most useful cases, and it may prove of use to give a short statement of them, pending more detailed publication.

The self-induction has a simple expression only if the two wires be equal in radius. In this case it takes the form

$$\frac{L}{l}=4\log\frac{c}{a}+\frac{4\mu}{x}\cdot\frac{\operatorname{ber}x\operatorname{ber}'x-\operatorname{bei}x\operatorname{bei}'x}{(\operatorname{ber}'x)^2+(\operatorname{bei}'x)^2},$$

where ber x, bei x are the functions introduced by Lord Kelvin, and subsequently tabulated (*vide* Presidential Address to the Institution of Electrical Engineers, 1889).

If $\frac{n}{2\pi}$ be the frequency of alternation per second, σ the specific resistance of a wire, μ its permeability, then

$$x=2a\sqrt{\frac{\pi\mu n}{\sigma}}.$$

This formula, passing naturally into the former when the frequency is small, becomes less accurate as c decreases and as the frequency or radius of a wire increases. So far as the first cause is concerned, it is subject to an error of not more than 1 per cent. when $c=10a$, and 4 per cent. if $c=5a$. If $c=3a$, which is the limiting closeness for most practical purposes, the error is about 10 per cent., which is not usually too great. The other causes of error may be considered together. The per cent. error they produce is of order $100.\frac{n^2a^2}{V^2}$, where $V=3\cdot10^{11}$. Practically, a is never more than about 2 millimetres, and thus, with a frequency of a hundred million per second, the error is not more than one-tenth per cent. The range of application of the formula is therefore extremely wide. A formula equally accurate may be given when the wires are unequal, but it is somewhat cumbrous.

J. W. NICHOLSON.

Trinity College, Cambridge, January 21.

Stock Frost or Ground Ice.

DURING the recent frosty weather the subject of what is locally called "stock frost" has been much to the front in this neighbourhood. This phenomenon is known to the scientific world, I believe, as "ground ice," and the circumstances in which it appears and disappears present to the ordinary observer a very great many puzzling features.

I should be exceedingly glad if some of your readers would kindly give me, through the columns of NATURE, their opinion on several points which puzzle and interest me and others in connection with "stock" or ground ice.

(1) I wish to know, first of all, what are the *essential* conditions for the formation of ground ice on the bed of a river?

(2) Is it essential, or does it favour the formation of "ground" ice, that there should be no surface ice? We notice that when a very cold and very strong north-east wind is blowing, violently agitating the surface water, there is no surface ice, but a formation of ground ice at the bottom of the river.

(3) What are the circumstances to which is due the presence of ice-cold water at the bottom of a river, cold enough to be precipitated into ice?

This ice-cold water cannot reach the bottom of the river by gravitation, because its density is inferior to that of water at a higher level. To what, then, is due this cold temperature on the river bed?

(4) Can the bulk of water in the river bed be a conductor of cold from the surface to the bottom of the river in any other way than that of the mechanical action of running water? I assume that when ground ice appears in a river the whole of the water above it is of an ice-cold temperature, but it has not formed into ice because of the lack of the ice-precipitating conditions which exist on the bed of the river.

(5) Do the conditions necessary for the formation of ground ice operate more favourably in ice-cold still water or in that which is agitated, say, by passing through a mill? My own observation is that ground ice appears nearer to a mill on its upper side than on its lower side, and I want to know the reason of this.

There is quite a long list of questions which might be asked in connection with the formation of ground ice, but I fear that I have already trespassed too much upon your space.

JOHN J. HAMPSON.

Costessey Vicarage, near Norwich, January 20.