lie in close proximity to warmer air. The available facts as to temperature, winds and pressures in cyclones and anticyclones are found to be in agreement with the results of computation, so that the statement can be made, "sharp contrasts in temperture in adjacent bodies of air causing steep gradients are fully capable of producing the permanent and wandering cyclones and anticyclones of the atmosphere in temperate regions." Mr. Clayton's views on this matter are different from the recently much-discussed Bjerknes polar front theory, yet there are points of resemblance between the two. Regarding tropical cyclones there is naturally a good deal of doubt, although here also differences of temperature between a central area and the surrounding air are believed to explain the origin.

Other subjects discussed in "World Weather" there is no opportunity to consider here. There are chapters on the physics of the air in relation to solar and terrestrial phenomena; and on the meteorology of the sun, and there are three appendices dealing with mathematical methods of treatment. We regret that, in a book of this character, many of the illustrations are very crude, and a few are so indistinct that they are barely serviceable. Many references are incomplete according to the usual standards in such matters, and occasional references to writers in the text without any indication as to what and where these persons have written are not helpful in a scientific discussion. Misprints are fairly numerous, but in no case are these so glaring that the meaning is obscured. The summaries at the beginning of each chapter are a very useful feature of the book. When so much that is new and necessarily still more or less controversial is presented by an author of Mr. Clayton's standing there is sure to be a more or less animated debate as to the value of the evidence and as to the methods of using it. Into any such critical analysis it is impossible to enter here, nor has the reviewer any desire to do so. It may very likely be that the author himself may see reason to revise and to modify some of his conclusions, and it is almost certain that a good many persons, meteorologists and others, will hesitate to accept them all as they stand. They are by no means all equally convincing. But that the author has taken infinite pains in his laborious and time-consuming investigations is evident on every page, and that he has written a very important chapter in the new world meteorology no one can deny. It is a very inspiring view of the future of meteorology in relation to long-range forecasts, of immense economic importance to man, which Mr. Clayton here gives us.

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SPECIAL ARTICLES

INHERITANCE OF DIRECTION OF COILING IN LIMNAEA

A RECENT paper by Boycott and Diver (1923, Proc. Roy. Soc., 95 B; 207) on the inheritance of dextral and sinistral coiling in the snail Limnaea suggests that this character may give an exceptionally clear illustration of "maternal" inheritance that is nevertheless dependent upon the chromosomes.

These authors find that if a single individual of Limnaea is isolated at an early stage it will reproduce, presumably by self-fertilization. Broods produced in this way are always either wholly dextral or wholly sinistral (with the rare exceptions noted below)—but either type of parent may produce either type of brood. This result agrees with the findings of Mayor (1902) and Crampton (1916) on the viviparous Tahitian land-snail Partula, where a given individual contains in its brood-pouch only one type of young. A sinistral individual may have either sinistral or dextral young—but never both types at once; and the same is true for a dextral mother.

Boycott and Diver have also mated together two individuals, and have reared from such pairs mixed broods, which they report as giving 3 dextral : 1 sinistral or 1 dextral : 1 sinistral. In the absence of numerical data, and in view of the fact that the eggs from the two parents were not separated in these experiments, one may doubt if these ratios are anything more than fortuitous ones due to the two members of the pairs in question producing different types of offspring. If one does interpret these ratios as merely chance ones, it becomes possible to formulate a much simpler interpretation than the one suggested by these authors.

An analysis of the data presented suggests that the case is a simple Mendelian one, with the dextral character dominant, but with the nature of a given individual determined, not by its own constitution but by that of the unreduced egg from which it arose.

This last assumption becomes extremely plausible when it is recalled that it was shown by Crampton and by Kofoid in 1894 that dextral and sinistral snails can be distinguished at least as early as the second cleavage division (perhaps at the first), since the cleavage-pattern of one is the mirror-image of that of the other. A character that appears so early in development might well be expected to be determined by the genes present in the mother—*i.e.*, in the unreduced egg, rather than by the combination present after reduction and fertilization. Yet the results obtained by Boycott and Diver can not be accounted for unless it is supposed that the sperm does actually

produce an effect, though the effect is delayed for one generation.

The hypothesis here suggested may be made clearer by the following elaboration. Let the recessive gene for the sinistral character be represented by *l*, and its dominant allelomorph for the dextral character by *L*. Then any heterozygote, Ll, will produce by self-fertilization three types of offspring—LL, Ll and ll. Since all the eggs contained the gene L before reduction, all these individuals will be dextral in somatic appearance; but the ll individuals will themselves produce only sinistral offspring. If an ll individual of this family mates, as a female, to an LL, the offspring will all be sinistral (since the mother carried no L); but they will be Ll in constitution and will therefore produce only dextral offspring. Further combinations may easily be worked out.

It is probable that dextral snails can not mate with sinistral ones; this being the case one might expect that heterozygous individuals would quickly disappear from the colonies, in which case no such results as recorded would be obtainable. The paper under discussion gives a clue as to why the heterozygotes do not disappear. In families that were expected to be purely sinistral a dextral individual occasionally appeared. If such individuals are due to some environmental cause and are genetically sinistral, they will of necessity mate with dextrals and produce new families of heterozygotes. This interpretation is borne out by Lang's results with Helix, where the occasional cases of reversed symmetry were found not to be inherited at all.

Further data on the case of Limnaea will be awaited with interest, for it seems likely that we shall have here a model case of the Mendelian inheritance of an extremely "fundamental" character, and a character that is impressed on the egg by the mother.

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VOICE AS A FACTOR IN THE MATING OF BATRACHIANS[1]

CHORUSES of frogs and toads form one of the impressive sounds of nature. Nevertheless, little or no significance has been attributed to voice in the mating of batrachians. It is stated not to control the direction of migration towards the breeding grounds, or the movements of individuals on the grounds (Boulenger,[2] Cummins[3]). It is generally believed that "courtship does not take place in any of the tailless batrachians. The female is seized by the first comer, . . . "[4] Some years ago it was pointed out by Courtis[5] and later by Miller[6] that the toad responds to sound readily during the breeding season, and that the female may even be attracted towards the calling male. But Cummins[7] has recently shown that in the case of frog material the "*voice does not direct* the movement of the frogs into the pond" and "that sex 'recognition' . . . results from the differential behavior of the two sexes when clasped, . . . "

During the past season I have studied the problem with tree frog material. Such material is especially favorable because their breeding grounds are generally less crowded than in the case of the other species, and direct observation of individuals is possible. This method of direct observation was unfortunately not employed by Cummins.

The species most thoroughly studied by me was the little-known *Hyla andersonii*. At Lakehurst, N. J., the males begin calling in early May. They call from the ground and generally from concealment. Later in the month they call from the tops of bushes or from trees several feet from the ground. The breeding does not occur simultaneously throughout the region, or even in the same bog. Individual males that were kept under observation by means of flash lamps throughout the night were seen to leave their high calling stations and make their way to nearby sphagnum-choked ditches or to slow-flowing streams in the bog. Each took up an isolated position near one of these basins and began to call again. Females were first discovered making their way across the bog. In three instances their movements were closely followed. They proceeded directly across the marsh, over ditches and puddles toward particular males. In all three cases the calling males paid no attention to the approaching females. In one case the female leaped directly upon the back of the male. He threw her off and continued calling. She leaped on his back again, but again he threw her off. This time, however, he turned and before she could spring again had embraced her. In the second case the female leaped at the calling male but receiving no attention, she circled twice around him, nudging him with her limbs as she endeavored to draw as near to him as possible. In the third case the calling male paid no attention to the female and amplexus did not occur. In the former cases oviposition took place in the adjacent water. Oviposition in *H. andersonii* differs from that of other American species of Hyla, in that the eggs strike the body of the male and are thrown to the bottom of the ditch, where they may or may not adhere to the sphagnum or other vegetation.

[1] Summary of a paper read before the Linnaean Society of New York, November 14, 1922.

[2] Boulenger, G. A., 1912, *Proc. Zool. Soc. London*, p. 22.

[3] Cummins, Harold, 1920, *Jour. Exp. Zool.*, XXX, pp. 325–343.

[4] Boulenger, G. A., 1897, "The Tailless Batrachians of Europe," p. 68.

[5] Courtis, S. A., 1907, *Amer. Nat.*, XLI, p. 678.

[6] Miller, Newton, 1909, *Amer. Nat.*, XLIII, p. 650.

[7] *Loc. cit.*, p. 342, italics his.