

animals has not been gradually evolved under the influence of darkness, but is the result of degenerative mutations of the same kind as those described in Mrs. Sexton's paper. She describes a series of retrogressive mutations, red-eye in 1912, albino-eye in 1915, 'spotted', and one-eye and no-eye in 1920. The absence of one or both eyes occurred among the descendants of a single mating in which the three earlier mutations were combined. In the latest generations, the shape of the head was frequently altered; in some cases the first antennæ were absent, the shape of the brain was abnormal, and finally there was a marked degeneration in the reproductive organs, many individuals being sterile and others intersexual. No such progressive degeneration in many directions has been shown to occur in the blind Crustacea or blind animals of other classes in the cave fauna, or in *Gammarus chevreuxi* itself in the wild state.

I would suggest that Mrs. Sexton's stock of *G. chevreuxi* offers a much closer and more obvious analogy to Japanese goldfish in their monstrous abnormalities than to blind cave animals. In both the former cases, the degenerative mutations occur in animals kept in close confinement under abnormal and unhealthy conditions, and it seems reasonable to conclude that such conditions are the real cause of the so-called mutations. Vigorous and normal development depends on normal conditions. The normal genes do not live a charmed and invulnerable existence; the evidence suggests that they are altered and enfeebled by confinement, by impurities and deficiencies in the surrounding air or water and in the diet, by want of exercise, with the result that in the course of generations their power to determine normal and vigorous development is enfeebled and all kinds of deficiencies and abnormalities appear and increase until the strain dies out. As Mrs. Sexton herself says, "the farther removed from the normal an animal is, the lower its viability".

Thus it seems to me that the significant fact is, not that blindness may be produced without the influence of darkness and that therefore the blindness of cave animals has not been due to the absence of light, but that degenerative and hereditary mutations are caused by the abnormal conditions involved in keeping animals confined in small vessels inside a laboratory for a long series of generations, and that further degeneration is produced by combining such mutations by interbreeding.

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<sup>1</sup> *J. Mar. Biol. Assoc.*, May 1932.

#### Cytological Differences between Closely Allied Species

IN 1931<sup>1</sup> I described important differences between the watery, neutral, red-staining vacuoles of the eggs of *Rana tigrina* and *Rana cyanophlyctis*. For details references may be made to the original paper, but the most important difference is in the size of the vacuoles, those of *tigrina* measuring as much as 0.02 mm. in advanced oocytes, whereas those of *cyanophlyctis* are very much smaller.

In the course of certain experiments carried out last summer on the eggs of a large number of animals with Sudan III. and Scharlach R. to determine the exact time when the lipoidal Golgi elements become fatty, it was discovered in *R. tigrina* that the fatty yolk, which had been reported by me in 1931 to be absent in the biggest egg (1.08 mm.) then studied, actually puts in its appearance when the egg measures 1.2 mm. From this stage up to 1.5 mm. (the biggest egg I have ever examined in this species) the fats stain deeply with the above dyes, but no red granules appear in

younger oocytes. In *R. cyanophlyctis*, on the other hand, the Golgi elements become fatty when the oocyte measures a little more than 0.5 mm.

In 1931 I sounded a note of caution as to "how discordant results can be arrived at by two workers investigating two species of the same genus". I added that "if I had not first studied the big vacuoles of *tigrina* I might have perhaps failed to notice those of the other species. I imagine that the British and European frogs in which no vacuoles have been described are like *cyanophlyctis*."

That is exactly what has actually happened. Prof. Saguchi,<sup>2</sup> working on the eggs of *Rana nigromaculata*, confirms most of my conclusions, but finds that there is no vacuole and that fat appears when the egg measures 0.3 mm.

I would like to recommend the eggs of *R. tigrina* to all teachers in India running cytology courses for demonstrating the Golgi elements, the mitochondria, and the vacuolar system in fresh oocytes without the aid of any vital dye. The most favourable stage for this is when the oocyte measures about 0.45 mm. In the highly advanced oocytes there is a well-developed cortex containing the vacuoles. This can be easily separated for demonstration.

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<sup>1</sup> *Zeit. Zellf.*, 1931.

<sup>2</sup> "Zytologische Studien", 1932.

#### The Inheritance of Acquired Characters

PROFS. MACBRIDE and Harrison have devoted some space to refuting a number of statements which I have never made.<sup>1</sup> "He suggested in his discourse that Harrison's strain of sawflies had become contaminated with a strain adapted to the new willow", writes Prof. MacBride. As the discourse is printed in *NATURE* of June 4 and 11, it is easy to verify the fact that I made no such suggestion. Nor have I ever made any of the criticisms found in Prof. Harrison's last paragraph. I was, however, quite aware of the facts of which he accuses me of lack of knowledge. They would doubtless have been relevant had I made the statement attributed to me above.

Perhaps the somewhat imaginative manner in which Prof. MacBride has dealt with my discourse will make readers of *NATURE* cautious in accepting his interpretations of the work of Dürken, Metalnikoff, and others.

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<sup>1</sup> *NATURE*, 130, 128, July 23, 1932.

#### A Reinterpretation of Relativity

THE theory of relativity is an undeniable achievement in physics and is a logical development of the theory of measurement; but it does not have the significance for the universe which is usually ascribed to it. Real time is not fused with space, and absolute simultaneity does have a definite and definable meaning.

Physics as a science is concerned with measuring and dating and so getting numerical laws. All this gives knowledge about the external world. But it would be a mistake to project this measurational knowledge into Nature without interpretation. The rejection of absolute simultaneity as meaningless has encouraged most relativists to do this.

My analyses have led me to make a distinction between *chronological time* and *real time*. Chronological time is an affair of dating and measuring in terms of some standard motion. Real time is the fact of change, or eventness. I hold that absolute simultaneity has meaning for real time, while operational simultaneity, which is the kind that relativity stresses,