by the present writer. Here the paired filaments or chromonemata of the individual chromosomes are spiral but run parallel to one another. Thus in certain cases the reproductive chromatids or chromonemata are contrasted with the somatic ones by the fact that they run parallel instead of in opposite directions. The present author has found the parallel condition to be present in the gametophytic soma of species of Trillium.

The situation outlined in the foregoing paragraphs seems to set the whole cytological situation in the somatic (mitotic) and reproductive (meiotic) divisions in a new light and establishes if confirmed by other observers a much closer resemblance between the two than has in the past been realized. The mode in which the contrast in chromatidal behavior between reproductive and somatic elements in Trillium and Tradescantia, etc., is achieved still remains to be elucidated.

It is worth while to add perhaps that the present course of investigation, which covers not only plants but a considerable number of animals, serves to set in relief the great superiority of good vegetable objects, such as Tradescantia, Trillium, etc., over the tailed Amphibia, such as Amblystoma, Necturus and Cryptobranchus, for the fundamental study of the chromosomes. Apparently, however, the same general chromosomal conditions prevail in the two great divisions of living beings.

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THE ROLE OF KINESTHESIS IN MAZE LEARNING

FROM the results of an early investigation by Watson[1] in 1907 the idea prevailed for some time that the only sense indispensable to maze learning in rats is the kinesthetic. However, in 1929 Lashley and Ball[2] demonstrated that the elimination of kinesthetic impulses by means of spinal sections did not abolish the perfected maze habit. Evidence showing that kinesthesis was unnecessary to the *learning* of the maze habit was soon forthcoming when Ingebritsen[3] demonstrated learning in rats that were deprived, prior to training, of kinesthetic impulses by sectioning of the cervical cord. Thus, kinesthesis was found unnecessary not only to the perfected habit but also to the learning of the habit.

There is now evidence that if all senses but the kinesthetic are abolished maze learning in rats is impossible. Previous tests by the writer had shown that the senses of vision, olfaction and audition, but not the tactual sense, play a rôle in maze learning, and it was therefore necessary only to render a group of rats blind, deaf and anosmic, but not tactually anesthetic, in order to show whether or not learning is possible when only the kinesthetic sense remains. A group of 45 blind-deaf-anosmic rats trained on a 14-blind elevated maze showed no signs of learning after 22 days of training (44 trials on the maze). The performance of these animals, measured by entrances into blinds, at the end of training was no whit better than the performance on the first trial; the performance of the group on the 22nd day was a "chance" performance.

It may be concluded, therefore, that not only is kinesthesis unnecessary both to learning and to the perfected habit, but that learning on the basis of kinesthesis alone is impossible. The evidence against kinesthesis would seem to be overwhelming. Far from being the one indispensable sense, kinesthesis appears to have no rôle whatever in the acquisition of the maze habit. But this conclusion, in view of other facts, would be hazardous. The smooth functioning of a well-learned motor habit or skill no doubt has in it a large kinesthetic element. It has been assumed that each movement in such a habit furnishes the stimulus for the succeeding movement, and that the smooth succession of movements is due to the close chaining of movements made possible by movement-produced stimuli. Our evidence shows, however, that the close chaining is possible only after the correct order of movements is learned on the basis of other classes of stimuli. Kinesthesis, in other words, seems to be essential to the acquisition of skill, that is, to the smooth flowing of movements, but this function it can assume only in conjunction with other classes of stimuli and only after learning has begun on the basis of other stimuli. Though Ingebritsen's animals learned the maze it is improbable that they could ever run through it with the speed and skill possible to normal rats.

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[1] J. B. Watson, *Psychol. Rev. Monog.*, 7: 2, 1907.
[2] K. S. Lashley and J. Ball, *Jour. Comp. Psychol.*, 71–106, 1929.
[3] O. C. Ingebritsen, *Jour. Comp. Psychol.*, 14: 279–294, 1932.

THE DATES OF PUBLICATION OF THE EARLIER NEW YORK STATE MUSEUM REPORTS

THE assertion has been repeatedly heard by members of the museum staff that the dates of publication of the earlier museum reports and bulletins are not reliable.

A typical case came to the writer's attention in connection with the catalogue of Devonian types now under preparation. The question of the priority of the term *Dolichocephala lacoana* Claypole, over *Stylonurus excelsior* Hall, which has been claimed by Beecher (1900) and others, came up. Investigation

has proven that Claypole's paper was read before the American Philosophical Society on September 21, 1883, and printed on November 2, 1883.

Hall submitted his paper in his thirty-sixth annual report to the Senate on January 12, 1883 (see Senate document 53). This Senate document, in which Hall's paper with figures is printed, had according to law (Law 1859, Chapter 437) to be printed and distributed before the end of the year. The printer, however, was wont to deliver the Senate documents before the end of the fiscal year, which then was September 30, in order to receive payment, and the bills of the year 1883 show that he also did so that year. That means that copies of the Senate documents with Hall's paper included were distributed before October. A separate reprint of Hall's thirty-sixth report was published and distributed in 1884. This report bears the date 1883 on the title page and that of 1884 on the paper cover. Furthermore, he also had still a reprint of his paper on Stylonurus distributed in 1884. These facts have led to the erroneous conclusion that Hall's paper was not in print until 1884, when as a matter of fact it was in print in Senate document 53 sometime in the summer of 1883, long before Claypole read his paper.

This typical case serves to explain numerous cases of doubt of the proper date of publication of the New York State reports. It has been even suggested that Hall dated his publications ahead. The fact is that the date of publication of many of our earlier museum reports and bulletins is the date of the Senate document, in which they first appeared. This is the date on the title page. Reprints which were often widely distributed bear later dates, but those are not the dates of first publication.

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A NEW WORD

IN the issue of SCIENCE for September 25, 1936, page 291, Dr. Robert T. Morris suggests that a new word might be useful, similar in form to benthon, nekton, plankton, etc., to designate the more or less organic mud of *shallow* bottoms on which various fishes, mollusks, birds and other animals feed. Why not "ilyon," from the Greek ἰλύς,-ύος, meaning mud or slime? With various appropriate suffixes, one might speak of "ilyonic" food, of animals living in the bottom mud as "ilyobic" or of those that feed on it as "ilyophagous." If the simple word "mud" is not clear enough, the new term would have to be more accurately defined to meet the requirements of ecological description.

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SCIENTIFIC BOOKS

THE PHILOSOPHY OF MATHEMATICS

Mathematics and the Question of Cosmic Mind and Other Essays. By CASSIUS J. KEYSER. Scripta Mathematica Library No. 2.

THE welcome effort of the Scripta Mathematica Library to encourage discussion of the philosophical and cultural aspects of mathematics is continued in this booklet, which contains some of Professor Keyser's essays collected from various sources. These essays, written clearly and enthusiastically, aim to explain several phases of mathematics to those laymen "who live to think and who are not satisfied with being merely told."

The first three essays form a sequence leading to the question suggested in the title of the book. First, the nature of mathematics is analyzed in terms of its method, which is taken to be strictly postulational. In other words, a mathematical doctrine starts with certain undefined primitive terms, which are really variables, and with a certain number of consistent axioms, and proceeds by defining new terms by means of the primitive ones and by deducing new statements from the axioms. This abstract concept of mathematics is explained vigorously and lucidly. However, some mathematicians might consider this identification of mathematics with postulational thinking to be incomplete. Does mathematics start with any old system of postulates whatever or does it content itself with any arbitrarily chosen deductions from a given set of postulates? Does the postulational approach account for the fact that, historically, mathematics consists of the elaborate development of a few particular postulate systems? How can the all-important consistency of these postulate systems be abstractly established, especially when Gödel has indicated the great difficulty of formal consistency proofs?

The second essay engagingly explores the "Bearings of Mathematics"—"a certain rich manifold of light-giving relations connecting mathematics with those great human interests . . . in which there is, properly, no question of establishing mathematical propositions." Such relations concern the art of exposition, the universality of the mathematical concepts of change and invariance and the ideal of logical rectitude.

The title essay then reviews the light which mathematics can throw on the question, "Is the world essen-