methods. The dry weight varies from 17 to 25 per cent. of the wet weight. The species growing near or below low tide are large and can be collected rapidly but only for a short time each day, while the species of the intertidal zone take more time to collect, but more time is available.

The yield of agar from *G. cartilagineum* was twice as great at pH 6.0 and pH 8.0 as at pH 10.0 and pH 12.0. In the case of one lot no acid or alkali was added and it maintained itself at pH 8.0 during the cooking. At pH 6.0 and pH 8.0 the strength of the jelly increased steadily during the first eighteen hours and afterwards remained unchanged until cooking was stopped after twenty-seven hours. This experience corresponds with the traditional Japanese method which includes the addition of a little vinegar to the cooking water and with the American commercial method in which no attempt is made to control the acidity.

The yield from *Pterocladia* was greatest at pH 6.0, but there was little difference between all lots except the lot at pH 10.0 which showed a very small yield. At pH 6.0 the maximum jelly strength was reached after fourteen hours cooking, after which a 20 per cent. decrease occurred. The greatest yield would probably have been obtained by stopping the extraction at pH 6.0 at the end of fourteen hours.

The yield of agar from *Endocladia muricata* was nearly twice as great at pH 12.0 as in any other lot. The maximum jelly strength was reached after fourteen hours' cooking and remained constant until cooking stopped. The yield of dry matter from *E. muricata* was about twice as great as from *G. cartilagineum* and from *Pterocladia*. However, the firmness of a 1 per cent. jelly was only half as great. Either *Endocladia* agar has a low jellying power or the crude dry extract contains considerable impurities.

None of the three species of *Gigartina* tested yielded a jelly after fourteen hours cooking at pH 6.0, 8.0, 10.0 or 12.0. In a second experiment, the alkalinity of the different lots was maintained by cooking in tenth molar calcium chloride, with excess calcium carbonate, or with excess calcium hydroxide, respectively. Under these conditions *Gig. canaliculata* at pH 12.0 (excess calcium hydroxide) yielded a soft jelly. Following the method described by Kizevetter[3] for the treatment of *Ahnfeltia plicata,* dried seaweed of each of the three species was soaked for three days either (a) in cold saturated calcium hydroxide or (b) in cold 2 per cent. calcium chloride. *Gig. asperifolia* was so badly disintegrated by these treatments that it could not be handled. The other two species yielded firm jellies after two to five hours' cooking either in 2 per cent. calcium chloride or in saturated calcium hydroxide. Under these conditions, the two species of *Gigartina* act like *Gracilaria* in yielding their agar readily.

The most important information obtained is that out of five species of red algae not previously considered agariferous, harvestable in moderate quantity at La Jolla without special equipment, four readily yielded agar, in quantity and quality equal to that obtained from red algae at present commercially exploited.

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## EARLY MASTERY OF THE GROUP CONCEPT

ONE of the most interesting facts in the history of group theory is that those who are now commonly regarded as having been the most influential in extending the use of this theory are not also those who first mastered the concept of a group. Among the former Sophus Lie (1842–1899), Felix Klein (1849–1925) and Henri Poincaré (1854–1912) are widely regarded as the most eminent, while the latter are represented by Arthur Cayley (1821–1895), Leopold Kronecker (1823–1892) and Heinrich Weber (1842–1923). None of the former three seems to have ever assumed explicitly all the postulates of the concept of a group which are now commonly regarded as essential. The most fundamental omission is that the associative law must be satisfied when three or more elements of a group are combined. Such a combination has been most commonly called a multiplication, but in the recent literature it is often called an addition.

The interest in the noted omission is partly due to the fact that it exhibits the wide use in mathematics of unannounced restrictions even by some of the most eminent modern writers. It seems, therefore, questionable whether the freshmen in our colleges should be advised to pay close attention to the associative law, which was first thus named by the noted Irish mathematician, W. R. Hamilton (1805–1865), and was effectively introduced by him into the common mathematical literature. It is of great importance in abstract group theory, but the very successful use of group theory by the first three authors noted above implies that in many fields the group concept can be used successfully without restricting it by this law. At any rate, the history of group theory would not be complete without noting the comparatively late emphasis on this law in the development of this subject.

The six names mentioned in the first paragraph of this article exhibit the gradual development of the modern group concept which was practically completed by the last of these writers in the *Mathema-*

*tische Annalen,* volume 43 (1893). The given list of six does not include any American author, but all the writers included therein were very influential in starting work along this line in our country and some Americans, including E. V. Huntington, made further studies relating to the simplification of the postulates of the group concept. While Heinrich Weber may now be reasonably regarded as the first man who fully mastered the group concept (1893), it is of some interest to note that about three years thereafter he made an erroneous assertion relating thereto in the first edition of the second volume of his "Algebra" (1896) when he stated (page 54) that the most important example of a commutative group is the system of our natural numbers when they are combined by multiplication.

On account of the wide use of this algebra this error was often repeated by later writers and seems not to have been publicly corrected before the appearance of the second edition of this volume about three years later. It may remind one of the error committed by Sophus Lie on page 163 of volume 1 of his "Transformationsgruppen" (1888) where he asserted in effect that the numbers which are less than unity form a group when they are combined by multiplication. This error was repeated by Felix Klein several years later in the *Mathematische Annalen,* volume 43, page 66 (1893). It is, however, less striking than the one by Heinrich Weber to which we referred, since neither Sophus Lie nor Felix Klein ever definitely adopted the now common postulates of an abstract group.

Contrary to what might naturally be assumed, all the possible abstract groups of certain low orders were determined long before a satisfactory system of postulates of the group concept was published. Forward steps in the development of mathematical subjects frequently preceded the establishment of a solid foundation of the subject. The history of the development of the theory of ordinary complex numbers furnishes many instances of such forward steps. There is, however, no satisfactory evidence now extant for the assertion that "as early as the fifteenth century mathematicians were compelled to introduce symbols for the square roots of negative numbers in order to solve all quadratic and cubic equations." This assertion appears on page 92 of the valuable volume entitled "What is Mathematics?" by Richard Courant and Herbert Robbins (1941).

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## WHEAT GRAINS WITHOUT EMBRYOS[1]

A CRITICAL examination of several thousands of wheat grains of the 1941 crop for separation of kernels only slightly affected by sprout injury showed occasional grains which had a slightly concave area where the embryo usually produces a convex area. This at once suggested the embryoless seeds described by Lyon.[2] Some of the grains were sent to Dr. George H. Conant for sectioning, and these sections show clearly the embryoless condition.

Miss Lyon was especially interested in studying the respiratory activity of such seeds because previous comparisons of activity of embryo and endosperm had been made from samples from which embryos had been removed. She did not discuss the origin of embryoless seeds. Her work was the first report of this condition in wheat. Harlan and Pope[3] had reported the first case in cereals, finding five such seeds in many thousands of barley. They suggested that either the fertilization from which the embryo is formed had failed to occur or that development had been arrested shortly afterward, since there was not more than a doubtful trace of embryo cells.

Miss Lyon found that such seeds were not infrequent in wheat, finding about 0.1 per cent. in 150,000 grains, using six different varieties representing both winter and spring wheats. The North Dakota material examined was chiefly one sample of Ceres, a hard red spring wheat developed at the North Dakota station, and the proportion was similar to that found by Miss Lyon. This adds another variety to the list and supports her conclusion that it is not an uncommon occurrence.

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[1] Contribution from the N. D. Agricultural Experiment Station. Published with the approval of the director.
[2] Mildred E. Lyon, *Jour. Agr. Res.,* 36: 631–637, 1928.
[3] H. V. Harlan and M. N. Pope, *Am. Jour. Bot.,* 12: 50–53, 1925.

# SCIENTIFIC BOOKS

## VERTEBRATE EMBRYOLOGY

*Introduction to Vertebrate Embryology.* By WALDO SHUMWAY. Fourth edition. 372 pp. New York: John Wiley and Sons. 1942. $4.00.

THIS text, having reached the fourth edition, has quite evidently established itself. The present issue is considerably altered, but retains the general method of comparative treatment, *i.e.,* each of the four animals, amphioxus, frog, chick and man, is compared in its development in each system or part. Physiology is also stressed as formerly. The changes relate principally to increased attention to organogeny, to de-