time occupied by each of the successive phases, but there is as yet no evidence that the sequence is altered.

This statement needs to be qualified by the additional remark that the rhythm may be interrupted at any point by the advent of low temperature and presumably by any unfavorable metabolic conditions, to be resumed again when a suitable environment is restored.

It must be remembered that spawning occurs on the coast of Southern California during seven or more months of the year, so that on approach of cool weather the population will be represented by individuals which are in all stages of growth and reproduction, from larvae to old adults. Growth continues below the critical temperature but the discharge of sexual products is inhibited. The phase in which the animal enters this period will be retained throughout the winter unless the time of inhibition happens to coincide with the completion of one of the sexual phases.

A further complication results from the fact that not all parts of the reproductive system reach any one phase of sexuality at the same time, so that we shall find one portion in a somewhat different phase than is another area in the same animal. And finally, there are all grades of intersexuality as one phase passes into the next. This is particularly true of the younger animals, there being no exclusively male or female individuals among them at any season.

With increasing age, however, the intergrading stages become reduced and the sexual phase may be occasionally strictly male or female except for the minute gonia which anticipate the next phase. But in nearly all cases a few sperm-balls remain in some part of the system through the female phase and, conversely, a few ovocytes in the male phase recall the preceding part of the rhythm or foretell the next.

We may conclude, then, that *Ostrea lurida*, like the European *O. edulis*,[4,5,6] is a protandric hermaphrodite, with an alternating rhythm of female and male phases throughout life.[7, 8]

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[7] Of some sixty species of the genus *Ostrea* ten are known to be monoecious. In some of the others hermaphroditism has been found in young animals or in some localities, while in one species, classed as dioecious, a considerable proportion of individuals have recently been shown by Amemiya (*Proc. Imp. Acad. Tokyo*, 5: 284–286, 1929) to change their sex during the winter.

[8] In a recent number of SCIENCE (74: 71, 1931) Burkenroad presents evidence that even *O. virginica* on the coast of Louisiana is protandrous, with an incidence of hermaphroditism of about 1 per cent. in the general population. The writer has also found a considerable percentage of intersexuality in small individuals of the same species at Woods Hole, Massachusetts.

RICE BRAN, A PREVENTIVE OF PEROSIS (DEFORMING LEG WEAKNESS) IN CHICKENS[1]

IN the fall of 1929 the animal husbandry division of the Bureau of Animal Industry and the departments of poultry husbandry of several Southern and Southwestern state agricultural experiment stations organized an informal cooperative project for the purpose of comparing, on a weight-for-weight basis, different feeding stuffs when included in a so-called "uniform" diet for growing chickens. During the spring and summer of 1930 the following experiment stations used the "uniform" diet in some of their feeding experiments with growing chicks: Kansas, Louisiana, New Mexico, Missouri, Texas, the U. S. Poultry Experiment Station, Glendale, Arizona, and the U. S. Animal Husbandry Experiment Farm, Beltsville, Maryland.

Several of the stations reported that when the "uniform diet" was fed to chicks kept in confinement a high percentage of them became afflicted with perosis (deforming leg weakness). One of the writers (W. M. G.), observed, however, that when 10 and 20 per cent. of rice bran replaced equivalent amounts of wheat in the "uniform" diet, no cases of perosis occurred. Soon after this observation was made, the other writer (H. W. T.) started a series of experiments for the purpose of studying the cause of the beneficial effect of rice bran in preventing this condition.

The results of these experiments are now being written up for publication. Since perosis, or leg weakness, has been a serious obstacle to the rearing of chickens in confinement, it seems to be advisable to call attention, at this time, to some of the conclusions drawn from these experiments.

Perosis, or deforming leg weakness, in chickens is a condition of dietary origin, in which the legs become deformed in various ways. The first observable symptoms are a slight puffiness of the metatarsal-tibia joints and a marked tendency on the part of the chicks to rest for long periods of time in a squatting position with the legs doubled up under them. As the condition becomes worse, the joints become more enlarged and a pronounced bending of the tibiae and tarsometatarsi may occur. Union of the diaphyses and epiphyses at the distal end of the tibiae is greatly delayed, or fails to occur. Sometimes there is a marked separation of the epiphyses from the diaphyses and the large tendons slip from their condiles leaving the metatarsal-tibia joints permanently deformed.

[1] Published with the permission of the director of the Louisiana Agricultural Experiment Station and the chief of the Bureau of Animal Industry of the U. S. Department of Agriculture.

This condition can be partially prevented by (1) adjusting the calcium-phosphorus ratio of the diet to a more suitable value, and (2) by adding from 6 to 10 per cent. of rice bran to the diet. When both of these changes are made simultaneously, it is possible to prevent the condition entirely. In the presence of 6 to 10 per cent. of rice bran, a dietary calcium-phosphorus ratio of 2.5:1 was found to be effective in preventing perosis.

It seems probable that in the past this condition has often been confused with rickets. That the condition is not a truly rachitic one is indicated by the following observations: (1) The ash content of the leg bones may be, and nearly always is, normal, and (2) the calcium and inorganic phosphorus content of the blood serum falls within the normal range.

In view of the experimental findings it seems necessary to postulate that, in addition to vitamin D, another accessory food factor, or vitamin, is necessary for the proper development of the leg bones (and possibly of the other bones) of the growing chicken. It is suggested that water-alcohol extracts of rice bran may be of value in treating refractory cases of rickets in human babies, when there is little or no response to treatment with viosterol, or cod-liver oil, alone.

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THE FORMATION OF GLYCINE FROM SERINE[1]

IN a recent paper, Daft and Coghill[2] have recorded the isolation of glycine in 28 per cent. yield from the vigorous alkaline hydrolysis of another naturally occurring amino acid, serine. While the reaction may appear anomalous, it is readily explained on the basis of a theory which the writer is finding useful for the explanation of the sensitivity toward alkalies of cysteine and its derivatives.

The reaction:

$$\text{(A.)}\ R'CHO + H_3CC(:O)R \rightleftarrows R'CH(OH)CH_2C(:O)R \rightleftarrows R'CH:CHC(:O)R + H_2O.$$

is very well known, as is the fact that all its stages are reversible, the various changes being powerfully catalysed by alkalies.

Glycine, $H_2NCH_2C(:O)OH$, is a substance which contains, at least formally, the same groups as the methyl ketone of equation A. It is generally recognized that the carboxyl group is much less, though not indefinitely less, active in the respects here discussed, than the keto group. Nevertheless, reactions analogous to those indicated in equation A take place with glycine when it is substituted for the ketone represented in that equation. As a good example, the customary synthesis of β-phenyl serine[3] from benzaldehyde and glycine may be mentioned.

In the writer's opinion, the formation of glycine from serine as described by Daft and Coghill is only a reversal of this reaction:

$$\text{(B).}\ H_2C(OH)CH(NH_2)CO_2H \rightarrow H_2CO + H_2C(NH_2)CO_2H.$$

It is perhaps worth while, in this connection, to call attention to the fact that methylenemalonic ester, $H_2C:C(CO_2C_2H_5)_2$, needs no stronger alkali than ammonia to give[4] a formaldehyde derivative (hexamethylenetetramine) and malonamide. This reaction, in which hydroxymethylamalonic ester is undoubtedly an intermediate, is quite analogous to that described for serine, but occurs under much gentler conditions, due presumably to the greater activating effect of two carboxyl groups, and to the fact that the latter are in this case esterified.

It may be added that when cysteine is hydrolyzed with alkali, no formation of glycine has as yet been observed. The reaction takes instead the other course suggested by equation A, and hydrogen sulfide is split out[5] in the first of a series of reactions. A strictly analogous reaction, with loss of water, apparently accounts for the major portion of serine when the latter is similarly treated.

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[1] From the Bureau of Dairy Industry, United States Department of Agriculture.
[2] *Jour. Biol. Chem.*, 90: 341, 1931.
[3] E. Erlenmeyer, Jr., *Ann. Chem.*, 337: 245, 1904.
[4] A. Kötz, *J. prakt. Chem.*, (2) 75: 506, 1907.
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