Treatment	Per Cent. Germination
None	0
Boiled 5 seconds	53
Boiled 30 seconds	60
Boiled 60 seconds	60
Soaked in cold water 12 hours	0
Soaked in cold water 12 hours and boiled 5 seconds	47
Soaked in cold water 12 hours and boiled 30 seconds	87
Soaked in cold water 12 hours and boiled 60 seconds	93

Buffalo clover is scattered over many states as a wild plant, but is cultivated nowhere. It somewhat resembles red clover in general appearance and habit of growth, but is smaller. Its leaves are narrower and more sharply pointed and its head, when dead ripe, turns over and hangs down like the heads of white clover. It is large enough to have value if it has other desirable qualities.

The writer obtained the idea of soaking the seed before boiling from similar experiments with bur clover by the Alabama Experiment Station. The fundamental experiment of boiling the seed of both species was original, however, with the writer.

A. D. McNAIR

GOLDFISH AS EMBRYOLOGICAL MATERIAL

FEW laboratories have at their disposal a constant supply of material for the study of living embryology. Frog and snail eggs are used occasionally, but the supply is uncertain and sometimes difficult to obtain in the right stages, and furthermore, these ova are not particularly favorable for study. While engaged in an investigation on the genetics of goldfish the availability of the eggs of this animal for studies on the living embryo became evident and led to this note.

Goldfish are readily obtained in almost every locality and are thoroughly normal in environments in which few wild fish could exist. They breed in tanks containing not more than fifteen or twenty gallons of water and consequently require no elaborate or extensive equipment. Cypress boxes a foot or more square and three feet long make excellent breeding tanks.

A half dozen pairs or less will supply ample material for class use. It is not necessary to have as many males as females. It is well to obtain fish at least four or more inches long, as the larger fish are more certain to mate and are much more prolific. It is impossible to distinguish the sexes except as the breeding season approaches, when the sides of the female become distended through the growth of the ovaries and small spiny projections appear on the operculum and the anterior edge of the pectoral fins of the male.

One or two months before the breeding season begins it is advisable to feed the adults small quantities of beef, liver, mosquito larvæ or worms several times a week, which strengthens the fish and often advances the mating season. If the fish have been properly fed in the fall, spawning may begin as early as January or February if the aquarium is in a fairly warm place, although I have seldom obtained eggs before March or April.

During the season goldfish spawn at intervals of two weeks or longer and experienced breeders say that large vigorous females may breed as frequently as eight times during the spring, though in my work four or five matings have been more usual. The number of eggs spawned ranges from a few hundred to several thousand at a period, depending on the size of the female, and consequently the season's production, even allowing for unfertilized ova, is very great.

Goldfish spawn in the morning for periods varying from two to eight hours. The female discharges a small quantity of eggs against some water plant and the male, who is at her side at the time, fertilizes the eggs in the water. The feathery roots of the water hyacinth seem to be preferred, although the water plants, myriophyllum and cobomba are very satisfactory. The eggs adhere to the plants and may be removed on them. When it is desirable to time the fertilization accurately the plants may be removed as fast as the ova are discharged against them and others substituted. Though the eggs may be removed from the thread-like leaves or roots of the water plants generally these threads do not interfere and make a convenient handle for moving and orienting. The unfertilized ova become milky and opaque within twenty-four hours.

Stripping these fish is not entirely successful, as the eggs are so sticky that they clump together and adhere to the fingers of the operator or to anything else they may touch. Moreover, it is difficult to obtain sufficient sperm for a large number of eggs by stripping the male. It is perfectly possible, however, to obtain a few eggs from the female in this way and enough sperm to enable the process of fertilization to be studied under the microscope. Attempts to strip should only be made on those fish which are actually beginning to spawn, when the eggs will flow freely. At this time there is little danger of injuring the female. It is usually possible to determine at least twenty-four hours before the act begins which female is ready to spawn, as the males will follow or chase her about the tank.

The eggs take from two days to a week or more to hatch, depending on the temperature. The ova are perfectly transparent and the developing embryo is easily visible under the binocular.

Further directions for breeding that may be desired can be found in the books of Smith[1] and Wolf.[2]

Robert T. Hance
University of Pennsylvania

[1] Smith, Hugh M., 1909, "Japanese Goldfish," W. F. Roberts Company, Washington.

[2] Wolf, Herman T., 1908, "Goldfish Breeds and Other Aquarium Fish," Innes and Sons, Philadelphia.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION M—AGRICULTURE

On account of the unusual number of bodies meeting at New York during convocation week whose field borders on agriculture, the Section of Agriculture held only a single session. This occurred Wednesday afternoon, December 27, 1916, in Brinckerhoff Theater, Barnard College, Columbia University, and was presided over by Dr. W. H. Jordan, of the New York Experiment Station. In the absence of the retiring vice-president, Dean E. Davenport, of Illinois, who was unable to reach the meeting on account of delayed train service, it was necessary to dispense with the vice-presidential address. This address was entitled "The Outlook for Agricultural Science" and has been published in this journal.[1]

The feature of the session was a symposium on "The Adjustment of Science to Practise in Agriculture," participated in by Dr. H. J. Wheeler, of Boston, Dr. J. G. Lipman, director of the New Jersey Experiment Stations, Dr. G. F. Warren, of the College of Agriculture at Cornell University, and Director B. Youngblood, of the Texas Experiment Station. Approaching the subject from different angles, the speakers brought out the many important considerations which affect the adjustment and determine the extent of the application of the teachings of science in agricultural practise.

Discussing "Some Factors lying between Scientific Results and the Farm," Dr. Wheeler laid down the proposition that true science is always in accord with the best practise; there is no antagonism between science and good practise, although political, economic and other factors may intervene to modify the extent to which the findings of science are profitable or directly applicable. The prosperity of the farmer is a prime requisite to the application of science in his business. The element of risk is unusually large in farming, and uncertainty as to the character of the season and the price of his products often makes the farmer of limited means hesitate to introduce changes suggested by science. A favorable tariff has in some countries been a large factor in creating conditions under which science can be profitably applied, together with a larger element of stability of the industry.

It was held that agriculture must be stimulated by political action; if the industry is depressed so that the farmers are not making money, science can not lend an effective helping hand to the art. The encouragement of private ownership of land, the adjustment of the farm to the farmer's capacity, and adjustment of the farming system so as to distribute and give employment to the labor throughout the year, are all important as determining factors lying between knowledge and its utilization on the farm. The condition of the land as, for example, the need of drainage, may be another factor in realizing advantages from the application of scientific principles. Illustrations were drawn from German agriculture to show how favorable conditions have been a means of developing agriculture and of putting into practise the teachings of the experiment stations and other educational agencies. As an example, the use of fertilizers was

[1] Science, N. S., Vol. XLV., p. 149.