

ters that depend on some other relation in the germ cells than that brought about by the shifting of the chromosomes in the reduction division to produce 'pure' gametes.

Ziegler's failure to give a satisfactory account of sex determination on the *differential* chromosome basis raises the wider question as to whether at the present time we are really obliged to look in this direction for a solution of the question. The known facts in regard to sex indicate that we have to deal with two sharply contrasted, yet interchangeable states. Furthermore, the facts seem to indicate that some internal mechanism exists that gives with great precision the one or the other condition. We lack completely at present the necessary knowledge of the chemistry of the cell on which alone we can hope to establish a real theory of sex determination. It might be possible indeed to invent a purely fictitious, *quasi* chemical, hypothesis, such, for instance, as assuming that the female and the male represent two contrasted conditions of the same protoplasm, one state being a combined (the female) and the other a separated (male) condition of the aggregate bodies (molecules) of which the protoplasm is composed. While we might, were it worth while, work out this or some similar idea into a more or less consistent hypothesis, the only value that such a conception might have at present would be to indicate that sex determination may not be the result of differential *nuclear* divisions that locate sex determining chromosomes in different cells, but that the process is chemical rather than morphological.

T. H. MORGAN.

COLUMBIA UNIVERSITY.

THE SARGASSO FISH NOT A NEST-MAKER.

EVER since 1872 the sargasso fish (*Pterophryne histrio*) has been famous as the builder of a remarkable globular nest made of the sargasso weed, in the midst of which it finds a congenial home. Professor Louis Agassiz first described such nests observed by him in December, 1871, during a voyage to Brazil and attributed them to the Antennariid. No one has since doubted the accuracy of the identification, and in innumerable works it

has been accepted as well established. A few weeks ago, however, Dr. Hugh Smith, deputy fish commissioner, informed me that he had obtained eggs laid by the sargasso fish and, on a visit to his office, he showed me some under a microscope, and I was surprised to find that they were quite different from those found in connection with the nests and which had been elaborately described by Vaillant and Möbius. Later I received a letter from Professor E. W. Gudger, of the State Normal College of North Carolina, containing an account of the pterophryne's oviposition. This corresponds remarkably with that practised by the fish's distant relative, the angler (*Lophius piscatorius*). The elaborate provision thus made specially for the eggs, as well as the absence of polar filaments, negatives the attribution of such eggs to the nest-maker of the sargasso sea and leaves the question of the real maker an unsolved problem. Similar eggs were found free on the surface of the sea off the African coast and noticed by Cunningham (1887) but not identified. Can such be the product of a flying-fish?

The fish, whatever it may be, is probably not a direct maker of the nest but the filaments of the eggs may, perhaps, become mechanically entangled with the fronds as well as with each other and the contraction into a subglobular mass may be the result.

Professor Gudger's communication is herewith submitted.

THEO. GILL.

A NOTE ON THE EGGS AND EGG-LAYING OF PTEROPHRYNE HISTRIO, THE GULFWEEED FISH.

SPECIMENS of the gulfwweed fish occasionally drift with the *Sargassum* into the harbor of Beaufort, N. C., and are picked up along the beach by boys and brought to the laboratory of the United States Bureau of Fisheries.

When I reached the laboratory about the middle of June, 1903, there were two of these interesting fishes confined in an aquarium of running salt water. These were put in my care and on one of them and its eggs the following observations were made. The two fishes were of unequal size and were contin-

ually fighting. In these daily combats, the smaller suffered considerably, its filamentous appendages and even the ends of its fins being bitten off. Finally it was killed and preserved as a museum specimen. Its sex was not determined.

The larger fish, thus left alone, did not seem to miss its companion. It fed voraciously, eating pieces of oyster, bits of shrimp and small fishes alive or dead. In catching its prey it would with closed mouth draw near, and then opening it suddenly (the premaxillaries and lower jaw protruding considerably), would take in its prey with an instantaneous gulp. Frequently, however, *Pterophryne* would remain perfectly quiet amid the *Sargassum*, holding on to the branches with its hand-like pectorals and waiting for the little fishes to come near it. It grew very fat with high feeding and its abdomen became much enlarged, in front of the anus becoming as square as if it had been cut to shape with a knife. Nothing, however, was thought of this save that the fish was getting very fat.

About noon, on July 25 (after the fish had been in captivity seven weeks), the writer passed through that part of the laboratory where the aquaria were, and found that the *Sargassum*-fish had laid a large quantity of eggs which, imbedded in jelly, floated at the surface of the water. The eggs, whose number there were no means of computing, together with the enveloping jelly, formed a long string which would have more than filled a pint cup (250 c.c.). This jelly had evidently swollen on contact with the water, for the fish, which was only three or three and one half inches long, had only about one third of the volume of the eggs and jelly combined. After the extrusion of the eggs, the size of the fish was noticeably decreased, and the 'fatness' largely disappeared.

The eggs were examined alive and, later, sections were made of them. The germinal disk begins to form shortly after the eggs are laid and this fact is noteworthy, in that, according to Agassiz and Whitman, in pelagic fish eggs this is generally not formed until after fertilization. The formation of the germinal disk, however, proceeds unequally

rapidly, and, at the end of four and one half hours (at which time the eggs now in my possession were killed), had in no egg examined made such a round, clearly marked off, button-shaped disk as all workers have found in the egg of the salmonoids, and as I have figured for the pipefish, *Siphostoma floridae*. On the contrary, observations on the living egg, confirmed by the study of sections, show that the germinal disk is partly sunken in a depression in the yolk, half of its thickness being below the general level of the yolk. The germinal disk in the eggs of the Salmonidæ is sunken in a depression, in the center of which it forms a mound, touching the yolk only at its base. In *Pterophryne*, however, the protoplasm entirely fills the depression in the yolk (this in eggs four and one half hours old), a phenomenon, so far as I know, not before reported for any teleostean egg.

The protoplasm first exists as a shell of uniform thickness surrounding the yolk, and in the living egg, shortly after it begins to thicken at one pole to form the germinal disk, there may be seen in optical section a clearly defined nucleus. On the contrary, however, I have never been able, either in sections or in the living egg of the pipefish, to find a nucleus in the one-celled stage. Unlike most pelagic eggs, there are no oil drops visible in the living egg of *Pterophryne*. In sections, some eggs show a small number of minute vacuoles indiscriminately scattered under the germ disk and around the circumference of the yolk; some are devoid of these, and two eggs had two large ones each. These vacuoles were in life presumably filled with oil drops, which have been dissolved out by the alcohol. In the living eggs, no oil drops were ever seen and until the sections had been examined the writer was confident none existed. Indeed, they would seem to be a negligible quantity. The function of the jelly then evidently is to serve as a float to keep the eggs at the surface of the water.

The yolk is colorless and without texture, and, being perfectly homogeneous, is so translucent as to approach transparency. The egg, which is surrounded by a thin, smooth, transparent shell, is as easily separated from

the jelly as that of the frog. The eggs vary in size, but on the average are about 1 mm. in diameter.

The fish continued to thrive, although feeding perhaps less ravenously, and was in perfect condition some five weeks later when I left the laboratory. About half the eggs were preserved in formalin, and, excepting the few kept by the writer, were deposited in the museum of the laboratory at Beaufort.

These observations were made at the laboratory of the United States Bureau of Fisheries of Beaufort, N. C. For permission to make use of the excellent facilities there, I am indebted to the Commissioner, Hon. George M. Bowers.

E. W. GUDGER.

STATE NORMAL COLLEGE,
GREENSBORO, N. C.,
October 7, 1905.

SEX DIFFERENCES IN THE ESTIMATION OF TIME.

IN volume 19, pages 707-708, of this journal Professor Robert MacDougall published an account of some experiments on the 'time sense' of men and women which seemed to indicate certain important sex differences. As he states, however, 'the noting of these sex differences was incidental to the primary purpose of the test, and attention is called to them here in order that observations on the part of others may be brought into comparison with the results presented by this group of persons.'

Since MacDougall's results were obtained by the examination of only fifteen persons of each sex, further investigation of the subject is evidently important. We have, therefore, carried out experiments along similar lines with hundreds of subjects for the purpose of ascertaining the significance of sex, age and physiological rhythms in the estimation of time. In the present report we shall consider only the relation of sex to time judgments.¹

The subjects were required to judge the length of each of four intervals, 18, 36, 72 and 108 seconds, under four different condi-

tions, which are designated in the table as idleness, estimating, reading and writing. During the *idleness* intervals the subject waited passively for the elapsing of the time; during *estimating* he made use of the method of his own selection by which he could best judge of the length of the period; during *reading* he listened while the experimenter read, and during *writing* he wrote from the dictation of the experimenter.

For comparison of the sexes groups of 251 males, from seventeen to twenty-three years old, and 274 females, from seventeen to twenty years old, were examined. In the accompanying table we present the means, mean variabilities and relative variabilities of each sex group for each interval and filling.

Intervals.	Fillings.	Mean.		Mean Variability.		Relative Variability.	
		M.	F.	M.	F.	M.	F.
18"	I	17.7"	20.7"	5.4"	10.4"	30	50
	E	19.5	25.6	4.9	9.8	25	39
	R	15.5	18.5	4.9	9.1	31	49
	W	11.5	15.6	3.7	8.6	33	55
36"	I	33.3	42.8	9.1	16.6	27	38
	E	33.1	41.5	8.4	15.2	25	37
	R	32.1	41.7	8.4	16.4	26	39
	W	24.7	30.1	9.0	14.7	36	49
72"	I	63.3	73.0	17.2	27.2	27	37
	E	63.1	77.1	16.0	26.6	27	34
	R	57.9	70.8	17.3	30.3	30	43
	W	51.2	54.9	19.8	24.2	37	44
108"	I	92.7	113.4	29.8	40.1	32	35
	E	99.8	114.9	26.3	36.4	26	32
	R	90.1	100.5	28.3	40.2	31	40
	W	75.5	87.5	32.4	45.3	42	52

Summarily stated our investigation indicates the following sex differences:

1. The females were much less accurate than males in the estimation of the intervals under consideration. The range of the male judgments was from 1 to 300 seconds, that of the female from 1 to 400 seconds.

2. The females greatly overestimate the intervals in most cases, whereas the males almost invariably underestimate them. The length of the second itself is usually much shorter in the judgment of the female than in that of the male.

¹A detailed account of the investigation is in process of publication in volume 2 of the *Harvard Psychological Studies*.