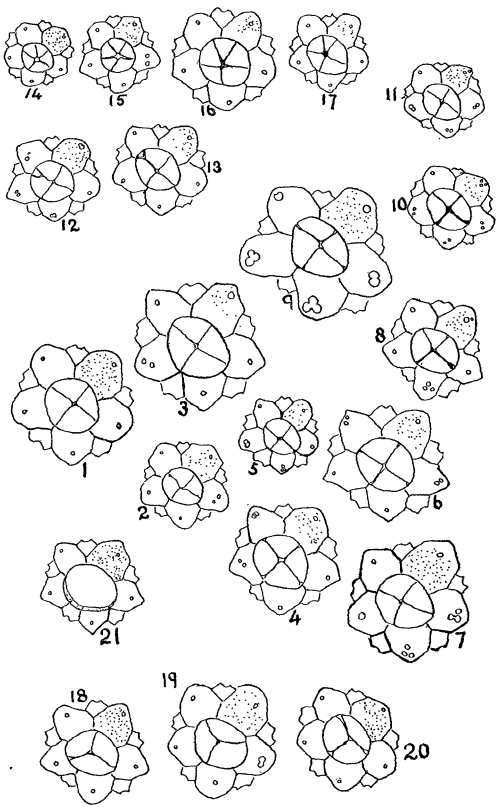
the slave of neither prejudice nor preconception and abandons the accepted truth of yesterday if only it be the demonstrated error of to-day. It places no premium upon personal prerogative, and extends no recognition to individual authority. It makes no proclamation of completeness, no pretension to sufficiency. It recognizes that truth is undergoing progressive revelation, not ending to-day, but continuing through the ages. It yields its plaudits to achievement, and recognizes that he is the greatest among men who reveals the most of truth unto men. It greets as a friend him who thinks, though he think error, for, thinking, he may think truth and thereby add to the common fund. It heeds all things, examines all things, judges all things.

To you, the exponents of this new school, of this new generation, of this new century; to you, representatives of the Democracy of Science; to you, citizens of the Republic of Letters, I extend greetings; and here, in our parliament assembled, here, where our will is supreme, I this day invoke upon our deliberations the spirit of liberty, the spirit of courage, the spirit of progress, the spirit of truth.

Charles A. L. Reed.

VARIATIONS IN THE APICAL PLATES OF ARBACIA PUNCTULATA FROM WOOD'S HOLL, MASS.

The object of this note is to call the attention of naturalists to three points of variation in the apical system of the common eastern sea-urchin, *Arbacia punctulata*. The variations may be already known, but I had not noticed them till a year ago, and have never seen any mention of them in print. The observations are based on the study of sixty-three dry specimens sent me for class use from Wood's Holl, Massachusetts, by Mr. F. W. Walmsley. The different plates can be seen very readily if, after removing the spines, the surface be washed and gently brushed with a weak solution of caustic potash and then dried. Great care is necessary in handling the anal plates or they will fall out. The drawings were all made under a camera lucida, magnified four diameters and then reduced one-third. The views are all placed in a similar position, *i. e.*, the anterior radius (as defined by Lang's 'Text-Book of Comparative Anatomy') is with the madreporic plate in the right anterior interradius. The views are arranged so that all those having four anal plates are in the center and those with three or five are below or above. This figure is a view of the



arrangement of apical plates most frequently found, the 'mode,' as it is called by recent writers on variation. It was selected to represent forty-five cases with

respect to the number of anal plates and genital pores. The other figures all represent different cases, none of them exactly duplicated in the whole collection of sixty-five. In No. 1, the mode, we recognize four anal plates an anterior, a posterior, a right and a left. Five genital plates, meeting by a considerable distance and totally excluding the ocular plates from the border of the anal ring. Each genital plate is perforated by a single genital pore. A study of the cases shows that none of these points are constant.

First, as to the number of anal plates, we find variation between three and five with four as the mode. In the case of those with five plates, two have the fifth very small, barely distinct, and the position of each one of the four large ones is similar to that of the mode. It is interesting to find that the fifth in both of the two cases is introduced at the same point, viz., near the left anterior radius. The position of the plates is nearly constant in the specimens with four, though there is a little shifting usually toward the right. Thus in No. 4, the centers of the anterior and posterior plates are strictly in the axial line, but in No. 7 they are not. In the cases with three plates, the anterior seems to have been the one to disappear, the posterior being present and showing the same tendency to shift as just noted. In the cases with five equal plates, Nos. 14–17, the plates show a tendency to be all of them radial in position, *i. e.*, alternate with the genital plates.

The number of pores in the genital plates is also subject to variation, which occurs in a greater percentage of cases than the preceding. In the mode, No. 1, there is a single genital pore in each genital plate. In No. 2, the right posterior genital plate has two pores, one being smaller. In No. 3, there are two large pores well separated. In No. 19, there is in the right posterior genital plate a pore imperfectly divided into two; it is the least deviation from the mode in the collection. No. 5 is an interesting case in which in one plate there are two pores nearly separate and in another three, one distinct and the other two fused. In No. 8, one plate has two pores and another three. Three pores is the maximum number that I have found in one plate. In some cases all three pores are united as in No. 9, or one is distinct and two are united as in 7, or all are distinct as in 7, 8, 10. The maximum number of genital plates in one individual thus furnished with extra pores is four (Nos. 10 and 11 and, possibly, 9); in no case are all the genital plates thus varied. As to frequencies, I notice that it is more often that we find two pores than three. No one of the five genital plates is wholly exempt from this division of the genital pore, but the madreporic plate is least frequently variable. I have found two cases in sixty-five in which it had two pores, and one case with three.

Summarizing the facts as to the number of genital pores, we get the following table, in which the number of pores for each plate is shown; thus the upper and left block of figures shows that the left anterior genital plate has one pore in seven cases, two pores in five cases and three in no case, and so on for the remaining four plates:

	1111111	=7		111111111	=9			
	22222	=5		22	=2			
	—	=0		3	=1			
11111	=5					1111	=4	
222222	=6					2222222	=7	
3	=1					3	=1	
			11111	=5				
			222	=3				
			3333	=4				

The three posterior plates are thus shown to be more variable than the two anterior plates, and the posterior plates show a stronger tendency to having three pores than any of the others. It is interesting to note that in the subcarboniferous sea-

urchin *Melonites* (Lang, '96, ii, p. 291, Macmillan edition; and Dana, '95, Manual of Geology, p. 641) there are four, or in some genital plates five, pores, instead of one, as regularly in modern genera.

The positions of the ocular plates with reference to the border of the anal ring are subject to variation. The facts in the case are these: In a majority of the 65 *Arbacias* observed the plates are located exactly as shown in Fig. 1, where the madreporic plate meets its two neighbors by a long joint, thus pushing the ocular plate far away from the border of the anal opening, as compared with the left posterior ocular plate, which is only slightly distant from the border. The right posterior ocular and the right anterior are also less separated than the remaining two. This is the mode. The variations from it are on the part of the left posterior ocular chiefly and, in addition, of the right posterior, and less of the left anterior ocular plates. The extreme case of this variation is shown in No. 5, where the left posterior ocular plate participates in the formation of the border of the anal ring, as the right posterior also does, though in a less degree. In No. 21, the same variation is to be seen. Cases in which this form of variation takes place, but in a less extreme degree, are frequently met. No. 17 is such a case; here the left posterior ocular plate barely touches the margin; this is also seen in No. 3. In No. 10 this ocular does not quite reach the margin. The left posterior ocular thus shows a strong tendency to push itself into the anal ring, a tendency shown, too, but in a less degree, by the right posterior ocular and slightly by the left anterior ocular plate. The specimen of *Arbacia*, figured by Brooks in his 'Invertebrate Zoology' ('82, p. 86), which came from Southern waters, shows this same variation as to the left posterior ocular plate. The specimen of *Echinocidaris* (*Arbacia*) *pustulosa*, figured in Lang ('96, Macmillan, Comp. Anat., II., p. 232), shows the two posterior and the left anterior oculars all bordering the ring.

In some sea-urchins (*e. g.*, *Diadema*) all the oculars take a part equally in forming the boundary of the anal ring. In *Salenia*, believed to be a very primitive genus, none of them touch it. In *Strongylocentrotus* there is a condition between these two extremes; in that form the left posterior ocular and the right posterior ocular regularly form a part of the border of the anal ring, and occasionally the left anterior ocular reaches it. In *Arbacia* the corresponding ocular plates vary in the direction of an arrangement which is the mode in *Strongylocentrotus*. A somewhat extended study of the apical systems of *Arbacia* from widely separated localities, together with a similar study of that of some of the other sea-urchins, would probably be of considerable interest to students of variation.

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INORGANIC FERMENTS.

An article on this subject appeared somewhat more than a year ago in the *Zeitschrift für physikalische Chemie* by Bredig and Müller von Berneck. Quite recently a monograph has been published by Bredig, under this title, containing an account of the experimental work which he has done with others and also an introductory chapter on colloidal solutions, method of preparation, etc.

The monograph begins with a discussion of the general properties of colloidal solutions. Graham found that colloids diffuse very slowly in comparison with crystalloids. Pfeffer showed that colloids exert very small osmotic pressures, and Tammann demonstrated that colloids lower the