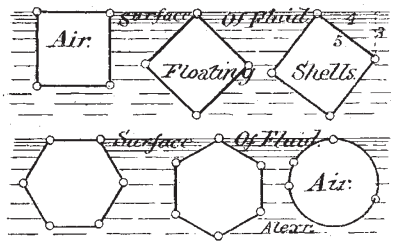
met with the approval, among others, of Prof. Perry, London, and Prof. Malverd Howe, America. In revising this matter for the new edition of our "Applied Mechanics," I find that polygonal cylinders of uniform plates freely hinged at their edges and displacing their own weight of fluid and lying horizontally are also in equilibrium, provided the polygon be regular.

In the diagram the square shell is shown just reaching the surface and rolled into three positions. The proof is the same as for the ordinary statical problems on festoons of rods hinged at the ends, only now there is the external fluid pressure in addition to the weights. The fluid is kept out by face plates at the ends, the face plates having the same density as the fluid and being quite smooth, so as to allow the shell freely to change its shape. If the shell be slightly compressed it will collapse, but



the friction of the face plates and the confined air afford a slight degree of stability. The diagram shows the regular hexagonal shell, and by increasing the number of sides we arrive, as before, at the circular cylinder. In the polygonal shells there are bending moments on the sides as well as the thrust, but on the circular there is only hoop thrust, as it may be a plenum of joints. Submerging only adds a symmetrical load all round, and the shells are still balanced. As they are also balanced with the axis vertical it follows that they are in equilibrium in any position whatever.

My first letter led to some correspondence, and I hope this may be of interest to your readers. THOS. ALEXANDER.

Trinity College, Dublin, April 19.

Mycoplasm.

SINCE 1889 a fungus hyphal layer has been known to exist in the nucellar remnants of the grains of the Darnel grass, *Lolium temulentum*, and to these hyphæ have been attributed the poisonous properties of the Darnel. Later investigations have shown that the fungus could be found in the growing point of developing plants, in the inflorescence, and finally in the ovular rudiments. The manner of entrance of the fungus had, however, escaped detection. Nestler (*Ber. d. deutsch. bot. Gesellsch.*, B. xvi., 1898, p. 210) and others failed to observe the fungus in the embryo in the mature grain. The hyphæ in the growing point could not be observed before the eighth day of germination.

Eriksson has recently[1] quoted the work of Nestler and others on the fungus of *Lolium temulentum* in support of his theory on mycoplasma. According to Nestler, the embryo does not contain the hyphæ, which appear in the seedling on the eighth day. In only one case was he able to see hyphæ in the embryo. In view of the support which this work appears to give to Eriksson's mycoplasma theory, an advance note on some of my results in the investigation of the fungus of *Lolium temulentum*, which has been carried on in the laboratory of Prof. Marshall Ward at Cambridge University, may be of interest. In appropriately stained sections of the embryo taken from the mature seed of *Lolium temulentum*, hyphæ in great abundance may be seen in the growing point, sometimes but two cells from the tip; these hyphæ may be traced to their point of entrance at the juncture of the coleorhiza and scutellum on the outer surface of the latter in the region of the median longitudinal plane of the scutellum. Previous investigators had entirely overlooked the presence of a considerable amount of mycelium in that part of the grain which lies directly against the scutellum in the median basal region, where it has grown around the end of the aleurone layer. The infection takes place apparently before the grain has reached complete maturity, as the fungus is well established in the ripe grain. There can, therefore, be no question here of mycoplasm, since direct hyphal infection can very easily be demonstrated. There is no evidence to prove that the fungus is a Uredine. The detailed results, with other particulars of the nature and development of the fungus, will be published soon.

April 20. E. M. FREEMAN.

[1] Eriksson, *Ann. des Sc. Nat.*, T. xv., 1902, p. 73, says:—"Les tentatives infructeuses d'A. Nestler d'apprendre à connaitre de quelle manière le champignon qu'on trouve presque toujours dans les fruits du *Lolium temulentum* est entré dans le cone végétatif de l'embryon du fruit amenent aussi la supposition d'un état mycoplasmatique latent."

Rearrangement of Euclid I. 1-32.

THE rearrangement outlined in my previous letter was devised to meet the difficulty which, as Prof. Bryan states, is the chief objection to Euclid's Elements as an elementary course. Beginners cannot solve riders because

(1) They do not grasp the reasons for Euclid's limited postulates and axioms, and never fairly understand the "rules of the game"; consequently their early attempts violate his conditions, and their rejection discourages.

(2) Too much time is occupied by the propositions, with the result that they regard them, not as tools, but as models, and imitate Euclid's methods of proof. There is nothing in 1-8 worthy of imitation.

(3) They do not distinguish between data and quæsita unless they have drawn accurate figures. It is impossible to draw accurate figures by proved methods in Euclid's scheme (*e.g.* I. 4), and we therefore have recourse to figures drawn on the principle of Artemus Ward's horses. This is the great difficulty in working riders. Allow a boy to assume the mid-point of a line and he will assume the most impossible constructions. He should never be allowed to quote a construction which he cannot perform, and no construction should be shown him without proof. Freehand copies of blackboard figures are useless; if he has drawn a dictated figure, there is no confusion between hypothesis and conclusion. There is also the additional advantage that the less intelligent feel that in drawing the figure they have accomplished something, and this frequently stimulates to further effort.

To remove these difficulties we must extend the axioms and postulates, reduce the number of standard propositions, and introduce problems as early as possible. The advocates of a purely theoretical scheme have two courses open to them—either they must teach constructions first without proof (which is extremely illogical), or they must postpone them until the completion of the theory, and therefore postpone riders indefinitely. Geometry without riders resembles arithmetic without examples.

In the scheme which we have found most successful, riders commence with the definitions. Every standard proposition is treated as a rider and evolved by the class; one proposition a fortnight is considered sufficiently rapid progress, the intervening lessons being devoted to riders.

The circle gives a method of drawing equal lines, and, with the idea of angular measurement, a method of constructing equal angles. Of course we assume the shape of the circle.

I. 15 and 32 give the fundamental fact of rotation and introduce easy theorems and numerical examples.

I. 8 with its riders elicits I. 9, and I. 4 is followed by I. 10, locus of points equidistant from two given points, I. 11, 12, 5. Having reached this point, possible riders are endless, and the only difficulty lies in their selection; many propositions of III. and IV. may be included in the riders. Every pupil can now draw an accurate figure from dictation, and knows exactly what data he has to work upon. The rate of progress may appear slow, but we are teaching Book VI. in the second year. It should be noted that I. 1 is a rider, 20 an axiom, and that 2, 3, 7, 18, 19, 21, 24, 25 are not read.

In teaching riders, theorems should, as a rule, be grouped on methods of proof; the required figure should be dictated and the class asked to prove any fact they can concerning it. A general enunciation should then be invented; in this way standard propositions for future proof are frequently suggested. It is a mistake to hurl a general enunciation at a class of beginners. Problems usually give more trouble, but if grouped on loci their difficulties vanish.

There would be no examination difficulty if papers were set on riders only. Euclid's Elements might then be reserved for university examinations—a geometrical "Paley."

Leyton Technical Institute, April 25. T. PETCH.