

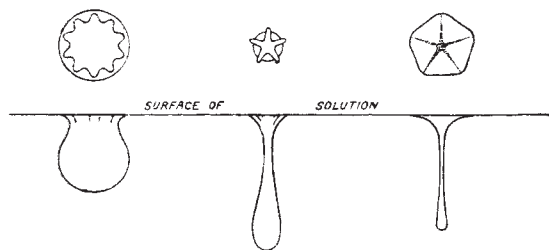
LETTERS TO THE EDITOR.

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Production of Medusoid Forms from Gels.

THE reference to the phenomena of ordinary drops in Prof. D'Arcy W. Thompson's letter on "Medusoid Bells" in NATURE of August 8 has suggested to me the possibility of obtaining permanent imitations of such forms as he describes by producing drops of gelatin in a suitable medium. The latter must be one of the solutions which harden gelatin, must have a specific gravity very near that of the gelatin sol at the temperature at which it is used, and must possess an appreciable interfacial tension against the sol. I have found that a solution of aluminium sulphate can be made which fulfils all these conditions.

If 20 per cent. gelatin sol, which may be coloured with any convenient dye, is dropped into such a solution from a tube about 4 mm. diameter, with its orifice from 2 to 8 mm. above the surface, rather interesting forms are obtained. The specimens do not lend themselves very well to photographic reproduction, but I have drawn diagrammatically three typical cases. In all instances the crenated or stellate portion rests on the surface. With a 10 per cent. gelatin sol permanent vortex rings can be obtained, as well as discs with a thickened rim, rings with a cylindrical fringe, etc.



To approach more nearly to the conditions of the budding organism, it would be necessary to discharge the drops below the surface of the liquid. This procedure entails some experimental difficulties, which, however, I hope to overcome. The forms so far produced do not show to me any evidence of vibration, but appear to be completely explicable by the effects of surface and interfacial tension and of the removal of water from the gel. Further experiments may show such evidence, and it would be very interesting if they could furnish support for so attractive a hypothesis in view of its two *prima facie* difficulties: the origin and the persistence of vibration in a medium with the peculiar elastic properties of dilute gels. Perhaps the results described may induce others, more competent than I am to interpret their biological and morphological aspects, to make such experiments; the conditions may be varied in a great number of ways which will readily suggest themselves to anyone familiar with the properties of gelatin.

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NO. 2548, VOL. 101]

Formulae for Tetrahedron.

PERHAPS some readers of NATURE may be able to tell me whether the following results are new:—

Let ABCD be any tetrahedron; $BC=a$, $DA=a'$, and so for the other edges; (BC) =dihedral angle of which BC is an edge, and so on; (aa') the angle between BC, AD, and so on; α , β , γ , δ the areas of the faces opposite A, B, C, D respectively. Then we have identically

$$aa' \cos(aa') + bb' \cos(bb') + cc' \cos(cc') = 0 \quad (i)$$

$$aa' \cos(aa') \cos(BC) \cos(AD) + bb' \cos(bb') \cos(CA) \cos(BD) + cc' \cos(cc') \cos(AB) \cos(CD) = 0 \quad (ii)$$

It is a known theorem, due to Steiner, that the four altitudes of ABCD are generators of the same hyperboloid. With the help of (i) and (ii) I have found that, taking ABCD as the tetrahedron of reference, the equation of Steiner's hyperboloid is, in volume coordinates,

$$aa' \cos(aa') \{a\delta\gamma\cos(BC) + \beta\gamma\alpha\cos(AD)\} + bb' \cos(bb') \{\beta\delta\alpha\cos(CA) + \gamma\alpha\delta\cos(BD)\} + cc' \cos(cc') \{\gamma\delta\alpha\cos(AB) + \alpha\beta\delta\cos(CD)\} = 0.$$

In these formulae certain conventions have to be made in the definitions of the angles (aa') , etc., so as to make the cosines come out with the proper signs.

Another interesting result is that if V is the volume of the tetrahedron,

$$4a\beta\gamma\delta \{ \cos(AB) \cos(CD) - \cos(CA) \cos(BD) \} = 9V^2 aa' \cos(aa')$$

with two other identities derived from this by interchange of letters.

All the formulae can be translated into vector identities; thus $\sum aa' \cos(aa') = 0$ corresponds to the quaternion identity

$$S\{(\beta - \gamma)\alpha + (\gamma - \alpha)\beta + (\alpha - \beta)\gamma\} = 0,$$

but the others do not seem to me to be so easily derivable.

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Rotating Discs.

A NOTE in NATURE, August 22, p. 491, referring to a recent article by Mr. H. Haerle, says: "The problem of ascertaining the distribution and magnitudes of the stresses in a revolving disc by means of mathematical formulae is tedious and complicated. With the exception of the cases of discs of constant thickness and constant strength, for which definite integrals can be found, the analytical solution involves highly complex equations, and the ultimate result is doubtful." May I point out that the ordinary approximate solution for the rotating circular disc of uniform thickness, whether complete or holed, involves only simple powers of the radius vector? The corresponding solution for the thin elliptical disc involves expressions of an equally elementary type, though naturally longer. But in addition we have possessed for more than twenty years (see Proc. Roy. Soc., vol. lviii., p. 39) a complete solution for an ellipsoid of any shape rotating about a principal axis. This involves only simple powers of the variables x , y , z , and it applies, of course, to discs of very varied shapes. All the ordinary elastic solid equations, whether internal or external, are exactly satisfied in this case. Thus the uncertainties are only those inevitable through the difference between the ideal elastic solid problem and its realisation in practice.

C. CHREE.

August 26.