by means of his equation given at p. 773 of NATURE of December 9, 1922.

Metal.	Pressure of Fluidity.
	Kilos per sq. cm.
Tin	1,080
Zinc . . .	5,000
Steel A . . .	19,200
Steel S90 . .	33,600

I have recently (with the generous aid of Mr. R. H. H. Stanger of the Broadway Testing Laboratories, and the following firms who prepared and presented the necessary three specimens of each metal) determined the pressures of fluidity of several metals by direct experiment, so it will be interesting to compare the results, remembering of course that the specimens were *not* made from the same piece of metal as those used by Mr. O'Neill. In the case of my tests the three specimens of each metal were made from the same piece.

The British Aluminium Co. Ltd. supplied the specimens of aluminium.

Messrs. David Colville and Co. Ltd. supplied the specimens of mild steel.

Messrs. Dewrance and Co. supplied the specimens of tin, lead, and zinc.

The Elliott's Metal Co. Ltd. supplied the specimens of copper.

The Muntz's Metal Co. Ltd. supplied the specimens of Muntz's metal.

The experiments were made not merely to determine the pressures of fluidity, but also to test an hypothesis to account for the phenomenon of pressure of fluidity. This hypothesis is far too long to reproduce here, but it will be found in the Transactions of the Society of Engineers for the quarter January-March 1923. It connects the pressure of fluidity with the ultimate shearing and tensile strength of the metal, and was devised in connexion with experiments with clay, and then found to apply to plastic metals as well.

If p be the pressure of fluidity in kilos per sq. cm.,
f be the shearing stress in kilos per sq. cm.,
c be the ultimate tensile strength in kilos per sq. cm.,

then the hypothesis shows rationally on the assumptions made that

$$p = 3 \cdot 68c + 5 \cdot 21f. \qquad (1)$$

The pressures of fluidity were determined by means of cylindrical specimens 70 mm. in diameter and 70 mm. high, using a flat-nosed punch 10 mm. in diameter at the end and reduced in the shank to 9 mm. so as to clear the sides of the hole.

Metal.	Tensile Strength c.	Shearing Strength f.	Pressure of Fluidity p.	p' the calculated Value of p.	$\frac{p'-p}{p'} \times 100$.
Lead . . .	114·5	125	777	1,072	+27·5
Lead-tin alloy	244·0	156	1,233	1,706	+27·7
Tin . . .	223	232	1,367	2,025	+32·5
Aluminium .	827	577	4,015	6,045	+33·6
Copper . .	2192	1445	10,860	15,590	+30·1
Muntz's metal	3686	2004	(16,800)*	23,966	
Mild steel .	4380	2990	(22,140)*	31,625	Mean +30·3
Zinc . . .	214	755	[7,760]	4,707	..

All stresses are in kilograms per sq. cm.

* These are *not* experimental values, but merely predictions.

The relation given by equation (1) thus on the average gives results which need reducing by 30 per cent. to arrive at the actual values, and the maximum departure from this mean is 3·3 (aluminium).

Zinc is a rank outsider as regards this hypothesis! But zinc has no plasticity. It did not elongate or show any contraction of area under a tensile force. In shear even it failed by tension, and when the pressure of fluidity experiment was made, the specimen gradually burst by yielding in tension on several vertical planes.

With regard to the variation of the figures in the last column, it must be remembered that these depend on the experimental values of f and c, which themselves vary. For example, in the case of the shearing tests, two experiments were made with each metal, the planes of shear being about one inch apart on the same specimen. For all this the values of f differed by 4·3 per cent. and 5·5 per cent. in the cases of tin and aluminium respectively.

A. S. E. ACKERMANN.

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March 31.

Use of the Millibar in Aerodynamics.

THE millibar, introduced by Sir Napier Shaw into British meteorology, brings the same drastic simplification into the numerical relations between pressure and velocity in aeronautics.

The accompanying diagram (Fig. 1) shows the

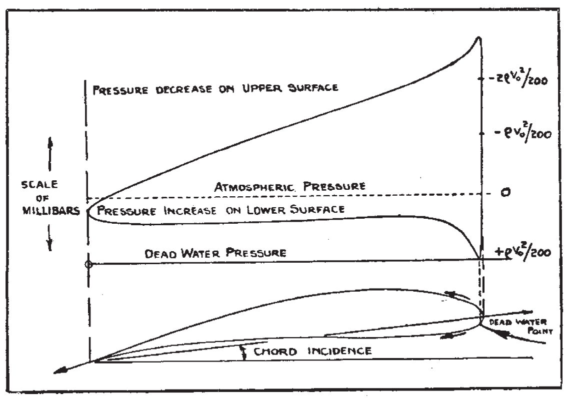

FIG. 1.

pressure distribution round a wing profile, calculated in accordance with Joukowsky's theory.

In C.G.S. units $p - p_0 = \frac{1}{2}\rho \, . \, (v_0^2 - v^2)$ dynes/cm.^{2} or microbars, where p, v are the variable pressure and velocity at points on the profile, p_0, v_0 the values at a distance, and ρ the density of the air.

Expressing ρ and v in M., Kg., S. units, which are more convenient for aeronautical measurements,

$$\begin{aligned} \text{pressure} &= \tfrac{1}{2}\rho \, . \, (v_0^2 - v^2) \text{ m.kg.s.}^{-2}\text{m.}^{-2} \\ &= \tfrac{1}{2}\rho \, . \, (v_0^2 \, . \, 10^{-2} - v^2 \, . \, 10^{-2})\text{mb.} \\ &= \tfrac{1}{2}\rho \, . \, 10 \, . \, (v_0^2 \, . \, 10^{-2} - v^2 \, . \, 10^{-2}) \text{ megadynes/m.}^2. \end{aligned}$$

The last two forms lend themselves to computation, since flying speeds usually lie between 10 m./s. and 100 m./s. The absence of all extraneous factors save integral powers of ten is sufficient proof of the practicality of Sir Napier Shaw's action.

In the minority of cases where the forces considered are produced by the action of gravity on known masses, they are easily transformed, for the megadyne is 10/9·81 = 1·02 kgm. weight, and the millibar is 1000/981 = 1·02 cm. head of water with an accuracy amply sufficient for aeronautical measurements.

A. R. LOW.

London, March 22.