



# Note on the application of hydraulic power to mercurial pumps

Frederick J. Smith M.A.

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in this manner, they showed no appreciable deflexion when placed in position relative to the magnetometer.

The results tabulated indicate that tungsten greatly increases the magnetic moment of nickel, if the alloy be forged and rolled, but, on the other hand, has but small influence if it be simply cast. Furthermore, changes in the amount of tungsten do not appear to cause corresponding changes in the magnetic properties.

To see whether the remarkable effect in bars 2 and 3, as compared with bar 1, of Group I., was owing to some molecular condition of their surfaces induced by rolling, two bars from the same steel, one rolled and the other pressed, were magnetized and then measured. The ratio of the specific magnetism of pressed to rolled was as 9 to 5, the rolled having the smaller amount. The existing difference, in this case, is probably owing to a difference in hardness rather than to any molecular condition of the surfaces,

The specific magnetisms of all the bars are small when compared with good steel magnets. Kohlrausch says that good magnets of common form should have  $S=40$ . The bar of ordinary tool steel, however, retained but 7.46. Still it was soft, and by tempering would doubtless have doubled this value.

If forged nickel and tungsten can be made to maintain a specific magnetism of 10, it will form a useful addition to the resources of physical laboratories. From the high polish of which it is susceptible and its freedom from damaging atmospheric influences, it will be most hapily suited for the manufacture of mirror magnets where magnetic damping is to be employed.—Silliman's *American Journal of Science*, December 1889.

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NOTE ON THE APPLICATION OF HYDRAULIC POWER TO MERCURIAL PUMPS. BY FREDERICK J. SMITH, M.A., MILLARD LECTURER, TRINITY COLLEGE, OXFORD.

In vol. xxv. p. 313, 5th series, *Phil. Mag.*, a description is given of the application of hydraulic power to the working of mercurial pumps.

Since the paper was written the author has ceased to use rubber tubes, and has, in their place, introduced flexible tubes made of steel. As the alteration has proved itself to be satisfactory, and may be of use to those who work with mercurial pumps, or similar apparatus, he ventures to add this note.

The steel tube is made by the Flexible Metallic Tube Co. in the form of a hollow screw, or tube on which a screw-shaped indentation has been impressed. The outcome of the construction is that while the tube is under a great pressure it is quite flexible, behaving itself in much the same way as a strong rubber tube, with the advantage over the latter of being durable when subject to, constant motion. Several pieces of tube, made of steel and bronze, have been tested up to 200 lb. per square inch, without showing any signs of being injured. These have been used in the laboratory for connecting together vessels which are subject either to a

high pressure or a vacuum. Sometimes the tube has been used for liquids which act upon the metal it is made of; when this has been the case, a rubber tube has been threaded through the metal tubes, so as to form a protective lining.

ON EVAPORATION AND SOLUTION AS PROCESSES OF  
DIFFUSION. BY PROF. J. STEFAN.

In a paper published in 1873 the author described experiments which he made on evaporation from narrow tubes. Those observations led to the law that the velocity of evaporation is inversely proportional to the distance of the surface from the open end of the tube. The application of the theory of the diffusion of gases to this process led to the same law, and at the same time furnished a complete determination of the velocity of evaporation, which renders it possible to calculate the coefficient of diffusion of vapours. These experiments have been extended by Winkelmann to several series of liquids, and have been used to determine the coefficients of diffusion of their vapours.

Similar experiments to those on evaporation may be made on the solution of solids in liquids. A rectangular prism of rock-salt was made; its height was 30 millim., and the two other dimensions were 7 and 9 millim. Glass plates were cemented by Canada balsam to the bottom and sides, so that only the top surface of the prism was free. In one of the glass plates a scale is etched. If the prism, with its top upwards, is immersed in a large vessel of water, its solution takes place from the top and the process can be observed on the scale. After 1, 4, 9, 16 days the solution had extended to 6.3, 12.6, 18.8, and 25 millim. These depths are as the square roots of the times. Hence for this process the law holds that the velocity of the solution is inversely proportional to the distance of the rock-salt surface from the open end of the prism.

If such a prism is dipped with the free surface downwards, the solution proceeds with almost uniform velocity. In one hour 17.1 and in  $1\frac{1}{2}$  hours 25.6 millim. were dissolved. A prism of a metre in magnitude requires for its solution from upwards 70 years, and downwards  $2\frac{1}{2}$  days; the former times increase with the magnitude in a quadratic, and the latter in simple ratio.

Experiments of the first kind may be used for investigating the diffusion of salts through their solvents. It is necessary for this to represent the process in a form which can be calculated from the theory of diffusion. This gives a new method for determining the coefficient of diffusion of salts. The method is not restricted to such bodies as can be obtained in large crystals. If a uniform mixture or a magma is formed of the powder and its saturated solution, and if a graduated tube is filled with it, the progress of the solution can be as well observed by it as with a prism of rock-salt. The law in this case is the same as in the former case, though the absolute value of the velocity with which the plane of separation of the solution and of the magma moves downwards