

large if the imposed force has the same frequency as any of the natural vibrations of the bubble.

When the bubble is long, as in an ordinary level, the result when such a coincidence is reached is that the long bubble is broken up into a number of small ones, but in the bicycle level the bubble was small and nearly spherical.

The slowest natural vibration which a spherical bubble is capable of is that in which it becomes alternately a prolate and oblate spheroid.

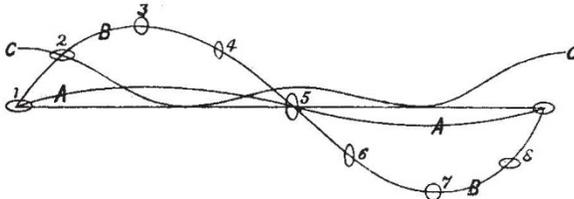
It would take too long to enter in detail into the character of the deforming forces acting on the bubble. They are of two kinds, one depending on the acceleration and the other on the velocity. The former tends to make the bubble egg-shaped (*i.e.* big at one end and small at the other) to a degree proportionate to the acceleration; the latter involves the ratio of the cross section of the bubble and tube, and tends to make the bubble oblate as the velocity increases.

When the impressed motion has the same period as the bubble, the latter will pass through its zero position in opposite phases. Thus, if in moving forwards it is an oblate spheroid as it passes through the zero, it will be prolate half a period later when returning backwards through the same position, but both the deforming force and resistance to motion through the fluid which the bubble experiences when prolate are less than when it is oblate, so that there is a balance in favour of the oblate deformation, which will tend to increase and perpetuate a vibration once started.

Since the resistance experienced by the prolate form is less than oblate resistance, the excursion of the bubble will be greater in the first case than the last, with the result that in time it will move to such a position that the slope of the tube there supplies a force sufficient to balance the difference of resistance met with in moving in opposite directions.

In the accompanying diagram the direction of the level tube is supposed to be at right angles to the abscissa axis, which represents the time of one oscillation.

AA displacement of level tube; BB displacement of bubble relatively to the tube; CC deforming force depending on the



velocity; 1, 2, 3, &c., the forms assumed by the bubble at various phases.

There is some particular ratio between the diameters of the bubble and tube, and some absolute diameter of the tube, depending on the surface tension and density of the fluid, which gives the maximum displacement, but even an approximate analytical solution of the problem would present great difficulties.

In the level experimented on, the surface tension of the fluid employed was 27 (in C.G.S.) and density .88.

The radius of the bubble was .142 cm. and that of the tube .23 cm. (rough measurements).

A spherical bubble of the radius given if surrounded by an unlimited quantity of fluid of its surface tension and density would have for the frequency of its slowest natural vibration 120 per second nearly (see Lamb, "Hydrodynamics," p. 463), but in the case under consideration the small distance between the sides of the bubble and tube must greatly diminish the frequency of this form of vibration.

By experiment it was found that the greatest displacement occurred with a frequency between 40 and 50 per second, the bubble then being driven to the ends of the tube where the slope was about one in five.

A. MALLOCK.

3, Victoria Street, October 3.

Rural Education.

THE Countess of Warwick and Prof. Meldola are entitled to all praise for their zeal in establishing the School of Science at Bigods, to which reference was made in your issue of October 5. There should, however, be some recognition of the similar

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work done by others in purely rural districts. At Bruton, a village in Somersetshire, the success of such a school has been quite phenomenal. Sexey's Trade School, as it is called, owes its inception to Mr. Henry Hobbhouse, M.P., and was founded a few years ago out of the old endowments of Sexey's Hospital under a scheme of the Charity Commissioners, with aid from the Somerset County Council. Recently I had an opportunity of seeing the school, and could not sufficiently admire the excellence of what is done there. The buildings consist of a master's house, large schoolroom and lecture-rooms, well-equipped physics and chemical laboratories, wood and metal workshops, gymnasium, &c., with about two and a half acres of garden and playground attached. Besides instruction in the ordinary subjects of a higher primary or secondary school, the boys in the upper division (Classes II. to V.) are taught magnetism, electricity, chemistry, mechanics, manual work in cardboard, wood and metal, mensuration, French, botany and bookkeeping, and the instruction in technical subjects is throughout of a *practical* nature, being given in the garden, field, and workshops, as well as in the class-room. Outdoor lessons are given in land measuring. Visits are occasionally paid to farms in the neighbourhood to inspect the stock, implements, buildings and crops. Botanical walks are taken at intervals in order to study plants in their natural habits, and the boys are encouraged to make collections of botanical and other specimens.

Since 1896 the school has been organised as a School of Science, and through the courtesy of the headmaster, Mr. Knight, I am able to place the following details before your readers. The fees for tuition are 4*l.* and for boarding 20*l.* per annum. The school has been accepted by the Somerset and Wilts County Councils as one of those at which junior and intermediate county scholars may attend. There are 103 boys at the school, of whom 25 are the sons of farmers, 20 of artisans, and 32 of small tradesmen. Of those who have left the school 34 have taken to farming as an occupation. From the forty-fifth Report of the Science and Art Department it appears that in 1897 the school presented 63 pupils for examination. The grant earned was 384*l.*, being an average of 6*l.* 2*s.* per head. The High School at Middlesbrough stood next on the list with an average of 5*l.* 13*s.* per head, and the general average for the 143 organised Science Schools in Great Britain was 3*l.* 9*s.* 6*d.* Such an experience as this ought to be of the greatest encouragement to those who are really anxious for the improvement of rural education, and the facts cannot be too widely known. This school differs from the one at Bigods in that it is only for boys; but a school is now being erected in the immediate neighbourhood to provide a modern education for girls, corresponding as far as possible with that provided for the boys.

JOHN C. MEDD.

Stratton, near Cirencester, October 15.

THE good work being done at Sexey's Trade School is of course well known to all who have interested themselves in rural education. Readers of NATURE will no doubt be glad to have Mr. Medd's independent testimony, and more particularly the detailed statement of figures concerning grants and fees. At the present time, when the subject of rural education is so very much before the public, it would, however, be of the greatest assistance to those who are engaged in carrying on this work if Mr. Medd could supply more detailed information concerning the aid which the County Council has given and how this assistance has been rendered; whether in the form of grants for building and equipment or for maintenance of staff, or both. Also what proportion of the initial cost of foundation as a School of Science was contributed by the Somersetshire County Council? In the present state of rural education one cannot help feeling that the whole future success of these schools is very largely dependent on the constitution of the Technical Instruction Committees of the County Councils—especially in those cases where the County Council has become recognised as the central authority. Any information, therefore, that can be given on these administrative points, either with respect to Sexey's or any similarly constituted school, would be most opportune. In the case of our school at Bigods, the initial cost of foundation and conversion into a School of Science has been mainly borne by Lady Warwick. The Essex County Council, as regards maintenance of staff, have put us on the same footing as the endowed schools in the county by granting 100*l.* annually.

R. MELDOLA.