Eur. J. Phys. (1984) 193–194. Printed in Northern Ireland

The Oxford electric bell

A J Croft†

Clarendon Laboratory, Parks Road, Oxford OX1 3PU, UK

Received 18 January 1984

Editor's note The first three articles in this issue are devoted to experiments of long standing; the oldest set up nearly 150 years ago, the most recent, over 50 years. They are presented in order of seniority. Readers are invited to submit accounts of other experiments which call for patience on the part of the recorder.

Abstract An account is given of an electric bell which has been ringing for 144 years.

Summarium Relatio campanae electricae iam CXLIV annos sonantis.

In the foyer of the Clarendon Laboratory in the University of Oxford is an electric bell which has been ringing almost continuously since it was bought and first displayed in 1840. It was made by Watkin and Hill, instrument makers, of London, and purchased by the Rev. Robert Walker, Reader in Experimental Philosophy. His handwritten notice, 'Set up in 1840', was attested by his grandson, and is to be seen in the photograph. The bell is, of course, practically inaudible.

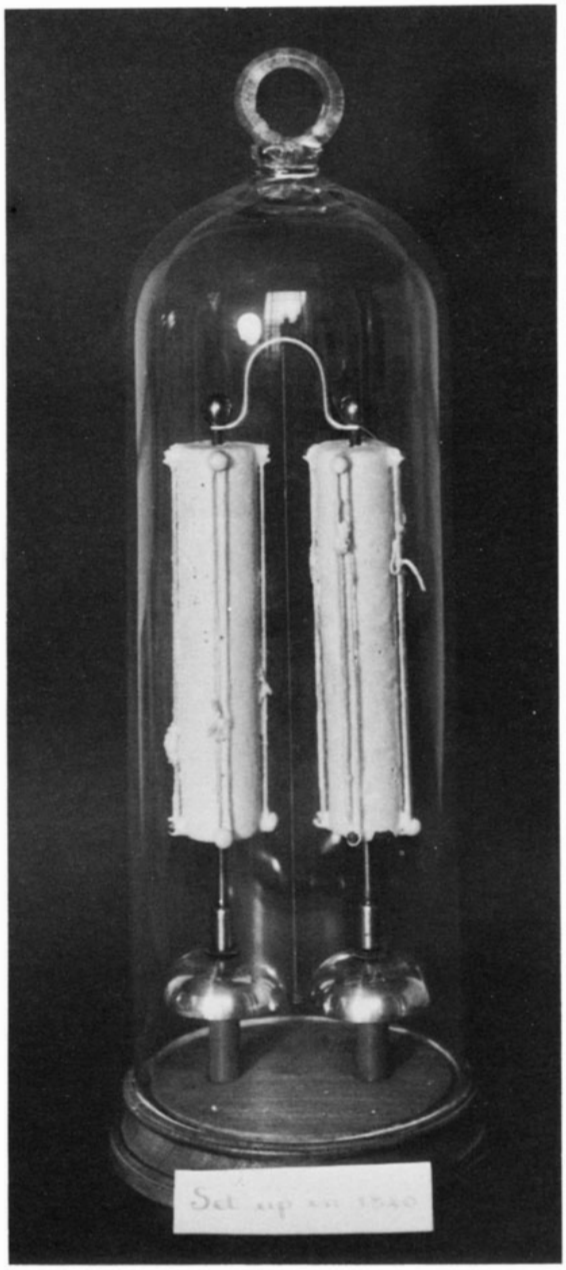
The construction is apparent from the photograph: a tiny clapper made of metal, probably brass, is suspended by a thin silk fibre between two vertical pillars, dry piles, connected in series. The clapper is pear-shaped and has become slightly grooved on one side where it strikes the edge of the bell. On the other side the clapper is not grooved because it strikes above the edge of the bell, which, on this side, is set rather lower than the other.

The voltage between the bell terminals (which also appear to be made of brass) at the base of the pillars is about 2 kV. The clapper draws about 1 nA as it oscillates between the terminals with a frequency of about 2 Hz, twice as fast as the period would be under gravity alone (the length of the suspending fibre is slightly greater than 21 cm.). The period is actually variable, depending on the weather: the oscillations are slower when the weather is humid, and humidity causes movement to cease from time to time. It begins again without external assistance. The bell has also been deliberately stopped on the few occasions when it has been necessary to move it to a new location.

What the piles are made of is not known with certainty, but it is clear that the outer coating is of sulphur, and this seals in the cells and the electrolyte. Piles similar to this were made by Zamboni, whose batteries were constituted of about 2000 pairs of discs of tin foil glued to paper impregnated with zinc sulphate and coated on the other side with manganese dioxide. The piles, of course, are not dry, but contain the right amount of water to provide the electrolyte without causing a short-circuit.

The Oxford dry pile is closely similar to that illustrated by Singer (1814)—thought to be the first text-book on electricity. The dry pile was important in its time because it showed that the high-voltage electrostatic experiments and the low-voltage experiments of Volta were in reality concerned with the same phenomenon. Over the 15 years from 1800, workers in many countries were trying out a great variety of recipes and reporting on the role of humidity. Contemporary sources point to Jean de Luc, FRS, as the first in the field. (*Nicholson's Journal* for June 1810 states that he was experimenting in 1800.) His work was first published in his *Traité Elementaire sur le Fluide Electrico-Galvanique* published in Paris and Milan, 1804. Other notable workers in the field were

† In compiling this note the Editor has drawn extensively from a pamphlet written in 1980 by Dr Croft and from other information furnished by him. Dr Croft also provided the illustration.



Marechaux, Behrens and Zamboni, and exhaustive accounts of their research appear in Gilbert's *Annalen* over the years 1803–20. Interest was not confined to inorganic substances, and there are accounts of the performance—usually but not always negative—of piles made of slices of such substances as walnut wood, beetroot, radish etc. The conviction that natural processes were involved may have led to the use of manganese dioxide—impressive as a substance which released oxygen on heating. Zamboni certainly included manganese dioxide in his recipe and it is possible that the longevity of the Oxford pile may to some extent be due to the same depolarising action as occurs in the later Leclanché cell.

Dry piles were made to drive not only electric bells, but also pendulum clocks. Many publications appear in the early part of the last century, for example, Ronalds (1815a,b), and Zamboni (1831).

The Oxford dry pile played a curious part in the scientific history of the 1939–45 war. An infra-red telescope using an image-converter tube with a lead-sulphide cathode—later to be superseded by lead telluride—was developed at the Admiralty Research Laboratory, and this called for a portable battery giving about 3 kV at very low current. Dr A Elliott, an Oxford physicist, remembering the dry pile in the Clarendon Laboratory, followed the recipe given by Charles E Benham in the *English Mechanic*, February to March 1915, and a considerable number were produced.

Meanwhile, the activity of the Oxford dry pile continues, and on present form the clapper seems more likely to wear out than the electro-chemical energy to be exhausted.

(A referee kindly pointed out that a current of 1 nA for 144 years implies the transformation of about 1 μg of each reacting substance in each of the two piles, taking the electrochemical equivalent weights to be about 50.)

References

Ronalds F 1815a *Phil. Mag.* **65** 261
—— 1815*b ibid.* **66** 203
Singer G J 1814 *Elements of Electricity and Electro-Chemistry* published in London
Zamboni G 1831 *Verona Poligrafo* **5** 87