

An account of the history of the Ayrton fan

by A. P. Trotter

(past) President of The Institution of Electrical Engineers.

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Those who saw her experiments at home or the results at the front cannot forget them, but few of the younger generation have heard of them, and that is why, admiring her work as I do, I will put my recollections on record.

Early in 1915 the Germans with fiendish brutality began to use poison gas. She thought that eddies of air might be used to repel gas attacks. Air is a very different fluid from water. The one has, in the scientific sense, low elasticity, its easy compression is accompanied by heating, it is light and almost impalpable; the other is almost incompressible, capable of massive motion and more obvious internal and skin friction. To anyone else the idea was so wild as to be absurd. But she was so thoroughly acquainted with her subject, and had such a sound knowledge of physics, that she saw that in dealing with fluids the question of scale was of little importance. To imitate a gas cloud she used the smoke of brown paper, but this while warm tended to rise above her laboratory battle field (the glass tanks and sand and water had been cleared away). Cooling chambers and pipes were devised and made, and smoke poured out and rolled along the floor. A few flaps with a card on a matchbox serving as the parapet of a trench drove it back.

I did not see the experiments until they had developed, and model "dug-outs" and "pill-boxes" had been built. These could be cleared of smoke with a few flaps of a tiny square paddle or fan. The fan with a flexible blade rather more than a square foot in size was mounted on a T-shaped handle. When smacked on the ground facing the on-coming gas, the cross bar of the handle hit the ground first, the blade flattened out, and sent a puff of air. The friction of the ground retarded the lower part of the puff, which became a vortex cylinder. When smoke rings are formed at the end of a gun, or the funnel of a locomotive, or the lips of a smoker, the central part of the puff advances faster than the edges, and so a ring is formed revolving on itself. Discussing this with Mrs. Ayrton, I asked where the ends of the vortex cylinder were, for I had the impression that a vortex ring must be continuous and cannot be cut. I cannot remember her reply, but it may have been that the under surface of the blade retards the air, and forms an upper vortex cylinder rotating in the opposite direction. But whether the two join to form a ring, I cannot say. An ordinary smoke ring increases in size as it travels, and induces a blast of air to pass through it. It was this that drove the gas back. Of Mrs. Ayrton's originality, perseverance and enthusiasm I was aware, but I found her greatly depressed, and showing a sensitiveness of disposition that was new to me. She could stand up to academical mathematicians, but now she was up against officialism. I must confess that the toy-like models in her laboratory-drawing room seemed a long way from the battlefield. So far as experiments went they were convincing when she showed them to me, and many who saw

them, including intelligent soldiers, were impressed. But those who did not or would not come, and those who refused to give the invention a trial, the exasperating officials who would not listen to anything new because they shirked the responsibility of giving a decision, were obstacles with which she has not reckoned and did not know how to deal. The three years spent in brown paper smoke were not all concerned with research, that was soon done; her labour was to convince others.

I had nearly twenty years of government officialism, and already, during the war, something of the military variety. We discussed in confidence, without going into psychological analysis, the strange constitution of the official mind. I could only sympathize with her and show her that she was not the only special victim of obdurate nonchalance of those who were trained to be afraid of considering a thing on its merits, and so dutiful in clinging to a policy.

In spite of the disheartening opposition commonly shown to inventors at this time, several supplies of gas-repelling fans were sent to the front. These were not intended to be merely waved about, and perhaps the name "fan" was unfortunate. The inventor almost accidentally, perhaps intuitively, acquired the knack of using it in the best way, and this needed instruction. One of her assistants from the Central College went out and demonstrated the proper use of the fans, and a few officers were convinced of their value. If the reports which she showed me had been published, they must have come into general use, but the safest way to deal with a report is to consider it as confidential, and to put it away safely in a pigeon hole.

Discouraged and almost in despair after trying for two years to gain the attention of the War Office, she asked me to help her with the Admiralty. Thirty years had passed since I had dealings with that Service. I knew very few officers: Bacon had been a contributor to *The Electrician*, but he was at sea, and I recommended C. H. Wordingham, Electrical Engineer in-Chief of the Admiralty, with whom I was well acquainted. I have a letter from him dated Nov. 21, 1917, thanking me for the introduction and saying that he was going to see a demonstration. He was a practical engineer and was convinced on the spot, and thought that the use of such fans would be valuable for emergency ventilation of ships.

It must be remembered that when poison gas was first used in war, chlorine, a heavy gas, was blown across by the wind. The Ayrton fan was quite capable of rolling it back in the open, and, unexpectedly, even I think by Mrs. Ayrton, of clearing dugouts into which gas had fallen.

A. P. Trotter (1857 – 1947) was, among other things, the President of the Institution of Electrical Engineers, the editor of *The Electrician*, Government electrical engineer at the Cape of Good Hope, and the electrical advisor to the Board of Trade in Britain. He retired in 1917.

Dow, J. S. (1947, September 20). Mr. A. P. Trotter [Abstract]. *Nature*, 390-390. doi:10.1038/160390a0