

of another element which exists in the form of two isotopes differing much less in their atomic weights than those of chlorine. Furthermore, if we put $A=f(t)$, and if $f(t)$ can be expanded in the analytical series,

$$f(o) + t \cdot f'(o) + \frac{t^2}{2} \cdot f''(o) + \text{etc.},$$

and $f'(o)$ is zero as Nernst assumes, then it must be explained how the series

$$f(o) + \frac{t^2}{2} f''(o) + \text{etc.},$$

can become almost equal to $t \cdot R \log_4$ between wide limits of temperature.

In fact, if the isotopes are inseparable by chemical means, I think that the most natural conclusion to draw is that the difference in the entropies of the reactants and resultants of a chemical change taking place at zero temperature is a finite quantity which depends on the type of the change, and also, of course, on the number of molecules transformed.

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Anti-Gas Fans.

OWING to my absence from home I did not see Prof. Allmand's letter in NATURE of June 10 on my indictment of the War Office until too late to reply to it last week, but I hope you will now allow me to put before your readers a few of the points he has missed.

First, may I repeat that I had no personal interest in the number of fans sent out, since I neither asked for nor would accept payment or reward of any kind or description for their use during the war. I attributed the suffering and loss of life, which I deplore and Prof. Allmand denies, even more to the lack of training, and consequent ignorance of what the fans could do, than to their scarcity.

From this letter I gather that his own knowledge concerning them is of the slightest. He seems never to have heard of the clearing of trenches with them, the purpose to which they were principally put; but he allows that they were "found useful" for clearing shelters and dug-outs that would otherwise have remained dangerous for "hours, or even days," after a gas attack. We have only to picture our men, after hours of hard fighting, perhaps wounded or already gassed, compelled to remain in the open, whatever the weather, with the remains of gas still there, to realise the vital importance of clearing every space, dug-out, and shelter the moment it was possible. Yet for a whole year (May, 1915, to May, 1916) the use of the fans with which it could always have been done in a few minutes was held up by the wilful obstruction of War Office officials. It must be remembered, too, that at the beginning of that year the respirators were still quite crude and untrustworthy, and that even by the end of it they were very far from perfect. Is it too much to say, then, that "much suffering and loss of life could have been avoided" had the fans been accepted, and the troops properly trained to use them, nine months earlier, as they could so well have been? On this point Prof. Allmand is silent.

He says that, later, fires were found to be as efficacious as, and less fatiguing than, fans. They were not as efficacious, but they were certainly less fatiguing, as I have said, when the materials were ready to hand; and it was perfectly right to use them when practicable. But each time a space was cleared by fire, fresh dry wood and paper were required. Now it is common knowledge that there were wide areas which, over long periods, were so wet that dry wood for even one clearing would have been hard to find,

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let alone many. Is it an exaggeration to say that "much suffering and loss of life could have been avoided" if those responsible had remembered this, and had provided not only plenty of fans for every area, but also men trained to use them? On this point also Prof. Allmand is silent.

"Working an Ayrton fan, even in the most approved fashion"—my italics—he says, ". . . is a tiring task." Prof. Allmand will, I am sure, be surprised to learn that there are at least three approved fashions, and that the efficiency of the fans depends almost more on the ability of the officer in charge to choose the right method for the particular space, and to place and move his men properly, than on the skill of the welders; moreover, the approved methods are not less fatiguing than the wrong ones, only infinitely more efficient. This ignorance on the part of an authority on anti-gas methods is not unique; it is typical. Let me show how it arises.

As soon as the fans were accepted I warned the War Office that, if they were to be of any value, officers and men alike *must* have two or three days' practical training in their use; and, at the request of the Commander-in-Chief, my assistant went to France to show how the training should be carried out. At first, after he left, it may have been fairly well done; but in time those who had seen for themselves what the fans could do died or became scattered; and after that the training degenerated at best into an hour or two of exercise in the stroke for trench-clearing, and at worst into the mere exhibition and naming of a fan, while numbers of men never even saw one at all. Major Gillespie, D.S.O., who practically saved his battery by means of the fans, when a howitzer battery within a hundred yards of it was wiped out, wrote to the *Times* of May 4: "Even after the introduction of the fans in limited quantities, I never met an officer or man who had been properly instructed in their use." This ignorance, for which the War Office is responsible, extended from the highest to the lowest officials in the Anti-Gas Service. The only men who did not share it were those officers who were clever enough and interested enough to make out for themselves what could be done with the fans. Small wonder, then, that most officers regarded them simply as nuisances, and that some of the men treated them as fuel.

This same ignorance and want of imagination led to the idea that the fans were useless for dealing with mustard gas. In describing the saving of his battery Major Gillespie wrote: "The gas hung about for days afterwards, but by judicious flapping at frequent intervals we kept our quarters fairly free from it." This is the evidence of a "fighting soldier." It is odd that those other fighting soldiers quoted by Prof. Allmand should not have thought of this very simple way of ridding themselves of a vapour that came off slowly and took some time to reach a dangerous concentration.

Finally, is not Prof. Allmand in his last sentence confusing scientific methods with the methods of some scientific men? In directing attention to the dire effects of the unscientific methods of the War Office in connection with anti-gas fans, I was adding my quota to the efforts of those who are trying to "ensure the application of scientific methods to military problems." The fact that it was scientific men who were responsible for those unscientific methods is surely no reason for condoning them, but rather for censuring them the more severely.

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41 Norfolk Square, W.2, June 22.

At the risk of the accusation of shirking inquiry, I repeat that I have no intention of entering into a