

was consequently very impure. Three thermometers were placed apparently at a distance of about 4 ft. or 5 ft. from the prism—one in the spectrum, and the other two in the shadow beside it—and the difference of temperature produced by the rays was noted. The bulbs of the thermometers were blackened; one of them measured $\frac{1}{2}$ in. in diameter, but the others were smaller. One and a half inches beyond the red there was a rise of $3\frac{1}{2}^{\circ}$ in 10 min., 1 in. beyond the red $5\frac{1}{2}^{\circ}$ in 13 min., and $\frac{1}{2}$ in. beyond the red $6\frac{1}{2}^{\circ}$ in 10 min. In the violet there was a rise of 1° in 15 min. The spectrum was about 3 in. long, and the heat rays could be detected a distance of $2\frac{1}{2}$ in. into the infra-red.

R. A. HOUSTON.

University of Glasgow, May 19.

Anti-Gas Fans.

IN a note in NATURE for May 13 you intimated that my "allegations" concerning the treatment of my anti-gas fans by the War Office and the suffering and loss of life thereby entailed could not be accepted without question, and you called upon the "well-accredited men of science," who, you say, largely staffed the Anti-Gas Service, to make a "plain statement of the facts." I waited to see if such a statement would be forthcoming, though I judged it scarcely likely; and now, since it has not appeared, I ask you, in fairness, to grant me space for a few remarks on your note.

You suggest that such an indictment as I have brought against the War Office, reinforced as it is with their own letters, reports, and pamphlets, can be refuted by the bare word of certain "well-accredited men of science." I pass over the implied slur on myself of being less well-accredited than they, my word of smaller value than theirs. No unprejudiced person who has read that indictment and that evidence with any care will agree with you that they can be thus easily disposed of.

In my dealings with the War Office I had to do with innumerable officials, some of them men of science, most not. From their behaviour I judged the larger number (and the exceptions were not, I regret to say, men of science) to be mere puppets, acting under the direction of some leading spirits behind. Who those leading spirits were I had no means of knowing; I was carefully kept in the dark. You, sir, intimate that they were "well-accredited men of science." If this was indeed so, then surely you will agree with me that, for the sake of science even more than in the interests of the nation at large, it is essential that this matter should not be hushed up, but that a public inquiry should be instituted. I am not only willing, but also most anxious to submit my case to some impartial tribunal. Will the men of science whom you have asked to speak, but who do not answer, come out into the open and join with me in demanding such an inquiry? If not, both the world of science and the general public will know what to think.

HERTHA AYRTON.

41 Norfolk Square, Hyde Park, W., May 23.

[WE did not express an opinion upon the charges made by Mrs. Ayrton, but limited ourselves to a statement of the indictment, and pointed out that it was really directed against the men of science associated with the Gas Service of the Army. Possibly these officers are not free to enter into a discussion of reasons for the neglect of the use of the fans, and nothing short of a public inquiry will elicit the whole of the facts in regard to them.—ED. NATURE.]

NO. 2640, VOL. 105]

A New Method for Approximate Evaluation of Definite Integrals between Finite Limits.

THE subject has a particular interest for naval architects, inasmuch as the majority of calculations relative to displacement, stability, strength, etc., of ships involve the finding of areas and volumes bounded by curved lines and surfaces.

The particular rule enunciated by Mr. A. F. Dufton in NATURE of May 20 has been in use at this college for some years, and gives very accurate results in obtaining areas and volumes, and also, by a further application, the positions of their centres of gravity.

The method of its derivation was from one of Tchebycheff's rules. $f(x)$ in this particular case is taken as $(a+bx+cx^2+dx^3+ex^4)$. It can readily be shown that the value of

$$\int_0^1 f(x)dx = \frac{1}{4}[f(x_1)+f(x_2)+f(x_3)+f(x_4)],$$

where

$$\Sigma x_1 = 2, \Sigma x_1^2 = \frac{4}{3}, \Sigma x_1^3 = 1, \Sigma x_1^4 = \frac{4}{5},$$

whence $x_1 = 0.1027$, $x_2 = 0.4062$, $x_3 = 0.5938$, and $x_4 = 0.8973$. The approximation to one-tenth, four-tenths, six-tenths, and nine-tenths was obvious, and all the more welcome because it is our usual practice to divide the ship's half-length into ten sections. No special sections have to be drawn, calculations being readily made with the aid of the existing drawings.

This rule was briefly referred to by Mr. W. J. Luke at a meeting of the Institution of Naval Architects in 1915 (Trans. I.N.A., vol. lviii., p. 210).

The application of Simpson's ordinary rule to find the area of a quadrant or semicircle, as quoted, manifestly shows Simpson's rule at its worst, owing to the wide divergence of the curve from the assumed curve from which the rule is derived. Where curves approximate to these forms, as in many sections of a ship, it is common practice in the use of this rule to interpose intermediate ordinates where the curve is "steep"—relative to the base line—to get greater accuracy.

An interesting paper dealing with this subject and giving a great variety of rules for approximate integration was read at the Institution of Naval Architects in 1908 (Trans. I.N.A., vol. i.) by Sir W. S. Abell entitled "Two Notes on Ship Calculations."

C. F. MERCHANT.

Royal Naval College, Greenwich, S.E.,

May 27.

Applied Science and Industrial Research.

YOUR correspondent Mr. J. W. Williamson says in NATURE of May 27 that much of my criticism of the Department of Scientific and Industrial Research "seems to lend colour" to current misconceptions of industrial research, which he proceeds to construct out of his own imagination, having first fathered them on me, and then submits that the cause of pure science is not well served by inconsiderate attacks on the industrial research movement, such as he would have it believed I made. I judge from this that he was not present at the meeting, and I therefore wish it to be known that the full text of my address to the National Union of Scientific Workers can be obtained by forwarding a stamped addressed foolscap cover to the General Secretary, 19 Tothill Street, Westminster, S.W.1. If Mr. Williamson will have the goodness to read it and the full report of the meeting published in the current issue of the *Scientific Worker*, the official organ of the union, and then say, if he still desires, what he objects to, it would help rather than confuse the issue.

FREDERICK SODDY.

MR. WILLIAMSON'S letter in NATURE of May 27, in which he criticises the attitude of Prof. Soddy and that of the National Union of Scientific Workers towards the Department of Scientific and Industrial Research and the struggling research associations, confuses the issue. To attack the Department or association entrusted with industrial research is tantamount neither to attacking industrial research nor to making invidious distinctions between pure and applied research.

In the minds of the members of this union there exists no belief in the superiority of pure science over industrial research; it has always been our expressed opinion that there is no difference in their scientific value. In one of our explanatory pamphlets this view is expressed: "It [the union] aims at including within a single scheme both academic and technical members. . . . The separation of science and industry has been a principal cause of our disastrous neglect of science in the past, and if continued will remain harmful to both in future. The present organisation, by ensuring the intercourse of the two sides, is therefore desirable on both national and scientific grounds." Embodied in our rules we have as avowed objects: (1) To advance the interests of science, pure and applied, as an essential element in the national life. (2) To promote and encourage scientific research in all its branches.

Our criticism is that in any scheme put forward by the Department inadequate facilities are given to that type of research which, though it has less immediate application, is probably of greater ultimate importance through leading to the better understanding of more phenomena. It would be quite unfair to expect particular industrial research associations to contribute more than others to the prosecution of research which might have a common application to industry or to some aspect of the national life. Obviously this type of work is best carried out at the universities or at institutions such as the National Physical Laboratory. Yet how is this research fostered at the universities? According to the last report of the Department, sixty-eight research workers and their assistants and thirty-five students in training received allowances and grants for equipment amounting to 14,170l.; this is at the rate of 53s. a week, and includes equipment. Contrast this grant with the salary of 4000l. a year for the director of the Glass Research Association—an appointment which is an affront to all scientific workers. Millions have gone into State-protected industries to the accompaniment of an astounding appreciation in the value of the shares held by individuals in the State-aided industry. But the universities are begging for funds to provide decent bench accommodation and instructors for their science students. Speaking at Liverpool on May 28, Dr. Adami is reported to have said that if the university raised the salaries of its demonstrators to a proper standard it would lead to bankruptcy.

It is unfair to suggest that we are criticising the Department for the starvation of pure scientific research because industrial research is fostered; on the contrary, we are anxious for the advancement of both. We are of the opinion that neither branch of science is receiving adequate support, but that research carried out in the general interest is in the more unfavourable position. If we attack the Department it is because we honestly believe it is for the betterment of research—a maximum of efficiency in the administration of the funds available which must inevitably tend towards the better appreciation of science.

At the conference of research associations held under the auspices of the Department of Scientific and Industrial Research on May 14, I heard several

representatives express opinions almost identical with those of the National Union of Scientific Workers; suggestions were made and questions asked which are provoked by Prof. Soddy's address. Mr. Williamson himself dealt with the economic position of the research workers, and made suggestions for improvement which might have been those of a member of the executive of this union.

We entirely concur with Sir Frank Heath that the Department of Scientific and Industrial Research is embarked on a great adventure. Mr. Williamson will agree that it is our concern to work for the safety, honour, and welfare of the adventurous scientific workers. So far we have heard too much of the rights of the financial interests concerned to work out their own salvation with money provided largely by the State, but very little of the rights of the scientific workers to safeguard their own interests. We wish to be assured that the leading spirit in the adventure is sufficiently well advised to guide him in his choice of officers for this army of truth-seekers, and that his army is not defeated by ignorance, mishandled by an unsympathetic staff, or starved to feed the parasites of science.

A. G. CHURCH,

Secretary.

National Union of Scientific Workers,
10 Tothill Street, Westminster, London, S.W.1, May 31.

The Great Red Spot on Jupiter.

WHEN this remarkable object came into striking prominence and attracted general observation in 1878, the rate of its rotation period was slightly increasing, and it continued to increase until the end of the century. Then in the early part of 1901 a large irregular spot appeared in the south tropical zone of Jupiter. This new feature, moving swifter than the red spot to the extent of about 23 seconds per rotation, soon affected the motion of the latter by accelerating its rate as it overtook it, and this influence has been repeated prior to the seven occasions on which the two objects have been in conjunction during the last twenty years.

The rate of rotation indicated by the red spot has, in fact, been a very variable feature in recent times, and the marking named has exhibited an increased velocity and a shortening period. In the years from 1894 to 1901 the mean period was 9h. 55m. 41.3s., but in the last eight years it has been 9h. 55m. 35.7s.

I have shown the annual differences in Fig. 1, and the rate of rotation determined each year I have also tabulated for inspection and comparison:

	h.	m.	s.		h.	m.	s.
1878	...	9 55	33.7	1899	...	9 55	41.6
1879	...		34.1	1900	...		41.4
1880	...		35.2	1901	...		40.7
1881	...		36.3	1902	...		39.6*
1882	...		37.3	1903	...		40.2
1883	...		38.2	1904	...		39.7*
1884	...		39.0	1905	...		41.2
1885	...		39.6	1906	...		39.5*
1886	...		39.9	1907	...		40.9
1887	...		40.1	1908	...		39.6*
1888	...		40.2	1909	...		40.3
1889	...		40.4	1910	...		37.4*
1890	...		40.5	1911	...		37.4
1891	...		40.6	1912	...		37.2
1892	...		40.8	1913	...		34.8*
1893	...		40.9	1914	...		35.5
1894	...		41.0	1915	...		37.5
1895	...		41.1	1916	...		36.4
1896	...		41.3	1917	...		34.5
1897	...		41.5	1918	...		33.7*
1898	...		41.7	1919	...		35.5