TABLE I. (*Continued*)—

Year.		Solar spotted area in millionths of visible hemisphere.	Abnormal barometric pressure in thousandths of an inch.					
			Mauritius.	Bombay.	Madras.	Calcutta.	Batavia.	Ti-ka-wie.
1875	1			− 5	− 22	+ 2	− 11	0
	2			+ 1	− 11	− 10	− 7	− 18
	3			+ 2	− 4	− 3	− 1	− 16
	4			+ 1	− 1	− 9	− 5	− 12
1876	1			− 3	− 16	− 14	− 11	− 13
	2			− 1	− 18	− 19	− 10	− 8
	3			+ 9	− 13	− 3	+ 1	− 12
	4			+ 21	+ 12	+ 27	+ 22	+ 8
1877	1			+ 29	+ 30	+ 49	+ 28	+ 4
	2			+ 43	+ 46	+ 48	+ 46	+ 11
	3			+ 43	+ 55	+ 43	+ 47	+ 12
	4			+ 38		+ 32	+ 49	+ 29
1878	1			+ 24		+ 51	+ 34	+ 39
	2			+ 13		+ 55	+ 17	+ 34
	3			− 15		+ 33	− 1	+ 16
	4			− 33		0		− 4
1879	1			− 40		− 26		− 10
	2			− 15		− 2		− 7
	3			− 4		+ 4		− 3
	4			− 1		− 2		− 8
1880	1			− 8		− 14		

Comparison of Abnormal Barometric Movements at Different Stations.—The general resemblance of all these curves to each other is very remarkable; indeed if the Mauritius curve for the years 1867 and 1868 be excluded, there is scarcely a single prominent feature in any one of the curves which is not reproduced in the others. To show this the corresponding points of the different curves have been marked with the same small letters. It will be seen, however, that there is strong evidence of a want of exact simultaneity in the barometric movements at different stations, and that as a rule the changes take place at the more westerly stations *several months earlier* than at the more easterly ones. This is particularly noticeable in the curves for St. Helena and Madras from 1841 to 1846, when the latter sometimes lagged behind the former by as much as six months; in those for Mauritius and Calcutta from 1855 to 1866, when the latter persistently lagged several months behind the former; in those for Bombay and Calcutta from 1862 to 1866, when the difference in time often amounted to *upwards of six months;* in those for Bombay and Batavia from 1867 to 1878, when (as already remarked) the latter lagged behind the former at an average interval of about one month; and in those for Bombay and Ti-ka-wei from 1876 to 1878, when the latter lagged upwards of six months behind the former. *It appears then that these long atmospheric waves (if such they may be called) travel at a very slow and variable rate round the earth from west to east, like the cyclones of the extra tropical latitudes.*

Bombay FRED. CHAMBERS

(*To be continued.*)

DR. SIEMENS'S NEW CURE FOR SMOKE

FROM among a number of letters which have been sent us on this subject we have selected the following for publication; to these Dr. Siemens has been good enough to append some important remarks.

IN NATURE, vol. xxiii. p. 25, I read with interest an article by Dr. Siemens describing an ingenious gas and coke fire which he suggests as a cure for the smoke nuisance. But although the darkening of the atmosphere or fog will certainly be prevented by its use, I am afraid the *gases from the coke*, especially the carbonic oxide, will make the fogs at least as poisonous and injurious to health as the open coal fires at present in use.

In these circumstances a description of an "Asbestos gas fire" free from this objection, which we have had in use in our smoking room for the last three years, and which, after a few alterations, has proved perfectly satisfactory, may perhaps interest your readers.

A ¼-inch gas-pipe furnished with four Bunsen burners is laid on the hearthstone under the grate and parallel to the ribs, so arranged that the tops of the burners (which are made elliptical to pass through the bars) are flush with the upper surface of the grate, and two inches back from the line of the ribs. The fire-place is loosely filled with a preparation of asbestos in pieces about the size of a hen's egg.

This fire not only evolves a large amount of heat, but has a very cheerful appearance, similar to that of a bright coke fire, and to insure this it is essential that the burners should be placed close to the ribs, as stated above, and not in the centre of the grate. If this is not attended to the asbestos in the centre of the fire will be raised to a high temperature, but will not be sufficient to heat those portions in front, which will then not only be of no use as radiators in themselves, but act as screens to the light and heat generated in the centre. I suspect this was the cause of the failure of Dr. Siemens' pumice gas fire.

The cost of maintaining this fire is simply that of the amount of gas burned, as the asbestos is not consumed, and its prime cost is trifling. I have only further to add that there is not the slightest trace of fumes or smell from the fire two minutes after it is lighted. D. A. STEVENSON

Edinburgh, November 15

DR. SIEMENS has described in your pages the form of coke-gas grate which he has fitted in his own house. As I had fitted a similar arrangement in this house before Dr. Siemens' letter appeared in the *Times* of November 3, and as it is simpler than Dr. Siemens' and succeeds even beyond my expectation, I send you a drawing and description of it. It varies, of course, according to the shape of the grate in which it is fitted; but for the sake of comparison I have copied Dr. Siemens' grate, and drawn my arrangement as fitted into it.

Instead of Dr. Siemens' arrangement for withdrawing the heat from the back of the fire and bringing it to the front, I merely line the whole grate—sides, back, and bottom—with fire-bricks. This obviates the necessity for the close-fitting ash-pan described by Dr. Siemens, which would be rather expensive to fit. I make the fire-brick in the bottom of the grate slope towards the front, and leave a space of one inch between the front of it and the perforated gaspipe down which space the ashes fall on to the hearth.

If my grate is not quite so economical in working as Dr. Siemens', it is very near it, and the first cost of fitting is considerably less. In fact, as most grates are lined with fire-brick at back and sides, nothing has to be done but fit a wedge-shaped fire-brick into the bottom, a half-inch iron gaspipe, perforated with holes in front, and connect it with the gas service, all of which can generally be done for a few shillings.

The saving of kindling-wood and of chimney-sweeping would pay for it in a year. In Dr. Siemens' grate the copper must cost about 1*l.* A grate fitted with this arrangement looks exactly the same as an ordinary grate, and there is nothing to prevent ordinary coal being burnt in it—in fact coal can be burnt in it with much less smoke than in an ordinary grate by turning on the gas for a few minutes when fresh coal is put on, when the dense black smoke emitted by the new coal is completely burnt up in the gas-flame. To people who object that a gas grate must produce a bad smell in the room I can only say, "Come and see." They will find that we have three grates with this arrangement in constant use in these chambers, and that they produce no smell and make a very pleasant fire. Any person who takes an interest in the subject is quite welcome to come in and look at them at any time. COSMO INNES

Adelphi Chambers, 7, John Street, Adelphi

HAVING been experimenting for some years in the direction referred to by Dr. Siemens in NATURE, vol. xxiii. p. 25, I must beg to differ with him most seriously in some of his conclusions. The gas-fire with coke which he describes has, so far as our experience goes, several practical objections which prevent its use in the place of an ordinary gas fire, whilst when compared with a *good* coal fire it fails seriously.

First, with regard to the objections to Dr. Siemens' fire. It requires about half an hour to become anything like warm, as against ten to fifteen minutes with a well-lighted coal fire. Second, it makes as much or more dust and dirt than a *good* coal fire. Third, the grate requires as much cleaning and care as with coal.

I am not surprised at the economy, comparing the coal fire as shown with gas and coke, but if the result had been taken in

comparison with a good Abbotsford grate with solid clay bottom, back and sides, the figures would have appeared seriously the other way.

In a room of exactly half the cubic area of the one referred to by Dr. Siemens we have an Abbotsford grate a little over ⅓rd cubic foot capacity, the actual measurement of the fire space being 5½ inches deep, 8 inches back to front, 14 inches wide. This is lighted at 7 o'clock every morning and at 10 o'clock the grate is filled (not piled high). This fire burns until 10 or 11 o'clock every night untouched, practically smokeless, making the room pleasantly warm all over in the severest weather, and without making a *handful of cinders in a month*. One ordinary boxful of coals lasts two days. We have five, sometimes six, fires going daily at an average cost for coal for the winter season of five shillings weekly, or less than twopence per day per fire. That Dr. Siemens is correct so far as the old style of fire-grate is concerned, I know to my cost, but taking any good grate with clay sides and back and a solid clay bottom, his fire at its best will not compare either for cleanliness, economy, or comfort.

Gas fires are wanted where absolutely no attention and dust can be permitted. Allowing either of these as possible, no substitute I know will approach a well-constructed open fire with a solid clay bottom and fire-box.

With regard to the waste heat, it is no greater than absolutely necessary to take away the products of combustion, as, with our grates, it is utilised for warming the upper rooms. At this moment, with five good fires, there is visible from the tops of our chimneys nothing except a clear transparent current of warm air; any one at a cursory glance would say there were no fires in the house.

It must be borne in mind when I refer to cost that we cook entirely by gas, and the price of good coal here is 14*s.* 2*d.* per ton, coke being about half this price. What is required in a gas fire is a perfectly clean source of radiant heat, without trouble, and quickly available: these conditions are not in any way fulfilled by Dr. Siemens' arrangement. With the exception of two or three minutes expended in lighting, all he has attained can be found in a more perfect form in many of the fire-grates which have been in common use for the last ten years. Amongst our many attempts at gas fires one, although not absolutely the same as Dr. Siemens', was practically so, and was condemned because it required as much trouble as our present fires, and was much slower in lighting. It would be both interesting and instructive if Dr. Siemens would test an Abbotsford grate under the same conditions as his coke gas fire, and supplement his report with one from the individual who has to do the cleaning up and dusting, a department which it is more than probable he ignores.

Another important matter is that I believe the cost of making and fixing Dr. Siemens' grate would be not less than that of a good modern fire-grate.

THOS. FLETCHER

Warrington

THROUGH your courtesy I am enabled to reply to the objections raised by three correspondents against my proposed gas-coke grate, before they have actually appeared in your columns.

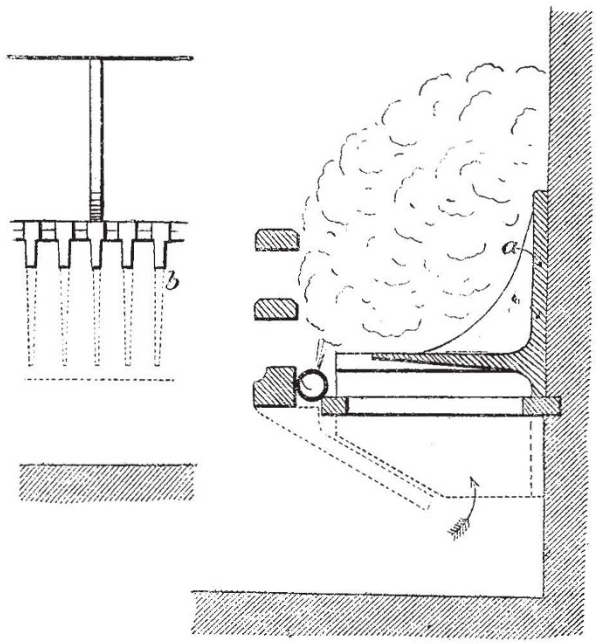
Mr. D. A. Stevenson considers that the use of coke is objectionable on account of the gases evolved in its combustion, and especially the carbonic oxide gas, which would poison the atmosphere. In reply I have to say that in burning coke with a supply of hot air, and in contact in front of the grate with the atmosphere, its entire combustion is insured, resulting in carbonic acid, which is a necessary constituent of our atmosphere. In obtaining the same amount of heat through the perfect combustion of gas, products of combustion at least equally objectionable from a sanitary point of view will be evolved.

The gas-asbestos grate which he describes appears to be judiciously contrived, but its power of heating the room depends entirely upon the combustion of gas unaided by hot air or solid fuel. Now 1000 cubic feet of gas weigh about 34 lbs., and the heat developed in the combustion cannot exceed $34 \times 22{,}000 = 748{,}000$ units of heat.

The heat units produced in burning a pound of coke may be taken at 13,400 (assuming it to contain about 8 per cent. of incombustible admixture, the heat equivalent of pure carbon being 14,500 units), and it requires $\frac{748{,}000}{13{,}400} = 56$ lbs., or just half a hundredweight of this coke, to produce the heating effect of 1000 cubic feet of gas.

Taking gas coke at 18*s.* per ton (which is an excessive price), the 56 lbs. of coke represent a cost of 5·4*d.*, as compared with 3*s.* 6*d.* for the 1000 cubic feet of gas producing the same amount of heat. This great difference of cost at once shows the advantage of making coke do as much of the work as possible. Without it a gas grate will consume 50 to 70 cubic feet of gas per hour, whereas my experiments prove that an average consumption of 8 cubic feet suffices to heat a large room when combined with a moderate consumption of coke, and with the use of the heating arrangement, to which I attach great importance. Another important consideration in favour of the joint use of coke and gas is that the existing gas companies produce both these constituents very much in the proportion in which they would be required, and could therefore provide the means of supplying an enormous number of coke-gas grates, whereas their plant and mains would be quite inadequate to supply a demand upon them for an extended application of purely gas stoves.

Mr. Cosmo Innes describes a gas grate of his construction, having the closed grate and single gas pipe behind the lower front bar which I advocate; he proposes to fill the grate with common coal, using the gas only as a means of kindling the fire. My objections to his proposal are that in using coal he must continue to make smoke, which we are desirous to prevent, and that the hot back to his fire means rapid distillation of the fuel up the chimney in the form of hydrocarbons and carbonic oxide. The gas arrangement as shown by him will be efficacious, no doubt, as a means of kindling a bright and cheerful fire, but he



would do better in that case to use a few logs of wood instead of coals. A bright but short-lived fire may thus be raised quickly at a cheap rate in a dining-room or in a parlour.

Mr. Thomas Fletcher admits that my grate has the advantage of economy over a common coal grate, but thinks the Abbotsford grate the best of all. This grate is according to him practically smokeless, and produces only a handful of cinders in a month, although common coal is used. Now I have no desire to detract from the merits of the Abbotsford grate, but I fail to see why it should be smokeless, considering that raw coal is used; and the extremely small production of ashes or cinder seems to imply that Mr. Fletcher uses an extremely pure and probably a smokeless coal, very different from the fuel we are usually supplied with in London.

He also objects to the cost of my arrangement, and his opinion in this respect, coming from a practical grate-builder, is entitled to every consideration. In first describing my plan I did not go into the question of cost of application; but having been since asked by grate-builders to advise them regarding the cheapest form of my grate and the easiest mode of applying it to existing fire-places, I have devised a form of application which leaves little to be desired, I think, as regards first cost.

The arrangement is shown by the accompanying sketch, and consists of two parts which are simply added to the existing