XIX. "On the Heat of Sunshine at London during the twenty-four years 1855 to 1874, as registered by Campbell's Method." By H. E. Roscoe, F.R.S., and B. Stewart, F.R.S. Received June 10, 1875.

During the above period Mr. J. F. Campbell observed at London the relative heating effect of the sun in the following manner (described in the Report on the Warming and Ventilating of Dwellings, printed by order of the House of Commons, 25th August, 1857, p. 151).

A hemispherical cavity was made in a block of wood, and a spherical lens was made to be placed in this cavity in such a position that while its centre coincided with the centre of the cavity its chief focus was at some point of the hemispherical concave surface, the exact point being of course determined by the direction in which the rays struck the lens.

Whenever, therefore, the sun shone, a portion of the wood would be carbonized or burnt out by his concentrated beams; and inasmuch as the sun continually changes his position not only from hour to hour, but from day to day, it follows that different portions of the wood will be acted upon not only from one hour to another, but also from one day to another.

The blocks were all of mahogany, being as nearly as possible of the same quality, and the diameter of the sphere was about $5\frac{1}{4}$ inches.

When these blocks came into our hands, we considered how it was possible best to measure the amount of wood burnt out. At length we hit upon the plan of filling up the hollows burnt out with a mixture of bees' wax and olive-oil, of such a consistency that we could easily work it into the burnt cavities until the whole internal hemisphere should be made to present the same smooth surface which it had before it was burnt.

A comparison of the weight of the block before and after this process was supposed by us to afford an approximately good estimate of the extent of the hollows. Mr. J. A. Dodge, a student in Owens College, was good enough to assist us in this part of our research. Indeed he made two determinations for each block, dissolving out the mixture by means of heat and refilling the cavities; and the near concordance of these two determinations gives us reason to believe that the results are as accurate as the nature of the experiment requires. We subjoin a Table containing these results:—

TABLE I.

Individual Determinates of the Burnt-out Spaces.

Date.	First measurement.	Second measurement.	Mean.
Dec. 1854 to June 1855..	8·045	7·570	7·808
June 1855 to Dec. 1855..	3·580	3·320	3·450
Dec. 1855 to June 1856..	1·285	0·905	1·095
June 1856 to Dec. 1856..	1·330	1·115	1·223
Dec. 1856 to June 1857 ..	1·085	1·100	1·093
June 1857 to Dec. 1857..	0·360	0·529	0·445
Dec. 1857 to June 1858 ..	19·591	19·376	19·484
June 1858 to Dec. 1858 ..	23·210	22·697	22·954
Dec. 1858 to June 1859..	20·795	20·510	20·653
June 1859 to Dec. 1859 ..	31·296	30·440	30·868
Dec. 1859 to June 1860..	13·115	12·865	12·990
June 1860 to Dec. 1860..	19·340	19·525	19·433
Dec. 1860 to June 1861..	10·580	10·205	10·393
June 1861 to Dec. 1861..	16·920	17·030	16·975
Dec. 1861 to June 1862..	8·578	8·670	8·624
June 1862 to Dec. 1862..	20·600	21·170	20·885
Dec. 1862 to June 1863..	5·780	6·040	5·910
June 1863 to Dec. 1863..	24·310	24·100	24·205
Dec. 1863 to June 1864..	3·990	4·250	4·120
June 1864 to Dec. 1864..	15·290	14·985	15·138
Dec. 1864 to June 1865..	10·400	9·741	10·071
June 1865 to Dec. 1865..	18·180	17·900	18·040
Dec. 1865 to June 1866..	6·600	6·970	6·785
June 1866 to Dec. 1866..	19·225	18·785	19·005
Dec. 1866 to June 1867..	9·820	9·750	9·785
June 1867 to Dec. 1867..	23·425	23·495	23·460
Dec. 1867 to June 1868..	15·430	15·440	15·435
June 1868 to Dec. 1868 ..	13·970	13·540	13·755
Dec. 1868 to June 1869..	6·820	6·720	6·770
June 1869 to Dec. 1869..	24·105	24·780	24·443
Dec. 1869 to June 1870..	9·750	9·750	9·750
June 1870 to Dec. 1870..	22·170	21·830	22·000
Dec. 1870 to June 1871..	15·700	15·660	15·680
June 1871 to Dec. 1871..	16·880	16·690	16·785
Dec. 1871 to June 1872..	5·140	5·200	5·170
June 1872 to Dec. 1872..	14·550	14·460	14·505
Dec. 1872 to June 1873..	3·545	3·760	3·653
June 1873 to Dec. 1873..	25·470	25·605	25·538
Dec. 1873 to June 1874..	9·190	8·620	8·905
June 1874 to Dec. 1874..	20·745	20·400	20·573

Before proceeding further, it will be well to state that the first six results of the table were obtained by means of a water lens, while those that follow were obtained by a glass lens. The first six are not therefore comparable with those that follow.

Let us now endeavour to compare the heat of sunshine between the winter solstice and the ensuing summer solstice with that between the summer solstice and the ensuing winter solstice. The results of this comparison are given in the following Table:—

TABLE II.

Comparing the heat of sunshine during the six months preceding the summer solstice with its heat during the six months following the same.

Year.	Heat of the Sun during the six months	
	Preceding solstice.	Following solstice.
1855......	7·808	3·450
1856......	1·095	1·223
1857......	1·093	0·445
1858......	19·484	22·954
1859......	20·653	30·868
1860......	12·990	19·433
1861......	10·393	16·975
1862......	8·624	20·885
1863......	5·910	24·205
1864......	4·120	15·138
1865......	10·071	18·040
1866......	6·785	19·005
1867......	9·785	23·460
1868......	15·435	13·755
1869......	6·770	24·443
1870......	9·750	22·000
1871......	15·680	16·785
1872......	5·170	14·505
1873......	3·653	25·538
1874......	8·905	20·573
	184·174	353·680

From this table it appears, as might be expected, that the heat of sunshine is greater during the second than during the first half of the year, reckoning from the summer solstice; and this result is borne out by the observations made by one of us* that the chemically active solar rays are of greater intensity during the autumn than during the corresponding spring months.

There is a remarkable uniformity in this law, the only cases where it is broken being the years 1855, 1857, and 1868—years, it may be remarked, which are near the epochs of minimum sun-spot frequency. It thus appears that in order to compare one set of observations with another, it will be necessary to form yearly instead of half-yearly values; this is done in the following Table:—

* Phil. Trans. 1867, p. 562.

TABLE III.

Containing yearly values of the heat of Sunshine.

Mean date.	Amount.	Mean date.	Amount.
June 1855	11·258	June 1865	28·111
Dec. 1855	4·545	Dec. 1865	24·825
June 1856	2·318	June 1866	25·790
Dec. 1856	2·316	Dec. 1866	28·790
June 1857	1·538	June 1867	33·245
Dec. 1857	......	Dec. 1867	38·895
June 1858	42·438	June 1868	29·190
Dec. 1858	43·607	Dec. 1868	20·525
June 1859	51·521	June 1869	31·213
Dec. 1859	43·858	Dec. 1869	34·193
June 1860	32·423	June 1870	31·750
Dec. 1860	29·826	Dec. 1870	37·680
June 1861	27·368	June 1871	32·465
Dec. 1861	25·599	Dec. 1871	21·955
June 1862	29·509	June 1872	19·675
Dec. 1862	26·795	Dec. 1872	18·158
June 1863	30·115	June 1873	29·191
Dec. 1863	28·325	Dec. 1873	34·443
June 1864	19·258	June 1874	29·478
Dec. 1864	25·209		

The first five of these values must be treated by themselves, inasmuch as the lens was a water one. They point to a minimum of solar-heat action in 1856 and 1857; this agrees very well with the minimum of sun-spot action which took place in 1856.

Of the remaining thirty-three values the mean is 30·468.

Now there was a maximum of sun-spot frequency in 1859 and 1870, and a minimum about the end of 1866 or beginning of 1867.

Let us take the values of sun-heat action about these dates, and see if there be any correspondence. We have sun-heat action, mean date

Dec. 1858=43·607
June 1859=51·521
Dec. 1859=43·858
Mean of the above ....46·329,

a value which is greater than the average.

Again we have sun-heat action, mean date

Dec. 1869=34·193
June 1870=31·750
Dec. 1870=37·680
The mean of which is ......34·541,

which is also greater than the average, although the difference is not so decided.

Lastly we have sun-heat action, mean date

June 1866=25·790
Dec. 1866=28·790
June 1867=33·245
The mean of which is ......29·275,

which is less than the average.

It would thus appear that, as far as we can judge from these observations, there is more solar heat at London in years of maximum than in years of minimum disturbance.

This agrees very well with a remark made by Messrs. De la Rue, Stewart, and Lowey, the Kew Observers, to the effect that the number of fine days in the year on which solar pictures might be taken appeared to be greater in years of maximum than in years of minimum sun-spot frequency.

XX. "On the Effects of Iron Masts on Compasses placed near them." By Staff-Commander E. W. Creak, R.N. Communicated by Captain Evans, R.N., F.R.S., by permission of the Lords Commissioners of the Admiralty. Received June 17, 1875.

The question of the position of the standard compass on board ship, whether of wood or iron, is one of the greatest importance with respect to safe navigation. In H.M. ships it is one of the principal duties of the Superintendent of Compasses to secure the best possible position for this compass, and when that position has been determined, to ascertain the horizontal and vertical components of the total magnetic force resulting from the iron used in the construction and equipment of every class of vessel, in order that the correctness of this choice of position may be insured and the facts recorded.

With proper instruments in experienced hands these observations can be readily made; but in iron ships it is a somewhat intricate matter to eliminate the part which the hull plays in producing these forces, from those caused by iron used in equipment, unless observations are made on completion of the hull and afterwards as the equipment progresses. In wooden ships, however, the case is different; for the great mass of the ship being of wood and the iron in detached masses, the latter can be attacked in detail, and the disturbance they cause to the several compasses nearly observed.

Carefully conducted investigations made in different ships on the effects of similar bodies of iron are very valuable to those directing compass arrangements, as they give the necessary information as to how near those bodies may be approached or of necessity avoided.

The effects of introducing iron riders for strengthening wooden ships were in a measure discussed by the late Captain E. J. Johnson in his work 'On the Necessity of ascertaining the Deviation of the Compass,' where he treats of the diagonal iron riders of the 'Encounter' and 'Conflict,' but afterwards more fully in the papers which the present Hydrographer, Captain Evans, F.R.S., has written and published in the Philosophical Transactions of the Royal Society, Journal of the United Service Institution, and Transactions of the Institute of Naval Archi-