penetrative energy, and go through a thickness of what are ordinarily considered opaque substances, but which are intercepted by the contents of the epidermic pigment cells largely developed in the African, a little more sparingly in Hindoos, and not absolutely wanting in the sunburnt excursionist or sportsman in our own country.

The Australian will tell you that he has done hard work—in a shade temperature of 100°—in the sun in a light wideawake and not felt exhausted; while continuous labour of some hours in much less heat—75° in the shade and exposed to the sun—in Hindostan would be simple destruction of the European's powers of exertion with all a Bond Street hatter could devise on his head.

A. T. FRASER

Equator of Heat, India, October 1

The Distribution of Scientific Works Published by the British Government

I HAVE read Dr. Valentine Ball's letter in your journal of October 30 (p. 634) expressing his astonishment that the scientific Reports of the British Government are not presented to the leading American scientific institutions. It may surprise Dr. Ball to learn that the Treasury recently refused to present one of the largest scientific libraries in Dublin with copies of the *Challenger* Reports on the ground that their "free list" was too limited!

G. F. B.

A NEW METHOD OF HEATING IN THE REGENERATIVE GAS FURNACE

DURING the present age, which may be called that of Electricity, the sister science of Heat is not receiving so much attention at the hands of the natural philosopher as it did formerly. But still there remain some scientific men who are giving a life-long attention to it—MM. Hirn and Berthelot in France, Herren Clausius, Helmholtz, and Frederick Siemens in Germany, Mr. Joule and Sir William Thomson in this country. During the late Sir William Siemens's lifetime, the one brother worked here in the science of Heat, the other in Germany, and the work of both was applied everywhere; now Mr. Frederick Siemens works alone, and, from the recent evidence of that work, it promises to play an important part in the economical application of fuel. Mr. F. Siemens has recently had an opportunity given him of bringing his views forward in this country, having read a paper at the Chester meeting of the Iron and Steel Institute on a new method of heating in the regenerative gas furnace, in which he treated the practical side of the question, whilst in the discussion of the same paper he gave his views on the theory of the subject. Mr. F. Siemens's investigations have led him to the conclusion that combustion can only be perfect, and be maintained perfect, if the space in which it takes place is sufficiently large to allow the gases to combine out of contact with solid materials. Having proved by actual experiment that solid substances interfere with the formation of flame and that flame injures solid substances with which it comes in contact, he brings forward an hypothesis to account for the phenomena. According to the electrical hypothesis, which Mr. Siemens prefers, flame is the result of an infinite number of exceedingly minute electrical flashes, the flashes being due to the exceedingly swift motion of gaseous particles, and a solid body which opposes itself to these flashes is cut by them, whilst, the motion being more or less arrested by the solid body, the flame is damped.

Another important deduction from these investigations is that combustion should be considered in two stages or periods, which may be respectively called active and neutral. In the first the purely chemical combination of the gases takes place, during which, as soon as the temperature of ignition has been reached, the whole of the heat of the highest possible intensity is produced, of which a large portion is given off by radiation, whilst in the second the temperature having fallen in the proportion of the heat given off by radiation, the remainder of the heat which is no longer of an active character, is best transmitted by conduction. For the purpose of utilising this portion of the heat, as well as for raising the temperature of the gas and air before combustion, the regenerators are requisite which form an essential feature of all furnaces worked at an intense heat on the Siemens principle, care being taken to design the furnace so that the gases shall have combined perfectly before the products of combustion are allowed to pass away.

Mr. Siemens in applying his investigations to practice insists that flame must not be allowed to impinge upon bodies to be heated, but must simply heat the bodies by radiation, and furnaces must be so constructed as to allow the flame to develop out of contact, not only with the substance on its bed, but with the walls and roof of the furnace itself; it thus follows that large furnaces must replace small ones, and to meet the objection that the loss of heat into the atmosphere must increase in the proportion of the area of the furnace, Mr. Siemens explains that the heat developed in the furnace increases in a much larger ratio than its increase in area, because flame radiates in every direction from every portion of its entire volume, while a solid substance radiates from its external surface only. The details of construction of metallurgical and glass furnaces and of steam-boilers are given in the paper in question, and need not be considered here; the main point is that furnaces heated on the radiation principle have been proved both in Dresden and at Landore to have been economical of fuel, whilst the saving in the materials treated from reduced oxidation and in the construction of the furnace has been found to be very great.

There is another point of view of this important question which is daily demanding and commanding more attention, and that is the abatement of the smoke nuisance. As is well known, smoke is but incomplete combustion, and the only way to get rid of it is not to produce it. Mr. Siemens insists that this can only be effected by not permitting flame to touch any substance whatever so long as it exists in the active condition; for, just as carbon is precipitated upon a glass rod put into an ordinary gas flame, so is it with any flame whatever its temperature; but the greater the difference of temperature between the flame and the body brought into contact with it the greater will be the amount of smoke produced. Mr. Siemens tells how in Dresden he succeeded in extending his works, without the production of smoke, by the application of the system of heating he recommends, and trusts that here also not only may smoke be abated, but that the public may also derive benefit by manufacturers being able to supply goods at cheaper rates owing to being able to economise their fuel and the material heated within the furnaces as well as that of which the furnaces are constructed.

THE PRIME MERIDIAN CONFERENCE

THE greatly extended and ever increasing intercourse, both commercial and scientific, which has grown up between different nations in modern times has naturally caused especial attention to be drawn to the question of assimilation of the different systems of reckoning employed. Weights and measures and money have been already dealt with more or less successfully, but always with steady advance in the direction of unification. More recently, and in like manner because of practical difficulties and inconveniences, unification of the methods of counting longitude and time has in its turn become a question pressing for solution by the establishment of some international agreement in regard to all matters relating thereto.

The subject became first systematically discussed at the Conference of the International Geodetic Association