usual, a prominent place is given to the biographies of eminent British and foreign men of science We know of no more useful work of reference, or of one which is consulted more frequently.

(2) This supplement to "Who's Who" contains a remarkable miscellany of information as to the offices held by distinguished men and so on, arranged conveniently in tabular form to assist rapid reference.

(3) With the assistance of an honorary consultative committee of women workers eminent in their respective spheres of activity, the editor has compiled an indispensable compendium of information for all women who participate in public or social life. Parents desiring guidance as to careers for their daughters will find this volume very helpful.

(4) The sub-title of this book, "A Directory for Writers, Artists, and Photographers"—exactly describes its scope and intention, which are fulfilled successfully.

*Papers of the British School at Rome.* Vol. vi. Pp. xiv + 511 + xl plates. (London: Macmillan and Co., Ltd., 1913.) Price 42*s.* net

THE severely archæological part of this work consists of reports of excavations in Malta and Gozo made in 1908–11, and of a survey of the megalithic monuments of Sardinia. The investigation was confined to Neolithic monuments. Buildings usually ascribed to the Phœnicians are now assigned to the end of the Neolithic age, or to the very beginning of the "Eneolithic" period or the age of metals (p. 5). They were "in part sanctuaries, in part dwellings." No Neolithic burials were discovered in them, but typical Neolithic burials were found elsewhere under other conditions (pp. 7, 8, 12). Such evidence fully warrants the happy description "megalithic sanctuaries" (p. 35). "Connection of origin with the pottery of the Ægean there is apparently none; at any rate, it is so remote that we cannot trace it, and of direct Ægean influence," says Mr. Peet, "I can see no certain evidence whatsoever." The builders were evidently allied to the people who made "the rock-hewn graves of Sardinia, Spain, and perhaps Sicily" (p. 17).

But the "sanctuaries" of Malta are, according to the second report, "dolmenic tombs" in Sardinia. As no evidence of burial is produced, one is forced to think that the investigation in that quarter is in the "dolmenic tomb" period of research. It is all about the "cult of the dead," with the dead conspicuously absent. In the first report Dr. Ashby says: "I do not think that it is possible to accept the idea of Evans that these mounments 'served, in part at least, a sepulchral purpose.'" (p. 8).

Excellent plans disclose orientations which rank in well-known categories, and the linear measures dovetail into striking harmonies, but the "British School at Rome" seems to care little for such trifles. Nowhere one finds the suggestion that the "sanctuaries" were also observatories.

JOHN GRIFFITH.

## LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

### The Pressure of Radiation and Carnot's Principle.

As is well known, the pressure of radiation, predicted by Maxwell, and since experimentally confirmed by Lebedew and by Nichols and Hull, plays an important part in the theory of radiation developed by Boltzmann and W. Wien. The existence of the pressure according to electromagnetic theory is easily demonstrated,[1] but it does not appear to be generally remembered that it could have been deduced with some confidence from thermodynamical principles, even earlier than in the time of Maxwell. Such a deduction was, in fact, made by Bartoli in 1876, and constituted the foundation of Boltzmann's work.[2] Bartoli's method is quite sufficient for his purpose; but, mainly because it employs irreversible operations, it does not lend itself to further developments. It may therefore be of service to detail the elementary argument on the lines of Carnot, by which it appears that in the absence of a pressure of radiation it would be possible to raise heat from a lower to a higher temperature.

The imaginary apparatus is, as in Boltzmann's theory, a cylinder and piston formed of perfectly reflecting material, within which we may suppose the radiation to be confined. This radiation is always of the kind characterised as complete (or black), a requirement satisfied if we include also a very small black body with which the radiation is in equilibrium. If the operations are slow enough, the size of the black body may be reduced without limit, and then the whole energy at a given temperature is that of the radiation and proportional to the volume occupied. When we have occasion to introduce or abstract heat, the communication may be supposed in the first instance to be with the black body. The operations are of two kinds: (1) compression (or rarefaction) of the kind called *adiabatic*, that is, without communication of heat. If the volume increases, the temperature must fall, even though in the absence of pressure upon the piston no work is done, since the same energy of complete radiation now occupies a larger space. Similarly a rise of temperature accompanies adiabatic contraction. In the second kind of operation (2) the expansions and contractions are *isothermal*—that is, without change of temperature. In this case heat must pass, into the black body when the volume expands and out of it when the volume contracts, and at a given temperature the amount of heat which must pass is proportional to the change of volume.

The cycle of operations to be considered is the same as in Carnot's theory, the only difference being that here, in the absence of pressure, there is no question of external work. Begin by isothermal expansion at the lower temperature during which heat is taken in. Then compress adiabatically until a higher temperature is reached. Next continue the compression isothermally until the same amount of heat is given out as was taken in during the first expansion. Lastly, restore the original volume adiabatically. Since no heat has passed upon the whole in either direction, the final state is identical with the initial state, the tem-

[1] See, for example, J. J. Thomson, "Elements of Electricity and Magnetism" (Cambridge, 1895 § 241): Rayleigh, *Phil. Mag.* (xlv., p. 222, 1898); "Scientific Papers" (iv., p. 354).

[2] *Wied. Ann.*, vol. xxxii., pp. 31, 291, 1884. It is only through Boltzmann that I am acquainted with Bartoli's reasoning.