far to seek. We would submit that many easy ways suggest themselves of avakinng a sluggard without need of molesting the sleep of his just, and presumably virtous, neighbour. There be, in manifold variety, clock-alarums, clepsydras, sand-glasses, and galvanic appliances, which are fully competent to privately admonish a slumberer, without any public scandal; not to speak of the old English method, by which an active lad gained a weekly wage by ringing the house-bells of his heavier-sleeping comrades. In one word, there is a right and a wrong in this matter of the bell-ringing, as science has made plain. It is not in the least a question to be determined to-day or to-morrow by the votes of interested parties; for the correct and the final solution of it was written long ago, in the name of eternal justice and the immutable fitness of things.

ON AN ALLEGED EXCEPTION TO THE SECOND LAW OF THERMODYNAMICS.

According to the received doctrine of radiation, heat is transmitted with the same intensity in all directions and at all points within any space which is void of ponderable matter and entirely surrounded by stationary bodies of the same temperature. We may apply this principle to the arrangement recently proposed by Prof. H. T. Eddy[1] for transferring heat from a colder body A to a warmer B without expenditure of work.

In its simplest form the arrangement consists of parallel screens, which are placed between the bodies A and B, and have the form of very thin disks with certain apertures, and the property of totally reflecting heat. These disks, or screens, are supposed to be fixed on a common axis, and to revolve with a constant velocity. For the purposes of theoretical discussion, we may allow this velocity to be kept up without expenditure of work, since we may suppose the experiment to be made *in vacuo*. If the dimensions and velocity of the apparatus are such that the screens receive a considerable change of position during the time in which radiant heat traverses the distances between them, the apertures in the screens may be so placed that radiations can pass from A to B, but not from B to A. It is inferred that it is possible, by such means, to make heat pass from a colder to a warmer body without compensation.

In order to judge of the validity of this inference, let us suppose thermal equilibrium to subsist initially in the system, and inquire whether the motion of the screens will have any tendency to disturb that equilibrium. We suppose, then, that the screens, the bodies A and B, and the walls enclosing the space in which the experiment is made, have all the same temperature, and that the spaces between and around the screens and the bodies A and B are filled with the radiations which belong to that temperature, according to the principle cited above. Under such circumstances, it is evident that the presence of the screens, whether at rest or in motion, will not have any influence upon the intensity of the radiations passing through the spaces between and around them; since the heat reflected by a screen in any direction is the exact equivalent of that which would proceed in the same direction (without reflection) if the screen were not there. So, also, the heat passing through any aperture in a screen is the exact equivalent of that which would be reflected in the same direction if there were no aperture. The quantities of radiant heat which fall upon the bodies A and B are therefore entirely unchanged by the presence and the motion of the screens, and their temperature cannot be affected.

We may conclude *a fortiori* that B will not grow warmer if A is colder than B, and none of the other bodies present are warmer than B.

Since the body A, for example, when the screens are in motion, does not receive radiations from every body to which it sends them, it is not without interest to inquire from what bodies it will receive its share of heat. This problem may be solved most readily by supposing the screens to move in the opposite direction, with the same velocity as before. One may easily convince himself that every body which receives radiant heat from A when the apparatus moves backward, will impart heat to A when the apparatus moves forward, and to exactly the same amount, if its temperature is the same as that of A. J. W. Gibbs.

[1] Journ. Frankl. inst., March, 1883.

PHOTOGRAPHIC FOCUSING.

Considerable discussion has arisen of late as to the propriety of focusing with a large stop, and then using a much smaller one with which to make the exposure. Most of those who have written upon the subject have assumed that it was merely a question of spherical aberration. It seems to the writer, how-