clearly pointed out by Sir W. Thomson, in a remarkably able paper 'On a Universal Tendency in Nature to the Dissipation of Mechanical Energy.' It is simply another method of saying that no known natural processes are perfectly reversible. Having thus briefly discussed the conservation, transformation and dissipation of energy, we propose concluding by investigating the sources of energy available for man.

A few moments' reflection will suffice to show that they are (1) Food, (2) Fuel, (3) Water Power, (4) Wind. Of these food and fuel are of the same nature, food being utilized by means of animal machines, such as men, horses, etc., while fuel is converted into mechanical motion by means of engines of various kinds. The kinetic energy which is thus produced by means of food and fuel is evidently derived from the heat and light radiated from the sun.

Water power and wind even more obviously obtain their energy from the same source.

Solar radiation is therefore the grand source whence nearly all the energy available for man is derived.

Various theories have been advanced to account for the enormous amount of energy in the form of heat and light annually sent forth by the sun, and of which the earth intercepts a very small portion.

It was by some supposed that the sun's heat was produced by the combustion of its materials. A very few facts will show that this hypothesis is utterly untenable.

The mass of the sun is approximately $4(10)^{30}$ pounds. The consumption of a pound of coal is known to produce an amount of heat equivalent to 9,200,000 foot-pounds. Combining these, we see that if the materials of the sum were supposed to be capable of producing by their consumption as much heat as equal masses of coal—an assumption eminently favorable to the hypothesis in question—the total mass of the sun would be consumed in producing a quantity of heat whose mechanical equivalent is $368(10)^{35}$ foot-pounds.

Further, according to the most accurate determinations of the amount of solar radiation, it is found that the energy radiated from the sun is very nearly $(10)^{34}$ foot-pounds per year.

It follows therefore that if the theory of the origin of solar heat under examination were the true one, the energy of the sun would be completely exhausted in 3680 years, while there are reasons for believing that the quantity of heat radiated from the sun has been as great as at present for millions of years.

The theory of combustion or chemical combination therefore falls to the ground; and it is now generally supposed that the perennial fountain whence flow the enormous energies of the solar system is the potential energy of gravitation, which is converted into kinetic energy by its mass moving towards the centre of inertia of the solar system, and thence into heat by a mechanism indicated by the physical constitution of the fiery ruler of the day.

A few simple calculations will suffice to show that this hypothesis, which is now almost universally accepted by scientific men, predicates a cause amply capable of producing the results which it is supposed to explain, and that therefore it is not inconsistent with the axiom that the cause must be equal to the effect.

Taking the case of a spherical mass equally dense at equal distances from the centre, let ρ represent the density at distance r from the centre.

Taking proper units of force, &c., and remembering the theorem that the attraction of a spherical shell on an internal particle vanishes, it follows that the force acting on this elemental mass is $4\pi\rho\, dr . \int_o^r 4\pi\rho\, r^2\, dr$, assuming of course the Newtonian law of gravitation. The work done by this elemental mass moving through an infinitesimal distance dc. will consequently be $4\pi\rho\, dr \int_o^r 4\pi\rho\, r^2\, dr.\, dc.$ Integrating with respect to r, we get as the total work done $\int \left\{ 4\pi\rho\, de \int_o^r 4\pi\rho\, r^2 dr \right\} dr$, a formula which will be found of considerable use in solving several important classes of problems.

If we suppose ρ to be constantly uniform and that the radius of the sphere is originally a, it follows that if the radius becomes $a - da$, the amount of work done in consequence is $-M_2 \frac{3}{5} \frac{da}{a^2}$ when M is the total mass—of course a constant. Integrating this expression between the limits a and b, we get as the amount of work done by a spherical mass M of radius a (supposed uniform) contracting to a uniform sphere of radius b, $-M^2 \frac{3}{5} \left\{ \frac{1}{b} - \frac{1}{a} \right\}$ where the unit of force is obviously the attraction of unit mass on unit mass at unit distance. Applying this to the present condition of the sun, it will be found that a contraction of one foot in the sun's radius will produce sufficient energy to sustain the sun's heat at the present rate of radiation for about 1-10 of a year, or a decrease in the diameter of the sun of less than 20 miles would keep up the supply for 5,000 years. The most refined instruments would not be sufficiently precise to detect so small a variation.

Further, if the mass of the sun were uniformly distributed throughout a sphere of the same radius as Neptune's orbit, and were to contract to its present dimensions, the amount of heat generated would be represented by $228\ (10)^{39}$ foot-pounds, or sufficient to meet the present demand for over twenty-two million years.

This amount would be materially increased by taking account of the masses of the other bodies of the solar system, and of the fact that the sun must become denser as the centre is approached.

This vast quantity is amply sufficient to account for the heat which has been radiated into space by the sun and the other bodies composing the solar system, for the thermal energy now possessed by all those bodies, and for the kinetic energy they have on account of their revolutions in their orbits and on their axes. We have, then, what is known to be a *vera causa* shown to be capable of adequately accounting for certain facts, and we may legitimately infer the relation of cause and effect.

CAINES' RECOLLECTIONS OF DANTE GABRIEL ROSSETTI.

Since the death of the poet-painter numerous biographical and critical notices have appeared, and of these by no means the least interesting is Mr. Caines' book, entitled "Recollections of Dante Gabriel Rossetti." In this work the literary side of Rossetti's art is considered, and his character and opinions are shown by numerous, and, as a rule, well-chosen extracts from his letters to the author. An ardent admirer of the poet, Mr. Caine corresponded with him for a considerable period before becoming personally acquainted, and by that correspondence an intimacy was formed which increased in later years to such an extent, that at Rossetti's request Mr. Caine took up his abode with him, and was with him almost constantly until his death. Perhaps then, with the single exception of Mr. Watts, no one has had such ample opportunities for observing the character, the artistic nature, the intense sensibility, and the literary likes and dislikes of the gifted poet. His aversion to forming new acquaintances, and his seclusion from the world were obstacles to a correct understanding of his life and thoughts, not usually found in the artistic or literary world, and it is only to a personal acxuaintance or bosom friend that one can turn for a true picture of the man as he appeared when free from the embarrassments of public notice, though in opinions from such a source there is a disadvantage, arising from personal bias—shown in lavish and indiscriminate praise.

There is a possibility that the public will never obtain a true estimate of Rossetti's literary ability. To one unacquainted with his inner life, many of his poems appear to be the morbid outcome of a hypersensitive intellect, and to show too plainly the stamp of the 'fleshly' school. To an intimate friend, however, the excessive sensitiveness, instead of seeming morbid, is quite in keeping with the character and feelings of the man, and only throws more fully into relief his kindly passionate nature, while in the fleshliness such an one sees only his artistic admiration for the beautiful in all its forms, and his overflowing love for the mysterious in life and death. Accordingly one finds his adverse critics condemning certain of his works as unfit for the public eye, and his friends panegyrising and lauding them to the skies, no deliberate unprejudiced opinion being, as a rule, offered. It is only by a careful study of Rossetti's character, feelings, and opinions, as expressed in such a work as Mr. Caine's, that one can place one's self in a position to judge fairly and honestly the merit of his works.

The early death of his talented wife was a blow which crushed him to the ground, and it was the rememberance of this affliction that gave the peculiar weirdness to many of his poems