sun, as here supposed, his argument about the conservation of the solar rays by this absorption, is untenable. In fact, the author of the theory himself says this, for he quotes Lockyer's idea, that at solar temperatures no metalloid can exist, and yet further on, he supposes the energy kept up by the production of carbonic anhydride and carbonic oxide, which can be demonstrably shown incapable of existence.

The prime cause of the movement of the atmosphere is the rotation of the sun upon its axes. But all the planets rotate also, and as they are all immersed in the atmosphere, we shall have the same action occuring in their case. Thus we ought to find an aerial current flowing constantly in the northern hemisphere from the north-east (allowing for the gradually increasing velocity of rotation), and in the Southern hemisphere from the south-east. In short, exactly in the same direction as the "Trade Winds." But these currents would occur in the higher regions of the atmosphere where the "Return Trades" are prevalent, and to these they would be exactly opposed.

The inner atmosphere of the sun is supposed to contain the metallic vapours. Supposing that dissociation does not occur and that combination does, we are still in a difficulty, for we have, at the bounding surfaces at any rate, a large mass of oxygen, in contact with hydrogen and vapors of the metals. Now, with which of these will this oxygen combine? The whole of the teachings of Chemistry tell us, not with the hydrogen, but with the metals for, as is well known, all the metals (with one or two exceptions) decompose water. It therefore seems, that instead of water being a product of the combination, metallic oxides, especially those of sodium and potassium, which have the most powerful affinity for Oxygen will be produced. Thus, owing to the action of chemical affinity, supposing it to occur, we should have produced not water and carbonic dioxide, but metallic oxides, either entirely or in combination with these.

Again it is supposed, that in consequence of the weight of the materials composing the inner atmosphere, they are not affected by the fan-like action, but only by that of gravitation. Now, this assumption of itself is difficult of acceptance, inasmuch as any force which affects one body, must also effect the other, even though they may differ in density. It is simply a question of degree, and if owing to centrifugal force hydrogen is projected x miles into space, then sodium vapor, which is 23 times as heavy, will be projected $\frac{x}{23}$ miles. And here another consideration comes in. We are told carbon dioxide and water are produced, drawn towards the equatorial regions, and there expelled into space. Also we know that large quantities of sodium, potassium, magnesium and lithium exist in the sun, forming, let us suppose with Dr. Siemens, the inner atmosphere. They, we are told, are not projected into space, because they are of greater density. But this is not the case. The specific gravity of carbon dioxide and of water, compared to hydrogen, is 22 and 9 respectively, while lithium vapour has a density of 7, magnesium of 24, and sodium of 23. While if we can imagine these metals to combine with oxygen, the density of lithic oxide is 15, of magnesic oxide 20, and of sodic oxide 31. According then to this view, the various products of combustion would be projected to the following proportionate distances:

Aqueous Vapor	$3\frac{1}{3}$
Lithic Oxide	$2\frac{1}{15}$
Magnesic Oxide	$1\frac{1}{20}$
Calcic Oxide	$1\frac{8}{25}$
Sodic Oxide	1

Similar reasoning will apply if we assume dissociation to occur, and consequently the composition of the stellar atmosphere must be far more complicated than Dr. Siemens supposes, and the existence of this inner metallic atmosphere is very problematical. I will only refer to one other point. The researches of spectroscopy and the revelations of the telescope have revealed to us undoubtedly the fact that our sun is only one of an innumerable number. A theory to be complete must thus account for the action of all. Moreover, Dr. Huggins has shown that the fixed stars may be divided into classes, according to the spectra which they emit.

Thus we have all gradations, from the spectrum of a white or bluish-white star, like Sirius, up to that of a reddish star, like Arcturus. Now, if we have the same atmosphere supplying all, and the same cause producing motion, it is difficult to see how these differences are to be accounted for. For, it must be remembered that Dr. Huggins' idea of different ages will not apply, the supposed cause producing their energy being independent of time.

In the foregoing, I have endeavord to present unprejudiced, if brief, views of the chief theories which have been proposed from time to time, to account for solar energy. The subject is a very fascinating one, requiring strict attention in order to prevent the imagination running wild when dealing with such actions and magnitudes. If it is the reader's opinion that it has thus run wild, I must respectfully ask his indulgence, and plead the nature of the subject as an excuse.

IMPROVED CALORIC ENGINE.

(*See page* 196.)

The Caloric Engine and Siren Fog Signals Company, of London, have been occupied in producing caloric engines suitable for general purposes, and our illustration, which we find in *Engineering*, shows the most recent design. This engine is of two horse power nominal, or 3½ actual horse power.

It consists essentially of three parts, viz., a pump for supplying compressed atmospheric air; a generator or retort into which the air is forced and there heated, and a cylinder into which the heated air is expanded for the purpose of operating the piston. The generator comprises a cylindrical firebrick lining of smaller diameter than the casing, so that an annular space is left between the two, and a set of grate bars upon which the fuel is burned.

After a fire has been lighted in the generator, the air is, in the first instance, supplied by a hand pump or (in the case of small engines) by turning the fly wheel until the necessary pressure is created, when the engine commences to work, and the air pump at the top delivers at each upstroke of the piston a charge of air into a valve casing, where, by means of a hollow cylindrical valve, it is divided into two streams, one entering into the annular space above referred to, whence it descends and passes through the grate bars and the fuel, the other stream being delivered directly into the spaces above the fire. The air passing through the incandescent fuel forms, in the first instance, carbonic acid and ultimately carbonic oxide, so that the space above the fire may be considered as a combustion chamber, containing carbonic oxide and nitrogen. The oxygen of the air delivered into this space enters into immediate combination with the carbonic oxide, and produces an intense heat with a consequent increase of pressure.