round the sun, one of which is the earth we inhabit. But the resistance which the earth offers to the motion of the ether is the cause which converts this motion into that which gives the sensation of light, heat, &c., just in the same way that other matter in motion is transformed by resistance into heat and light. A more simple illustration of what I mean would be given by supposing a current of sea-water to give out a phosphorescent light only when an obstacle to its motion is introduced, such as a stone or stick, or when the waves of the ocean give out light by dashing upon a rock or the sea-shore.

From this line of argument it will be concluded that the only causes which exhaust the sun's energy are the several planetary and other bodies, moving in space, upon which the waves of ether dash, thus transforming their energy into the sensational forces of light, heat, &c.; but the area of these resisting bodies is exceedingly small in comparison with the rest of space, in which the ether is acting by its own energy, and without coming in contact with any resisting or exhausting obstacle.

It remains, then, to account only for the amount of the sun's energy which is absorbed or transformed by these planetary and other bodies. Although we may have thus reduced the solution of this mighty problem to a narrower space, yet it is just as difficult to account for the maintenance of the exhausted energy occasioned by a single grain of sand moving in space as by all the planetary and other bodies together.

Seeing that constant exhaustion or transfer of the sun's energy does take place, although in a much less degree than would be the case if it were not confined to the moving bodies in space alone, it remains then to account for its maintenance. The first question we should ask ourselves is this: Is there any evident or known force tending towards the sun as a centre? The immediate reply will be gravitation; and although in the present state of scientific knowledge it may be difficult or impossible to define what gravitation is, yet there cannot be a doubt that it is a force acting on all matter, with a tendency to carry all material bodies direct to the sun. As such force dashes into or upon the sun, it becomes in its turn transformed into light, heat, &c. It is indeed not improbable that future discovery may teach us that gravitation may have its origin from and bear some certain proportion to the resistance presented by the several bodies in space, which are illuminated by the sun's energy; thus establishing the beautiful law of light and heat being transformed into the force of gravitation—gravitation again into light and heat; thus sustaining and maintaining, for all time, the sublime fountain of motion and life, thought, and every sensation and action that organic matter is able to experience. W. L.

Sir W. Thomson and Geological Time

THE strongest statement about the retardation of the earth's motion of rotation by tidal friction, supposing the earth had been for so long a time provided with an ocean, is to be found in the appendix to a sermon preached by Professor Pritchard, F.R.S., then president of the Royal Astronomical Society, before the British Association at Nottingham. He there, in combating Darwin, says, "One million of million years ago, if the solid earth could then have been provided with an ocean, the length of the day would probably have been less than the flash of the hundredth of a second of time!"

I announced to the Literary and Scientific Society of Nottingham that this was an error in calculation, and based on a fallacy in reasoning; and Mr. Pritchard withdrew the result, while maintaining the method, in a letter read to the meeting after a lecture on the subject that I subsequently gave. But I am informed that it has since been republished in its old shape.

There is a still more amazing statement put forward in this appendix by the champion of Anti-Darwinism. Mr. Pritchard says he is familiar with the optical structure of the human eye. He dwells on the wonderful mechanism, and hints at the wonderful chemistry of it; and quotes the well-known passage from Darwin (Ed. I. p. 188) in which, while he gives up all attempt at showing gradation in the structure of the eye of Vertebrata, recent and fossil, yet he shows that in the Articulata the series is more complete. He quotes this, I say, to show that Darwin undertakes to explain by natural selection the structure of the *human* eye, which is precisely what he declines to do. "Let us attend," he says, "to the process of natural selection by which this marvellous organ is said to have come into being." '"I can see," says Mr. Darwin, "no very great difficulty . . . in believing that natural selection has converted the simple apparatus of an optic nerve into an optical instrument as perfect as is possessed by any member of the great Articulate class," i.e. *as perfect as the human eye.*' Is not this amazing?

Rugby, March 22 J. M. WILSON

The Moon's Diameter

WILL you permit me to say a few words on the interesting question raised by Dr. Ingleby in your last? The sun, moon, and all the heavenly bodies appear set, as it were, in the blue sky when the weather is clear; and as they are rarely visible unless when surrounded by at least a small space of blue sky, it seems to me that they will be naturally judged to be at the same distance from us that the sky is. But what is this distance? What, in other words, is the mean distance from which the blue light diffused or reflected from the air or vapour comes to us? Prof. Tyndall, who has devoted much attention to the causes of this blue appearance, may perhaps be able to tell us. The problem, of course, is rather an indefinite one, but an approximate solution might assist us in determining the question.

As to the heavenly bodies appearing larger when nearer the horizon, I shall leave some one else to settle the angular magnitudes in the case. Mr. Abbott, to whom Dr. Ingleby refers, proves that the fact is not confined to the heavenly bodies, but that portions of the sky seen under the same angle appear at least three times as large when near the horizon as when near the zenith ("Sight and Touch," pp. 136-7). But then, does the blue light come to us from the same mean distance when we look towards the zenith and when we look towards the horizon? or does it come from a much greater distance in the latter case, and thus apparently increase the magnitude of a portion of it whose size remains unchanged? In other words, is the sky seen as a hemisphere, or as a much smaller segment of a spherical surface (the observer being at the centre, not of a sphere, but of a small circle, the plane of which coincides with the horizon)? Most persons who look at a clear sky will, I think, adopt the latter alternative. It will be interesting to know if scientific research bears out natural impression in the case.

Other solutions of the difficulty might undoubtedly be proposed. Association of ideas, which is now the favourite device for helping a lame dog over a style, might be called to the rescue, and with some plausibility. Clouds and birds—everything, in fact, that passes above us—are nearest to us and look largest when most elevated. Elevation is thus associated with comparative nearness, and approach to the horizon with comparative distance. It is, however, simpler, if correct, to maintain that we see the sky as it really is, and that the apparent distances and magnitudes of the heavenly bodies are determined by the fact that they appear to be set in the sky, not placed at a great distance beyond it. W. H. STANLEY MONCK

Trin. Coll. Dublin, April 2

Heat Units

THE science of heat, which is capable of being made and is rapidly becoming one of the most exact of the experimental sciences, seems to labour unnecessarily under an excessive variety of units of measurement. At present there are used—

Units of Mass.	Thermometric Degrees.
Grain,	
Pound,	Centigrade,
Gramme,	Fahrenheit.
Kilogramme.	

Whence, evidently, there result *eight* different thermal units, to all of which the common name "unit of heat" is applied, or, at least, names inadequately distinctive. In the face of this it would really seem that some such suggestion as I here proceed to make must eventually be adopted.

Define, first, as follows:—A *therm* is the quantity of heat necessary to raise the temperature of 1 gramme of water from 0° C to 1° C. Secondly, 1 kilotherm = 10 hectotherms = 1000 therms = ... , thus having kilotherm, hectotherm, &c. suggestively corresponding to kilogramme, hectogramme, &c., in name as well as in nature.

Therms and kilotherms, which would probably alone be required in practice, would thus take the place of "thermal units, centigrade," "gramme-water-units," "kilogramme-units of heat," and others more or less lengthy and inexact at present to be found in writings on Heat and Energy.

College Hall, St. Andrew's, April 4. THOMAS MUIR