portant of his many splendid contributions to physics, and one having the most direct bearing upon the future of the physical universe. The rest of the statement, as it stands, is also false. It may be made correct by writing one of the words, *work*, *power*, *potency*, or preferably *energy*, in place of *force*, and also in place of *momentum*. What would be thought of a man who should say—"I paid six weeks for it," meaning "pounds" by "weeks." For "momentum" cannot be transformed or "transmuted" at all, it remains for ever unchanged.

Again, when bodies impinge on one another, "the rise of temperature is exactly proportioned to the visible momentum destroyed." Let us put the correct word "energy" in the place of momentum, and we find that this asserts the startling physical fact that the specific heat of every body is the same at all temperatures. If we take the statement as it stands without correction, it is simply nonsense.

Again, "the foot pound, meaning the force expended in raising one pound weight one foot, which is the same as a (*sic*) momentum of one pound moving at eight feet per second."

Raising one pound weight one foot is a feat which, by proper combinations of machinery, may be effected by any given force whatever, be it the weight of a grain or of a million tons. But a "foot pound," and the "momentum of one pound moving at eight feet per second" cannot possibly be compared with each other, any more than a cubic yard can be expressed as a number of square yards, or the height of a mountain in acres, roods, and poles.

You will see that the error in the examples I have just chosen (excepting of course the fatal one about restoration of energy) is in great part due to the misuse of words. Yet it is from a treatise on Logic that I have quoted!

The essence of the lesson taught by all this is simply the conviction that scientific knowledge has reached such an immense development that no one man can now possibly master thoroughly more than one or two of its many branches. There can be no "Admirable Crichtons" in our days. The greatest logician the world has produced, or is likely to produce, for many a long day, the lamented George Boole, more than once expressed his regret that a systematic logical treatment of human knowledge, even in moderate compass, and going little farther than the elements in each branch, had become absolutely impossible as the work of one man—impossible, that is, for a man who revolted at the idea of publishing anything he knew to be defective.

MOUNTAIN CLIMBING

IN the number of NATURE for June 23, 1870, I described an ascent of Mount Etna which I made on March 4 of this year, with an excellent guide, Pietro Cravagna.

I now propose to make some remarks on a few points of interest with regard to mountain climbing. One of the most important of these is the alleged lowering of the internal temperature of the body under such conditions.

During two ascents of Mont Blanc made on the 17th and 26th of August, 1868, by Dr. Lortet, of Lyons, and Dr. Marcet, of London, and described by Dr. Lortet in the *Lyon Médical* of September 26, 1869, experiments made apparently with great precaution on Dr. Lortet himself with a registering maximum thermometer (of Walferdin), by which (between + 30° C. and + 40° C.) hundredths of a degree could be appreciated, showed that the internal temperature of the body under such conditions is lowered to a very remarkable extent.

I will quote Dr. Lortet's own words: "A jeun et exactement dans les mêmes conditions, *pendant la marche*, la décroissance de la température intérieure du corps est très-remarquable, *elle est à peu près proportionelle* à l'altitude à laquelle on se trouve."

In effect, from the table given in the paper referred to, I find that during the first ascents the internal temperature descended *gradually* from 36·3° C. (that *during exercise* at Chamounix, 1,050 metres above the sea) to 32° C. at the summit of Mont Blanc (4,810 metres above the sea); while during the second ascent the difference was from 35·3° C. to 31·8° C.

Dr. Lortet found that as soon as he stopped for a few minutes, the temperature of his body rose briskly to the normal standard, except on the summit itself, where "il a fallu près d'une demi-heure pour que le thermomètre atteignît sa hauteur habituelle."

During digestion, in spite of the exercise being taken, the temperature remains normal, or even rises; but this does not last long: "Une heure à peine après avoir mangé, le corps se refroidit de nouveau par les efforts." The descent of the temperature of the body under such conditions, then, amounts sometimes to more than 4° C.; and if we take the difference between the normal temperature of the body *at rest*, and that observed by these experimenters on the top of Mont Blanc, the difference amounts in one case to 5° C., "abaîssement énorme pour les mammifères dont la température était reputé constante!" as Dr. Lortet justly exclaims.

Now Mount Etna is particularly suitable for such experiments; one begins to walk either at Nicolosi, or preferably at the Casa del Bosco, and one has nothing to do but to go straight up; there is nothing in the way, it is simply a long "grind" of some five or six hours or more, according to the state of the snow. A series of misfortunes with my maximum thermometers prevented my repeating the above-described observations, and I have referred to them at such length in the hope that some one may be induced to take the excellent opportunity afforded by the expedition to Sicily of deciding so important a point.

The state of the circulation is hardly less important than that of the internal temperature.

Dr. Lortet found that the pulse increased in frequency from 64 per minute at Chamounix to 172 on the summit of Mont Blanc, and he was further enabled, by means of the sphygmograph, to make some observations as to the *state* of the pulse at various altitudes. In ascending Etna I made some comparative observations on the frequency of my guide's pulse as compared with my own, which show some points of interest.

At the Casa del Bosco my pulse was 68, my guide's 74; we had both *ridden* to that point, and the difference is probably an illustration of the established fact that the circulation of persons living in mountainous districts is quicker than that of those living in plains. On arriving at the summit of Etna after a ride of an hour and a quarter (from the Casa del Bosco), a rest of fifteen minutes, and a stiff walk of three and a quarter hours over dry, hard, snow (an exceptionally easy ascent),* my pulse was very irregular, and about 114 or 115 to the minute, while the guide's was only 89—that is to say, that mine had increased 46 beats in frequency, his only 15; or mine was about $\frac{2}{3}$rds, his only about $\frac{1}{8}$th, as fast again; showing the slight effect of such ascents on those who are used to them, and who live habitually in mountainous countries.

But this was still more forcibly illustrated by the state of our pulses after a very quick descent, a regular trot all the way (we had stayed two hours at the summit, and eaten a hearty breakfast); at the place where we left the mules, I found that while my pulse, after a minute or two's rest, was at 106 or 107, the guide's was at 99 or 100; mine being 8 beats *less* than it was on arriving at the top, his 10 beats *more*; his circulation was *less* disturbed by

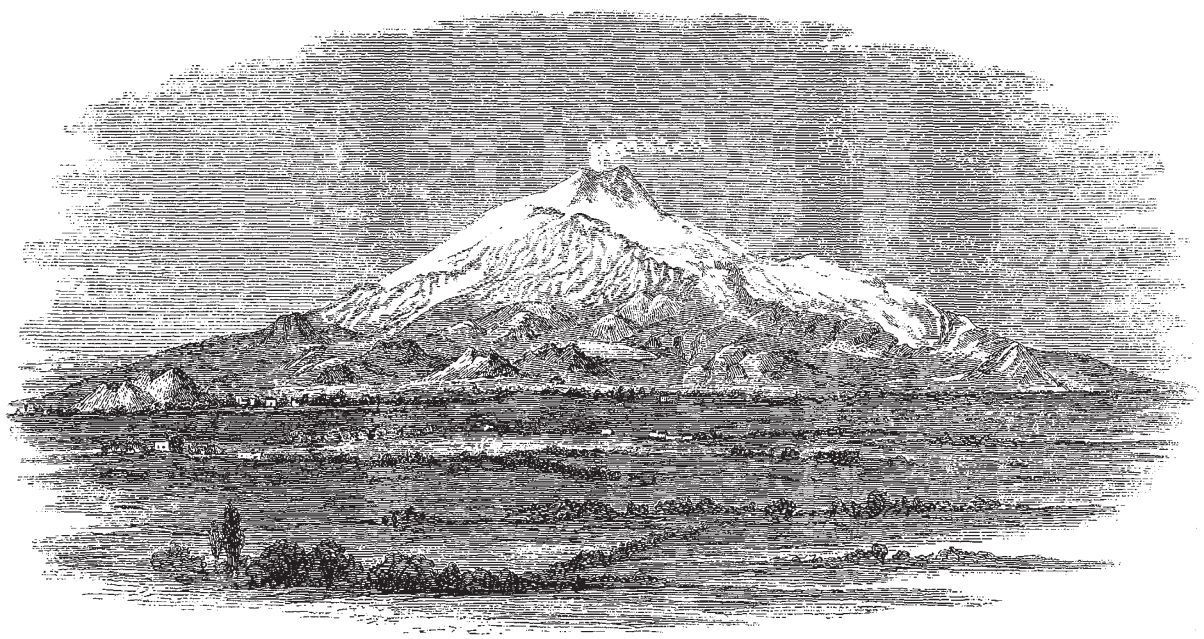
* Later on in the month of March, when much snow had recently fallen the Rev. A. G. Girdlestone and I, with two other friends, made an ascent: it took us nearly eight hours to walk from the Casa del Bosco to the Casa degli Inglesi, and we saw nothing but a very heavy snow-storm.

walking fast up the mountain, carrying a load of provisions, than by running down it with nothing to carry; mine, on the contrary, as one would expect, much more so by walking up than by running down. (Of course I could get nothing in the shape of sphygmograph at Catania.)

Dr. Lortet has recorded some interesting observations, made with the aid of the anapnograph of MM. Bergeon and Kastus, on the state of the respiration. It is much quickened, as is well known; the expiration is much prolonged, its amplitude much lessened, the inspiration shortened and quickened; much less air being inspired and expired than is normally the case.

These effects are partly due to the rarefaction of the air, less oxygen by weight being taken in at each inspiration, and partly to the excessive muscular exertion, which demands a corresponding increase in the animal heat, and so a corresponding increase in the amount of oxidation taking place in the blood; this not being always obtainable and the exercise being continued all the same, the normal temperature of the body cannot be maintained, and so it falls, and one becomes miserably cold while walking, and has to stop to get warm again.

Now as to the amount of work done; that is very much greater than is commonly supposed: leaving out of consideration the difficulties encountered in walking either over soft snow or over slippery places, especially when very steep, I find that in climbing Etna, starting as I did, on the occasion that I have already described, from some distance above the Casa del Bosco, I lifted about 150lb. to the vertical height of at least 5,700 ft., or about 380 tons one foot; adding 10 foot-tons (little enough) for the horizontal distance traversed, we have 390 foot-tons as representing work done in 3¼ hours: now 390 foot-tons is about the work done by a person of the weight above mentioned in walking 22 miles on level ground; that is to say that, without making any allowance for the increased difficulty of breathing due to the rarefaction of the air or for any of the consequences of this (increased action of heart, &c.), one has walked 22 miles in the time ordinarily taken to walk 13.



A VIEW OF ETNA

To put it in another way: 390 foot-tons is a hard day's work, as it is found that something over 300 foot-tons is the average day's work of strong labourers. One therefore does a hard day's work in 3¼ hours, and this after an ordinary day's work, *plus* a fatiguing ride of some four hours on a mule, over lava currents and cinders, in the middle of the night and without any chance of sleep.

Taking everything into consideration, it is difficult to believe that the fatigue is, as it is often stated, out of all proportion to the work done; we must not only consider the amount of work, but *the time in which it is done*, and this is what I have especially wished to point out, as one can easily understand that the fatigue must increase very fast as the time in which the work is done decreases.

At the summit of Etna (the accompanying woodcut, from a rough sketch taken when a good deal of the snow had melted, can give but a feeble idea of the exquisite effect produced by the dazzling whiteness of the snow against the perfectly clear blue Sicilian sky) the range of temperature within a few feet of vertical distance is very remarkable. Just after sunrise I found that the temperature of the air at the height of four feet or so above the ground was — 2° C.; on the ashes where the snow had melted it was + 9° C.; just under the surface it was 20° C., and a few inches under it was higher than 36° C. (my minimum thermometer, the only one I had left, not allowing me to register a higher temperature than this).

This high temperature of the ashes only occurs where they are mixed with sulphur, which is continually undergoing oxidation; the other parts of the cone and crater are in the winter covered with snow, and it is very strange to see snow a foot deep or more, quite close to ashes that really feel uncomfortably hot.

Those who wish to "get up" the history of Mount Etna and its structure, should refer to Sir Charles Lyell's "Principles of Geology," tenth edition, vol. ii.; or for a much more detailed account of the eruptions, its present and past conditions, &c., to "La Vulcanologia dell' Etna," by Carlo Gemmellaro, published at Catania in 1858.

W. H. CORFIELD