Lawd By'on. Moze people pwefeh 'im to Shakspere, in fact. Well, you muz go? I am ve'y 'appy to meck yo' acquaintanze, Mistoo Itchlin, seh, I am so'y Doctah Seveeah is not theh pwesently. The negs time you call, Mistoo Itchlin, you muz not be too much aztonizh to fine me gone from yeh. Yesseh. He's got to haugment me at the en' of that month, an' we 'ave to-day the fifteenth mawch. Do you smoke, Mistoo Itchlin? I smoke lawgely in that weatheh. I feel ve'y sultwy to-day."

And then the author's summing up of this character who carried his folly on the surface and his good sense at the bottom :—

Farewell, Byronic youth! You are not made of so frail a stuff as you have seemed. You shall thirst by day and hunger by night. You shall keep vigil on the sands of the Gulf and on the banks of the Potomac. You shall grow brown, but prettier. You shall shiver in loathsome tatters, yet keep your grace, your courtesy, your joyousness. You shall ditch and lie down in ditches, and shall sing your saucy songs of defiance in the face of the foe, so blackened with powder and dust and smoke that your mother in heaven would not know her child. And you shall borrow to your heart's content, chickens, hogs, rails, milk, buttermilk, sweet potatoes, what not: and shall learn the American songs, and by the camp-fires of Shenadoah sing, "The years creep slowly by, Lorena," to messmates with shaded eyes, and "Her bright smile haunts me still." Ah, boy! there's an old woman still living in the Rue Casa Calvo—your bright smile haunts her still. And there shall be blood on your sword, and blood—twice—thrice—on your brow. Your captain shall die in your arms; and you shall lead charge after charge, and shall step up from rank to rank, and all at once, one day, just in the final onset, with the cheer on your lips, and your red sword waving high, with but one lightning stroke of agony, down, down you shall go in the death of your dearest choice.

Mr. McLennan's sketches which have appeared in *Harper's Magazine* are, of course, only the first prospecting in a new field. Everything remains to be done. A story written in dialect is almost always at a disadvantage with the general reader, and it is not the least merit of this "new star in the Canadian literary galaxy" that he has made so unpromising an instrument the vehicle of quaint and delightful narrative. We cannot speak too fair of this art or the artists.

Who help mankind along,
More by their fascinating lies,
Than all the learning of the wise.

Luke Hough.

FORCE AND ENERGY.

"Fidelis" in her article, some time since in The Week, on Mr. Grant Allen's career as a writer on literature and science, tells us that his work with the above title was commented on very unfavourably by some scientists. This is true enough. Indeed, no work by him was subjected to such a scathing fire of adverse criticism, and that, too, it must be admitted, by some who, by reason of their own achievements as physicists, had earned at least a quasi right to speak on this particular subject—the dynamics of the universe. Still it may be that those who wrote opposingly had never fully mastered the theory on which they so fiercely animadverted; and inasmuch as this work was that of one who did not belong to the special guild of physicists, and as his terrible heresy had been accepted by many, as his opponents inform us, as a very "gospel" of scientific truth, a necessity lay on them to consign it to their Index Expurgatorius and himself to the pains and penalties of all the unorthodox. Still, it may happen to him, as in a former case where an adverse, but conscientious, critic, having pronounced an unfavourable sentence on a book of his, afterwards recalled it and even pronounced a verdict in his favour. But why multiply instances that look hopeward—from Harvey who lost many patients in consequence of his great work on the circulation of the blood, and whom many of his contemporaries regarded therefore as a crank; up to Newlands on the Periodic Law; and many others? And is it impossible that Grant Allen's work on "force and energy" may not also, on a reconsideration of the subject, have a verdict yet recorded in its favour? But, meanwhile, let what I have to urge be regarded only in the light of a plea for getting him a hearing. And here let me say that one very able critic, though himself profoundly disbelieving Mr. Allen's theory, allows that "Mr. Allen is unusually well qualified in many respects for the work he has undertaken," and adds, "we can safely assure our readers that they will find Mr. Allen's book pleasant and profitable reading, which is very much more than can be said of most theories of the universe." His theory, however, was put forth by him only "in a tentative way . . for wiser heads to accept or reject." Not being himself, in any special sense, a physicist, he takes the facts and experiments of others—*the disjecta membra*—as he finds them scattered throughout the works of such men, and endeavours to endow them with such an informing principle as may build them up into unity so that they may all gather round a great central or root idea, to govern and explain them all. And let me add—and of course I am a quite unprejudiced person—that Mr. Grant Allen has considerable insight into the workings of the world, and a rare power of bringing under the dominion of some pregnant principle or law so many of the outlying and seemingly unrelated provinces of nature.

Mr. Allen's contention, then, is this, that Force and Energy, in ceaseless antagonism, are the two great powers that divide between them the empire of *the All* that force binds together, whereas energy separates. It is deeply important, thinks Mr. Allen, to keep this clearly before the mind, that *Force* is that which draws things together and holds them so; whereas *Energy* is that which separates things and keeps them separate; and he maintains that to the *forces* belong gravitation, cohesion and chemical and electrical affinity; whereas heat, light and electricity are *energies*. Every substance that stands *separate* from another has energy, whether it be a weight lifted from the earth, or molecules separated from their cohesions, or atoms in a state of singleness, or electrical units as in the Leyden jar, whereas *force* combines masses, molecules, atoms, and electrical units, and when so combined (like a weight on the ground) they have parted with their energies as such. Let this be kept steadily before the mind. It will help to clarify it. Great mistakes have been made through not regarding energy as *separative* power. To the definition given to energy by physicists as "the power of doing work," Grant Allen strongly objects, believing that thereby "the concept of the two great powers that divide the universe have not been realized and assimilated in all their *separation and antagonism*;" for (apart from anything else) "the practical consideration of energy, as that which performs work, overlies thus the theoretical consideration of it as *separative* power." But, indeed, "if we look closely into the matter, we shall see," says he, "that force is *just as much* requisite for the performance of work as is energy. In a single-action steam engine, the gravitation which pulls down the piston when it reaches the dead point, is as necessary as the heat that elevated it to that point: and the attractive force of chemical affinity which draws together the atoms of carbon and oxygen, is as necessary as the energy of passive separation which before divided them . . In short, in every case it is the *interaction of the two* powers which performs the work."

Now, to show how far this inadequate view of energy has been wholly misleading, I quote the following. Professor Tyndall says: "I have seen the wild stone-avalanches of the Alps, which smoke and thunder down the declivities with a vehemence almost sufficient to stun the observer. I have also seen snow-flakes descending so softly as not to hurt the fragile spangles of which they were composed; yet to produce, *from aqueous vapour*, a quantity which a child could carry of that tender material, demands *an exertion of energy* competent to gather up the shattered blocks of the largest stone-avalanche I have ever seen, and pitch them to twice the height from which they fell."

Now, "anyone," thinks Mr. Allen, "who reads over this passage carefully will see that it expresses the exact opposite to the real fact. The aqueous vapour, in its *uncondensed* state, did indeed possess the amount of energy which Professor Tyndall mentions; but this energy was not *exerted* in the formation of the snow; on the contrary, it was *liberated* (as heat), and turned loose upon space. To raise the snow to aqueous vapour would require a fresh integration of the same enormous amount of *energy*. It is in the production of the vapour, therefore, not of the snow, that energy is exerted. *Force* turns vapour into water, and then into ice, when energy is liberated. Energy turns the ice back again into water." This, however, Mr. Allen expressly states, he regards merely in the light of a "slip" of this truly admirable physicist. Indeed, it seems almost a shame to have to disagree with one who has done so much and has done it so well; a shame, too, to say anything that might seem to spoil this singularly beautiful and poetic passage; but he who has written so much and so charmingly may well afford to lose a single paragraph out of multitudes of similar ones. Still, truth is greater than any man. Perhaps he may think even this one not lost; for I can fancy him smiling at my temerity and ignorance. Of course, I know how he may still explain the phenomenon. But energy is separative power—separates and keeps separate; while force is aggregative—draws things together and holds them together. All particles and aggregates of particles, when apart, are kept apart by an energy or separative power. Energy, as heat-motion, finding the ice particles bound firmly together by cohesive force, drives them apart. A further increase of energy, as in the case of fire under a boiler, would force them still further apart—*i e*, into steam—and these particles thus driven apart would, if there were no force to control their movements, keep on in their course (as first projected) throughout space. Or, if it were possible to bring them to rest, or to poise them in space, they would so remain *in statu quo* for ever if some energy or force did not otherwise compel them.

Indeed, Professor Tyndall tells us himself, with his usual force and lucidity, that the greater the amount of heat (energy) we impart to a body *the wider the amplitude* of the atomic oscillation, but "that by the force of *cohesion* particles are held together, while by the force (energy) of heat they are pushed asunder. So far, so right; and had this great physicist held the theory, so simple and cogent, that the powers of the universe are of two kinds, forces *and* energies—that force causes aggregative motion and resists separation, whereas *energy* causes separative motion, and, when things are separate, is that which keeps them so, he could hardly have fallen into what, it appears to me, is the above great mistake. Yet how near he came to this theory of force and energy! "I draw up a weight" says he, "with a string. . the weight suspended now is just as motionless as when it rested on the floor, but by introducing a *space between* the floor and it (molar separation), *I entirely change the condition* of the weight. By raising it I have conferred on it a motion-producing power so that *it can fall*, and in its descent can turn a machine. It has no energy as it hangs there dead and motionless; but energy is *possible* to it" (as, I add, to all bodies and particles in a state of separation), and we may in fact call it "possible" or "potential energy" in contradistinction to dynamical or *kinetic* energy; that is the energy of a body *in the act* of falling (kinetic energy). This potential energy is derived from *the pull of gravity*, but which pull has not yet eventuated in motion. "Thus are there the two modes of energy, the potential and the kinetic. "Potential energy," writes Mr. Allen, "is equivalent to actual or statical separation. Any mass, molecule, atom, or electrical unit, in a *state* of separation from other masses, molecules, atoms, or electrical units, possesses potential energy"—energy *in posse*. Here, say, is a bar of steel. The two powers of attraction and repulsion reside in the bar. But *the bar* is neutral, *i.e.*, the one magnetism balances and neutralizes the other, and there can consequently be no display of energy, *for there is no separation*. The bar is in the position of a stone *on* the ground. But magnetize the bar, *i.e*, separate its positive and negative magnetisms, and then it is in a position to manifest its energies, in the same way as the stone lifted into the air can. They are then both in a state of potential energy. As Professor Tyndall says, "the act of magnetization consists in the forcible *separation* of two powers which exist in the steel before it was magnetized;" separation here, as everywhere, constituting all the difference. Phosphorus burns in the air. Why this? Because the oxygen of the air rushes attractively to combine with the phosphorus. The oxygen, as an uncombined atom, *i. e.*, when in a condition of separateness, falls into the embrace of the phosphorus—itself in its uncombined separate state also, and therefore both of them, being in a potential-energy-mood of readiness to unite, do unite.

Let us suppose that a cube of iron, lifted to a great height by some energy, say by steam, or a pulley, or any other energy, falls on a similar cube of iron on the ground, what would be the result when it had squarely struck the mass of iron beneath it? Would not the result be the conversion of its molar energy into the molecular energy of the particles of the two iron cubes, and in exact equivalence? In other words—for motion never ceases—the motion of the iron mass would, when arrested, be exchanged for the fearful motion-agitation of the several molecules of the iron, or, as heat is a mode of motion, would be changed into heat; or, as Mr. Allen states it, "at the moment of contact, all the motion of the fall, or aggregative molar kinetic energy, is changed into heat or separative molecular kinetic energy. *There is just as much separateness at last as at first*, only when the iron was at its height the separation was molar; and when the iron from above crashed with the iron on the ground the separation was molecular or heat-motion. And the formula which tells us how many heat-units were generated by the fall of the cube of iron through so many feet, is the formula for the equivalence of molar separation for molecular separation. While the really aggregative power of force was causing these bodies to combine, the energy of their motion *represented for a while* their original separateness, and was finally transformed into a similar separateness between other bodies. So that the energy of kinesis is a mere transferential mode from one kind of separation to another"—a mere incident of the transferrence—the only way, in fact, in which the potential energy could reach the kinetic stage, or that the molar separation could come to be molecular separation.

But "what *is* motion?" writes Mr. Allen, and he answers thus: "Divesting our minds of all *concrete* associations, and looking at the phenomenon in itself, we arrive at the following unfamiliar conclusion: Motion is *the mode by which* energy (or separation) is *transferred* from one portion of matter to another, and ultimately from matter to the ethereal medium. . . A ball fired upward, a weight carried to a height, an atom disengaged from a compound, show us motion as equivalent to separation." Again: "every motion originates in an aggregation, whether it be through the fall of a body at a height, or the heating of coal in an engine, or the oxidation of food in an animal body," while "free bodies can only be kept from aggregating by a continuous movement." Thus the planets, shot off from the condensing and rotating nebula by centrifugal energy, would have gone on travelling forever, with the speed first communicated to them, in a straight line throughout space (subject to slight retardation owing to the tenuous ether) but were deflected from this course by the force of gravitation, which, if there were no such thing as energy, would have drawn them in a straight line into the powerfully attractive sun. But thus acted on by two powerful agents in a line at right angles each to each, they had to effect a compromise by proceeding in a course that bisected the right angle of each, and so took a mediate course—tangential and, so, orbital.

Thus it is that Force and Energy, acting antagonistically, keep the world in a state of harmonious adjustment and healthy activity.