

force itself of gravitation, *i.e.*, assuming the very thing to be accounted for?) caused the grosser ether to gravitate towards sun and moon and planets. But Fresnel maintains that the ether inside matter is, on the contrary, denser. I do not myself believe either statement, nor do I think that Newton's hypothesis satisfies anyone.

Again, writes Newton, "it is inconceivable that inanimate brute matter should without the mediation of something else which is *not material*, operate upon and affect other matter without mutual contact." Now, passing over the question of any real contact of matter with matter, and of the assumed effect of contact, I am not sure that I apprehend what was in the mind of this marvellous mathematician when writing thus. He could hardly have meant by "something not material," that some dynamis of the void, bodiless as the void, presides over matter and governs its movements, for there is no such thing as a dynamis, except as the dynamis of matter.

Again, says he, gravity must be "caused by an agent acting constantly according to certain laws, but whether the agent be material or immaterial I leave to the consideration of my readers." It might be *material*, then! Some effect of inert, brute matter, after all! But what was in his mind, when he used the words "immaterial agent," I do not know. Or had he, though his efforts had always been directed to the end of accounting for natural phenomena on the basis of their physical properties and laws—had he, baffled, slipped back into supernaturalism? Or does he mean, by "immaterial," some spiritual power of nature governing matter? But of such a power, science, as such, knows nothing. "*Nec Deus intersit.*" Indeed, no "*angeli rectores*" for science.

"Brute, inert matter, indeed! But in the whole wide universe of things this is a kind of matter that is wholly unknown. All the matter we know anything of, instead of being this, is penetrated through and through with forces and energies of all kinds, and only needs the right conditions to enable it to manifest them in all kinds of ways—in volcanoes and earthquakes, in mountain upheavals and mountain torrents, in lightning and tempests, in electricities and magnetisms, in our furnaces and fires, working and counterworking everywhere. This is what the potences of matter effect, and potence is never separable from matter. Indeed, what is there that is not matter, or a property of, or inseparable from, it? There is not anything that is not intimately blended with it, netting it and pervading it and of it. Indeed, Bosovich represents it to himself as so many points of force; and Grant Allen says, each "unit of force is rigidly bound up with each atom of matter." Force and energy are the force and energy of matter. They do not stand in dynamical isolation as things apart, but inhere in the matter of the Kosmos.

"Brute matter!" when a pinch of arsenic (more matter) would suffice to lay in ruins one of the most marvellously subtle and powerful brains the world has ever known—that of the great Newton himself—a mind that traced comets in their wayward courses, weighed suns and planets as in a balance, and bound worlds to their courses by the changeless power of law. And everything accomplished through the one theory of gravitation. But I do not represent the force of gravitation as the attraction of a particle in some star for a particle on earth, though that is true, but rather as a steady, equable, ever present, always persistent force, co-extensive with matter, embracing it in its folds, and permeating through and through all the systems of the stars, and every atom of their mass, never more and never less, but always manifesting itself according to the one normal law of mass and distance. You may have seen in the morning those beautiful and delicate spider-webs with dewdrops suspended all over—little worlds held together in liquid spheres by cohesive force, with their bounding lines and electric wires from every part. The drops are not isolated. There are the connecting threads that hold them, and the circumambient air that bathes them, and the great impalpable ocean of ether they are immersed in equally with the most distant stars. This ether ocean, in which swim all worlds, and of which we are beginning to learn so much, brings us into real contact with all the realms of space. We touch Sirius at every moment as I touch a stone with my stick, as a distant object strikes my eye through a pencil of rays, as the telegraph operator on this side is in (real) touch with the operator on the other side of the ocean. In this way all things touch everything, and influence everything. For space is not a vacuum, but an *ether-ocean*. And as the spider "feels in each thread and lives along the line," so force may be said to live along the line, too, and to act, as Laplace says, instantaneously, as water thrust aside by the hand falls immediately into its place; for an ever present force prevents the leaving a hole in it. In short, matter is one and refuses to be separated. It pulls against us with an elastic, India-rubber force.

But "brute matter!" when all matter from its centre to its circumference is so wholly dynamical, and bristles over with forces and energies. As Prof. Tyndall tells us, all matter is fraught with saturating potencies. Nitro-glycerine, a piece of matter, what fearful energies can it not display? Only supply the right conditions, and then speak of "inanimate brute matter."

I regard gravitation as due to the essential oneness and absolute inseparability of the whole matter of the universe. Let us imagine a globe of iron, of the size of an ordinary cannon-ball of the usual summer temperature. Its molecules cling together by cohesive force. Yet are they kept

apart, too, by the certain amount of temperature still present in the globe. Now as force acts here and in no other way essentially, so it acts everywhere; and as separating energy (the antagonist of force) acts here, so it, too, acts everywhere.

"The force," says Grant Allen, "which aggregates masses and resists the separation of masses, is known as gravitation." Energy, on the other hand, "separates masses, molecules, atoms and electrical units, and is that which keeps them separate," for "energy is separative power." Now "energy has two modes, the potential and the kinetic." "Any mass, molecule, atom, or electrical unit, in a state of separation, has potential energy." But potential energy is by some controverted. Still, the ablest writers maintain it as a verity. Amongst others, Sir William Thompson defines it as the ability to do work, while kinetic energy is the actual doing of it. But, to understand the whole subject thoroughly, the book itself needs careful study and will repay it.

The heat of the sun is due chiefly to the gravitating inrush of its particles (see Sir William Thompson and Prof. Langley here); or, as Nicola Tesla says, "all the force (energy) of the universe is due to the falling together of lifted weights, and the same result is produced, whether these weights have been lifted apart by chemical energy, and rest in the form of oxygen and hydrogen ready (potential energy) to combine chemically or in the form of mechanical energy."

May I be permitted a few words in conclusion? Energy resists aggregation, as may be seen when the motion of a falling body, instead of coming to absolute rest, is transmuted into the motions of its contained particles, *i.e.*, into separating heat. The pull of gravity of a great cube of iron 100 miles above the earth is less than its pull on the same cube of iron raised two inches above the earth. But let me suppose the force of gravity to be in each case equal. Yet how vast the difference of effect resulting from the fall of each! The potential energy of the cube of iron raised to the height of two inches is, when its potential energy of molar separation is transformed into molecular energy, sensibly and really almost nil; whereas the potential energy of the iron cube, fallen from the height of 100 miles, would be very great, indeed. To what, then, is this great difference due? Not to the force of gravity, surely. For the pull of gravity is really greatest where the effect is less—vastly less. And gravity was at no additional expense through the motion of the descending iron mass—lost nothing by it—the motion being necessitated, for it could not remain poised in mid-air, so that all that gravitation had to do was only what it had to do when it was at its greatest height before it began to fall. Its motion was simply incidental to its position. It was, in fact, the only way in which the potential energy of the iron mass at its greatest height could reach the kinetic molecular stage, or that molar separation could come to be molecular. Now, adds Grant Allen: "There is just as much separation at last as at first." "Accordingly," says he, "we are justified in regarding the motion as essentially a transitory form of separative power"; and again: "In short, the alternative modes of energy are actual separation, and motion which eventuates in separation."

But to any who may wish to study without prejudice the theory of force and energy, by me so inadequately presented, I say, get the work itself. But I am not at all sure that the author would approve of much of which I have taken upon myself the responsibility, and he knows nothing at all of my attempt. J. A. ALLEN.

A BACCHANALIAN.

WHAT'S ambition's hated strife?
What are all the cares of life?
What are honour, birth and pride?
Wavelets, drifting with the tide.
No deceiver of the soul
Is the bright, convivial bowl.

Quaff the measure while ye may,—
Banish care,—be ever gay,—
Though ye dwell in fancy's bowers,
Soon will fade life's fairest flowers;
God of wine and flashing eyes,
Bring us pleasure though it flies.

—A. MELBOURNE THOMPSON.

A CURIOUS effect of the wear and tear to which the earth's crust is ever being subjected is exhibited in the singularly capped pinnacles existing on South River, in the Wahsatch Mountains, says the *St. Louis Republic*. There are hundreds of these slender pillars ranging in height from forty to four hundred feet, most of them crowned by large caps of stones. They are not works of human art, as might be supposed, but are the memorial monuments of the hill from which they have been cut by the action of air and water. Those pinnacles alone remain of many square miles of solid rocks, which have been washed away to a depth of some four hundred feet. The greater hardness of the surface has caused it to resist corrosion more than the under-lying rock, thus leaving huge caps of stone perched high in the air on the points of their column. One double column, capped by a single stone, forms a natural bridge both unique and picturesque.

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TWO KNAPSACKS:

A NOVEL OF CANADIAN SUMMER LIFE.

BY J. CAWDOR BELL.

CHAPTER XIV.—(Continued).

THERE was trouble in the kitchen. Timotheus and Maguffin had each a Sunday suit of clothes, which they had donned. Sylvanus and Rufus having special claims on Tryphena, she had put their wet garments in a favourable place, and, being quite dry, handed them in to her befrilled brother, early in the morning, through a half-open doorway. The constable, attired in the garb presented to him by Sylvanus, having fastened his prisoner securely with a second stall chain, entered the house, and politely but stiffly wished the cook and housemaid "Good morning." Breakfast was ready, and then the trouble began. Ben had no clothes, and the boys enjoyed the joke. The company was again a large one, for Serlizer and Matilda Nagle were added to the feminine part of it, and the constable and the boy brought its male members up to six, exclusive of the prostrate Ben. Mr. Terry had temporarily deserted the kitchen. Mr. Toner's voice could be heard three doors off calling for Sylvanus, Timotheus, Rufus, Mr. Rigby and Mr. Maguffin. These people were all smilingly deaf, enjoying their hot breakfast. Then, in despair, he called Serlizer.

"What's the racket, Ben?"

"My close is sto-ul, Serlizer."

"They's some duds hangin' up here and in the back kitchen to dry. Praps yourn's there."

"No, Serlizer, myuns never got wayt. You don't think I was sech a blame fool as to go out in that there rain do you?"

"Didn't know but what yer might."

"Whey's them close, anyway?"

"I don't know nuthun 'bout yer clothes. Most men as ain't marrd looks after they own clothes."

"Is that you Ben?" asked the more refined voice of Tryphena, in a tone of surprise.

"Yaas, Trypheeny, that's jest who it is. Saay, ken you tayl me what's come o' my close?"

"They are here, Ben, close to the table;" whereupon all the company glanced at Mr. Rigby, and choked.

"Cayn't you take 'em off what they're on, and saynd one of the boys in with 'em, Trypheeny?"

The cook coloured up, and laughter could no longer be restrained. The constable laughed, and the contagion spread to Matilda and her boy.

"Dod rot it?" cried Mr. Toner, indignantly; "what are you fools and eejuts a screechin' and yellin' at? Gimme my close, or, s'haylp me, I'll come right out and bust some low down loafer's thinkin' mill."

"Now, be quiet, Ben," answered Tryphena, "and I will send Rufus in with your breakfast. You shall have your clothes when they are ready."

So, Rufus took in a plentiful breakfast to his friend Toner, who sat up in the big bed to enjoy it. "I'm powerful sorry for you, Ben," remarked the Baby. "You don't think Serlizer could ha' come in and taken your clothes out into the rain, do you?"

"Hev they been out in the rain, Rufus?"

"Why yes, didn't you know that much? If it hadn't been for the constable, they might ha' been out there yet. I'd say thank ye to him if I was you, Ben."

"Consterble Rigby!" shouted Toner.

"At your service, sir," replied the pensioner.

"I'm awful obligated to you, consterble, fer bringin' in my wayt close."

"Do not speak of it, sir," replied Mr. Rigby, with a large piece of toast apparently in his mouth; "I am proud to do you a service, sir."

Ben was a big man, and somewhat erratic in his ways, so the constable retired, and came back in his own garb, which he had carried out with him. "I think, Miss Hill," he said, "that Mr. Toner's clothes are now dry enough for him to wear them with safety. What do you think, Miss Newcome?"

"Guess we kin take them off now," answered Serlizer.

"Serlizer," growled Ben, "you're an old cat, a desprit spiteful chessacat, to go skylarkin' on yer own feller as never did yer no harm. Gerlong with yer!"

Rufus came in for the breakfast things, and deposited Ben's clothes on the bed. "It wasn't Serlizer, Ben, sure; if I was you I'd try the nigger. Them darkies are always up to tricks."

Mr. Toner got into his clothes, resolved to have it out with somebody, even if Rufus himself should prove to be the traitor. When, a few minutes later, Mr. Terry, smoking his morning pipe, foregathered with Ben in the stable yard, and asked him what he was after now, the answer he gave was: "Lookin' araoun' for s'ebody to whayul!" to which the veteran replied: "Bin, my lad, it's aisy talkin'."

When the men were out of the kitchen, Mrs. Carruthers and her sister-in-law came in to see the mad woman and her boy. The boy they knew already, and had always been kind to, giving him toys and other little presents, as well as occasional food and shelter. They were much taken with the mother's quiet manners, and, having heard that she had been a milliner, invited her to join them in the workroom. But, when they unitedly arrived at the door of that apartment, they speedily retired to the parlour, and there engaged in conversation. Mrs. Du Plessis