papers. It requires but little ingenuity to disguise the fact that your papers are the work of another man's brains, and I have no sympathy with the man who is idiot enough to copy so exactly that he gives the game away, and gets both himself and his obliging friend into trouble.

Any man of average intelligence ought to be able to checkmate an examiner. The examiner's hand must be more or less known to the candidate before he sits down to his desk. It has always puzzled me to understand how so many men with such tremendous chances in their favor can manage annually to get plucked.

"GOLD MEDALLIST."

ENERGY.

Read by J. M. Clark, B. A., before the U. C. Mathematical and Physical Society.

Prof. Tait, the eminent Natural Philosopher, says that in the physical world, besides the inevitable time and space, there are but four elementary ideas, viz: Matter, force, position and motion. This statement seems open to very serious objections. Though time may from one point of view be regarded as one of the conceptional elements of motion, and as such has been justly denominated the great independent variable, yet to the physicist it can not be regarded as by any means an elementary idea. This will be apparent if we remember the conventional measure of time universally employed. That measure shows that time is recognized not as a primordial idea, but as a very complex conception involving motion, position and space. Further, it seems utterly inconsistent with what is now known of the nature of force to regard it as an elementary idea. If matter be really inert the only rational use of the word force is to denote certain mechanical facts of motion. We may therefore regard space, matter, position and motion as the only elementary ideas in the physical world.

In looking on these ideas as elementary we must avoid the fallacy of regarding them as absolute and independent. This would be to run counter to the well-established principle of mental science that all knowledge is relative.

The nature of our mental constitutions is such that nothing in and by itself can possibly become an object of cognition. Hastening to obey Newton's warning of 'Beware of Metaphysics,' let us now proceed to analyze the idea of energy and to determine its place in reference to the four ideas above mentioned. Before doing this it is necessary to deal with the preliminary question. Are there two essentially different kinds of energy, kinetic and potential? If potential energy be defined to be the energy of position, its existence is utterly inconsistent with the proposition that matter is inert—a proposition the truth of which lies at the foundation of Modern Physics Newton has justly said "That one body may act upon another at a distance through a vacuum, without the mediation of anything else by and through which their action may be conveyed from one to another, is so great an absurdity that no man who has in philosophical matters a competent faculty of thinking can ever fall into it." From this it inevitably follows that no body or system of bodies can possess energy merely by virtue of its position, or, in other words, by virtue of the distances of its parts from all other bodies. In this sense, therefore, potential energy involves a contradiction in terms. But if we regard potential energy as a convenient name for those kinds of energy whose nature is not yet understood, the term is convenient and admissible, though liable to create considerable confusion.

There are not, therefore, two distinct kinds of energy—energy of motion and energy of position. The distinction can have no possible fundamental difference for its basis. But energy may be conveniently divided into two kinds, viz: Energy whose nature we in some measure understand and called kinetic, and energy of whose nature we know comparatively little, but which we regard as dependent on position, not that this dependence is an ultimate physical fact, but that it is a secondary or conventional mark, which in the absence of more definite knowledge it is convenient to adopt. Premising this as the nature of potential energy, let us now address ourselves to the problem of finding in what relation the idea of energy stands to the four elementary ideas of space, matter, position and motion.

A very little reflection on the nature of energy will make it manifest that the idea of energy involves as its conceptual elements matter and motion, or, to express the same thing mathematically, the energy of a body is a function of the quantity of matter or mass of the body and its motion, and is measured by the product of the mass and half the square of the velocity added to the quantity of energy generally called potential.

From what has preceded it will be seen that the all-pervading medium, unfortunately known as the luminiferous ether, is regarded as matter since it necessarily possesses inertia, the distinguishing test of matter. On account of the important part played in Modern Physics by this medium, which pervades not only intersteller but also intermolecular and interatomic space, it is of the greatest moment that this fact, which is so often disregarded with disastrous results, should be clearly realized. Its name, which is derived from its connection with the theory of light, does not at all suggest the varied functions which this mysterious ether is now supposed to fulfil. The recent investigations of Natural Philosophers tend very clearly to show that it acts as a medium for conveying not only light but also various kinds of energy, such as radiant heat, magnetic disturbances, &c. And further, that it plays a very important part in transforming one kind of energy into the various other forms. The well established fact that light is capable of producing various chemical changes shows that the vibrations of the ether particles, in which consists light, may be transformed into the motions of the atoms of bodies. Since all chemical changes result from accelerations of these motions. So important are the properties of the all prevading ether becoming that Tyndall predicts that the Physics of the future will be mainly occupied in their investigation.

Before proceeding to discuss the laws of energy it is well to mention the different forms in which it appears. There is first the only form of energy of which we become immediately cognizant by direct observation, namely, the energy which bodies possess by virtue of their translatory or rotational motions or the energy of mechanical motion. Next there is molecular energy, or the energy which bodies possess on account of the relative motions of their molecules.

Then comes atomic energy, resulting from the relative motions of the atoms of a body. Speaking generally, it may be said that alterations in motions of the first kind produce mechanical changes, in motions of the second kind physical changes, while variations in interatomic motions produce chemical changes.

Besides these there is the amount of energy which consists in the various undulatory movements of the luminiferous ether. Then there is what is generally called potential energy, which is in all probability really kinetic in its nature, but whose nature is as yet very inadequately understood.

It is now proposed to trace very briefly the history of the principle of the Conservation of Energy, which is perhaps the most magnificent reward of the researches of Modern Science. There can be now no doubt that the theoretical foundation for the modern doctrine was distinctly and cleverly laid by Newton in his wonderful scholium to his Third Law of Motion. In this scholium and the commentary on it, Newton not only states the law of the conservation of energy so far as the state of experimental science in his day would permit, but also clearly anticipated the so-called modern principle of vis viva and D'Alembert's principle. No further advance of any moment seems to have been made till about a hundred years later. Davy proved by experiment that the production of heat did not involve the destruction of matter, and that heat was therefore not a peculiar kind of matter, but a form of energy. About the same time Rumford effected an approximate calculation based on experiment of the mechanical equivalent of heat. These experiments conclusively established the immateriality of heat, and that since mechanical work and heat might be taken as the measure of each other, they must be species of the same genus, and that gems we now know to be Energy.

To be continued.

Our Wallet.

GOING BACK TO COLLEGE.

(*Dedicated to the W.L.C.*)

BY NEMO.

THE 'VARSITY being anxious to secure a reliable account of the departure of the young ladies going back to college this week, sent the Poet down to the station. He has handed in the following harrowing list of what he heard and saw.

"Just in time,"
"Here's that tease"
Gloved hand,
Gentle squeeze.
More girls,
Osculation,
Choclate creams,
"Graduation."