

Homœopathic Medical College.....	27
College of Dental Surgery.....	189
	2961
Deduct for students enrolled in more than one department.....	44
	2917
Students in Summer School, 1895.....	97
Total.....	3014

The number of instructors is 160. The average annual fees (including laboratory fees) are about \$50.00 per student.

MR. JOSEPH FIELD has given Mount Holyoke College \$6,000 to found a scholarship in memory of his mother. The Catholic University of Washington has received \$5,000 by the will of Mr. Bryant Lawrence.

DR. H. F. REID, late professor in the Case School of Applied Sciences, at Cleveland, O., has been made associate professor of geological physics in Johns Hopkins University.

THE accounts of the Cambridge University chest, as distinguished from the general University fund for the year 1895, shows that the total receipts were £39,681, 18s. 11d., and the total expenditures, £40,067, 6s. 8d. This sum includes £670 for the Observatory, £1,024, 7s. 7d. for the Botanic Garden, £4,550 for museums and lecture-room maintenance and £4,000 for the library.

THE French Chamber of Deputies has passed unanimously a bill giving the various French faculties the titles and privileges of universities. This would establish universities at the following places: Paris, Dijon, Lyons, Bordeaux, Montpellier, Lille, Toulouse, Nancy, Rennes, Aix, Poitiers, Caen and Grenoble. It is stated that there are now 24,000 students attending these faculties and that they receive annual subsidies from the government amounting to about \$2,800,000.

THE Electro-technical Institute of Darmstadt has received about \$100,000 from the government for the purchase of new ground and for the enlargement of the buildings.

WE learn from the *Naturwissenschaftliche Rundschau* that Dr. Julius Bauschinger, of the observatory at Munich, has been appointed as full professor of astronomy in the University

of Berlin. Dr. H. W. Bakhuys Rosebom has been made professor of chemistry at the University of Amsterdam, and Dr. A. Bistrzycki has been called to the professorship of analytical and technical chemistry in the University of Freiburg, in Switzerland.

DISCUSSION AND CORRESPONDENCE.

CERTITUDES AND ILLUSIONS.

EDITOR OF SCIENCE: Your correspondent in the last number of SCIENCE (pages 513-514), in making comments about my last article on 'Certitudes and Illusions' (pages 426-433), asks four pertinent questions, all of which were definitely answered in the article, but which are worthy of restatement in other terms. These questions are as follows:

First.—What is motion?

Motion is change of position. In the change of position two elements are involved, the speed of the change of position and the path of the change of position. We may reason about the speed or we may reason about the path, but these two elements must not be confounded, lest they lead to illusion. This is a concrete world, and there is no speed without path and no path without speed; we may reason abstractly, but the abstraction must be complete.

Second.—What is rest?

Rest is a mode of motion. I have defined the use of the terms particle and body, and the definitions need not here be repeated. In nature the ultimate particle is combined in a hierarchy of bodies, the atom is probably combined of particles, the molecule is known to be combined of particles, the molecules are combined into molar bodies, the molar bodies are combined in the earth, the earth is combined in the solar system. The particle has the motion of all of these bodies. If any body has a motion differentiated from the motion of any other body in the same rank of the hierarchy in such manner that the body as a unit has a motion distinct from the bodily motion of the next higher unit, that motion may be accelerated positively or negatively, but this can be done only by deflecting its motions in all other bodies of the hierarchy. Let us take the case of molar motion. The molar body partakes of the motion of the earth and the solar system,

and also partakes of the motion of its molecules, atoms and particles; a motion of the molar body, as a differentiated motion of that molar body, is a deflection of the motions in all the other bodies of the hierarchy, but if these other motions be not deflected, as a motion of the molar body differentiated from the other molar bodies, it is at rest. In this case, therefore, rest is the absence of motion in a molar body which differentiates it from other molar bodies in respect to motion. Rest, then, in molar motion is stellar motion and molecular motion. Rest is the motion of a body in its superior and inferior incorporation, undifferentiated from the motions of the bodies of its own rank in the hierarchy of incorporations.

Third.—If by 'motion as speed' is meant 'velocity,' and if by its 'persistence' is meant invariability of velocity, what possesses this invariability? bodies, molecules, particles, atoms? and in reference to what is the velocity constant?

So far as can be determined from research, speed is constant in the ultimate particle, but the speed of the atom, if it is a compound body, is not constant. The speed of a molecule is not constant, and in general the speed of a body is not constant. The speed of a particle is constant in reference to itself at different times.

Fourth.—As a molecule is considered as a 'body' when reference is had to the atoms which compose it, can it have an 'invariable velocity' as a molecule and variable velocity as a 'body'?

The molecule has an invariable speed (or sum of speeds) in its ultimate particles, but as a molecule, or one composed of many, this one may have a variable speed. It will be recognized that I use the term speed rather than velocity, for the term velocity as it is used in physics does not mean speed. First, velocity is positive and negative; second, velocity is speed and trajectory. I have been trying to dispel the illusion which inheres in the double use of velocity when we fail to distinguish between speed and path. The abstraction must be perfect when we reason abstractly; when we reason concretely then abstractions must be combined. Two molar bodies in motion as such may collide with each other, both may be deflected, both may come to rest, or one may be

deflected and the other come to rest. All of these cases are concretely explained as velocity in physics. Velocity is a concrete term, not an abstract term. The velocity of a body as speed and path is constant. When a particle or body moves in a straight line its speed and its velocity are the same, but when a particle or body moves in a deflected line the velocity is measured by its speed and the force by which it is deflected. The distinction between speed and deflection is well marked by some English physicists who speak of *spirt* and *shunt*. When we consider the rate of motion we consider speed, not velocity, and we may consider speed in every incorporation in which an ultimate particle is found, and its total speed is the sum of all its speeds.

Let me ask your correspondent to once more consider my definitions and demonstrations, freeing himself from the illusion that velocity is the same as speed, making a perfect abstraction of those things which we are considering abstractly and a perfect comprehension of those things which we are considering concretely.

Finally your correspondent says:

I cannot refrain from expressing a hope, however, that in addition to these answers, Major Powell will kindly furnish an explanation of what he means when he says that the transmission of light at the rate of 299,878,000 metres per second, furnishes an example of 'particle motion at a velocity so great that any observed molecular motion sinks into insignificance.'

This assures me that your correspondent was attentive to my language, and I wonder whether he detected some other misprints in my article. In the same paragraph I say: "The molecular motion of a cannon ball at its mouth is from 518 to 671 metres per second." Of course I should have said the *molar* motion of a cannon ball. If in these cases he will substitute molar for molecular he will understand what I intended. On reading the published article I discovered this and one or two other errors, which are probably due to my habit of dictation, but thought them hardly worth noticing, as I believed that every intelligent reader would discover the errors and correct them himself.

J. W. POWELL.