Unusually Large Hail.

SOME very large hailstones fell here about 3.30 p.m. on Sunday, June 2, during a short but sharp thunder-storm. Most of them were ellipsoidal in outline: some were mammillated, and some were evidently compound, formed of several hailstones partially fused together. Ten picked up at random as being fairly large ones measured from $\frac{7}{8}$ to $1\frac{3}{4}$ inches ($\frac{7}{8}$, $\frac{7}{8}$, 1, $1\frac{1}{8}$, $1\frac{1}{8}$, $1\frac{1}{8}$, $1\frac{1}{2}$, $1\frac{5}{8}$, $1\frac{3}{4}$, $1\frac{3}{4}$ inches) in greatest diameter. Many of them were formed of four, five, or six concentric layers, which were alternately clear and snow white. Some of these hailstones lying on the grass took more than an hour and a half to melt away (temp. 65° F.)

Mr. I. C. Thompson has just drawn my attention to the residue which they leave when melted on a clean glass slide. This, when examined under a high power of the microscope, is found to contain, along with inorganic particles, a number of minute plant spores. W. A. HERDMAN.

University College, Liverpool, June 2.

The Muybridge Photographs.

ALLOW me to state, in order to save correspondence due to the omission of a publisher's name in connection with the Muybridge photographs (NATURE, May 23, p. 78), that they may be seen and ordered of Mr. Muybridge, at 38 Craven Street, Strand, London. E. RAY LANKESTER.

University College, London.

THE VICES OF OUR SCIENTIFIC EDUCATION.[1]

THE subject which I desire to bring to the notice of the Association to-day must necessarily remind you of the attack which was recently made on our competitive examination system in the *Nineteenth Century*.

In some respects the writers of the article, or articles, in the *Nineteenth Century*, appear to me to have right on their side when they object to the existing state of our competitive system.

They begin by complaining against the dangerous mental pressure, and the resulting physical mischief, which accompany the working of nearly all parts of our present educational system. This complaint seems to me to be just.

The fact is, in my opinion, that nearly all our examinations are much too difficult—too much beyond the mental and physical abilities of the examined.

Let me take, as a supreme instance, the examination for the Mathematical Tripos at Cambridge. Ever since I have known anything of this examination, I have wondered how it can be possible that young men, three years after leaving school, can successfully grapple with problems, a great number of which are of transcendent difficulty, in such an immense range of mathematical and physical subjects as this Tripos contains. Indeed, when we are admitted behind the scenes by reading the solutions of these problems by those who have set them, our wonder is increased; for we find frequently that the discussion of a single problem occupies four, five, or six (and sometimes more) pages of small print. Such problems have a very great value for the student who has plenty of time to consider them in the solitude of his study; but I should think that the attempt to attain the amount of knowledge and adroitness necessary to deal with them on the spur of the moment in the Senate House must often produce mental and physical injury. Are we really to believe that a young man of twenty-one or twenty-three has made himself master of nearly everything given to the scientific world by Newton, Laplace, Gauss, Jacobi, Helmholtz, Cayley, Thomson, and Clerk Maxwell?

The desire to place before a student a standard which (I suppose I am right in assuming) he can never reach is, of course, quite defensible; and it is one which appears in every educational competition. But it is not in all cases carried out with a regard for rightness of method. For, this desire to be always in advance of the student leads some examining bodies to hurry him through a large number of subjects in a short time. It is, I think, a marked characteristic of our very modern method that we require half a dozen branches of mathematics and physics to be got through in a time which, say, twenty years ago, would have been devoted to the study of two or three. Is there, for example, nearly so much time now devoted to the study of pure Geometry as there was then? Is Trigonometry so thoroughly and leisurely studied now in the schools?

With the rage which now exists for rushing students through elementary mathematics in order that they may in the shortest possible time reach physics, both experimental and mathematical, the necessary foundations of scientific knowledge are seldom properly laid. Boys who ought to be learning skill in Algebraical manipulation, in assimilating Trigonometrical formulæ, and in applying them to various problems of Mensuration, are, I find, endeavouring to limp through Statics, Hydrostatics, and Kinetics. When to these comparatively advanced subjects we add some Chemistry, the phenomena (at least) of Heat, Optics, Sound, Electricity, and Magnetism—to say nothing of languages—the result is inevitable that the less showy subjects of elementary pure Mathematics must be insufficiently studied—must, in fact, be merely skimmed.

There is no subject in which the result of this overhaste is so easily recognized as Trigonometry; for, at the outset, the student's work in this branch must largely consist in committing to memory a number of formulæ, and nothing but long-continued practice in application will fix them in the mind. Hence, as the necessary time must be given to several other subjects, I find very many students exceedingly slow in repeating, and even in recognizing, some of the most elementary and frequently useful formulæ in Trigonometry. Hence also a large portion of the knowledge brought out in competitive examinations consists of what is called "Cram," and it is, therefore, customary to heap odium on the "Crammers." I do not think, however, that the fault rests with the Crammers, who do merely what they are invited to do by educational authorities.

I shall take as an instance of the excessive haste with which students are pushed on through various branches of Science the Matriculation Examination of London University; and what I say with reference thereto is the result of a present experience which I have in assisting a young relative in his reading for this examination. In last year's Regulations for Matriculation you will find that the course of Mathematics consists of Arithmetic, Algebra as far as easy quadratic equations with questions involving their use, Geometry to the extent of the first four books of Euclid, with simple deductions; and in Mechanics the requisites are "elementary notions as to Velocity, Acceleration, Force, Mass, Momentum, Work, and Energy, Composition and Resolution of Velocities, Accelerations, and Forces in one plane. Moments and Couples in one plane. Centre of Gravity, or Mass-centre. Transmission of Pressure in Liquids; variation with depth of the pressure due to weight of liquids. Specific Gravity and modes of determining it. Pressure of gases, and laws relating thereto. Atmospheric pressure. Common instruments and apparatus whose action depends upon the pressure of liquids, or of the atmosphere, or both." In addition to this, the candidate must take up either Chemistry, or Heat and Light, or Electricity and Magnetism.

Now you will observe particularly two things about this prescribed course. Firstly, the candidate is not supposed to have any knowledge of the fifth and sixth books of Euclid, and therefore no knowledge of the propositions relating to the ratios of linear or other magnitudes; and, secondly, that all knowledge of Trigonometry is excluded.

[1] A Paper read before the Association for the Improvement of Geometrical Teaching, January 19, 1889, by Prof. Minchin, President.