accurate determination of caseine might be effected by some rapid-fermentation process by which caseine could be broken up into other organic products that could be separated by albumen. He held to this point as to caseine, because it cannot conveniently be added in the manufacture of oleomargarine; while the acids upon which the saturation co-efficient depends could readily be added as sodium compounds.

On account of the difficulty of getting accurate results in determining nitrogen, it was thought best to use the wet-combustion method with permanganate, because a small quantity of material might be used, and there would be fewer chances for loss that otherwise occurs in nitrogen determinations that are effected by the combustion of butters.

Dr. Wheeler called the attention of the section to the use of what is known as 'cotton-seed-oil stock,' in the manufacture of oleomargarine. This, doubtless, contains considerable nitrogen, and, of course, would reduce the value of the caseine-test for adulteration. A sample was shown, supposed to contain cotton-seed-oil.

The sense of the discussion was, that it was very desirable that Professor Wiley should continue his experiments, as they are of great value; but there is yet a great deal of work to be done in the investigation.

List of other papers.

The following additional papers were read in this section:— The formation and constitution of chlordibromacrylic acid, by *C. F. Mabery* and *Rachel Lloyd.* Orthiodtoluolsulfonic acid, by *C. F. Mabery* and *G. M. Palmer.* Estimation of carbon and nitrogen in organic compounds, by *C. Leo Mees.* New forms of burettes, by *W. H. Seaman.*

PROCEEDINGS OF SECTION D. — MECHANICAL SCIENCE.

PAPERS READ BEFORE SECTION D.

A comparison of terra-cotta lumber with other materials.

BY T. R. BAKER OF MILLERSVILLE, PENN.

THE material called 'terra-cotta lumber' is made out of clay and sawdust. The investigation which formed the subject of this paper was to ascertain certain qualities of this artificial product. The paper also described the apparatus used for the tests. The results indicated that the material was 875 times as permeable to air as pine, and 135 times as brick. Air was forced by pressure of a column of water. Other tests showed that the material was four times as hard as pine, but not so hard as brick. Its grip on nails driven into it was about half that of pine. The author was careful to disclaim any intention of advertising the merits of the material, but he evidently regarded it as serviceable for the purposes for which it is intended. Specimens were exhibited.

Improvements in shaping-machines.

BY J. BURKITT WEBB OF ITHACA, N.Y.

IN the ordinary shaping-machine there are two defects, one of which is found also in the planer. The ram of a shaping-machine is a bar sliding in bearings, and carrying at one end the cutting-tool. If we represent by a the variable horizontal distance from the tool to the first bearing (or nearest end of the long bearing), and by b the variable horizontal distance from the tool to the second or farthest bearing (back end of long bearing), and by c the length of stroke, we shall have, —

Maximum value of a = (minimum value of a) + c.
Maximum value of b = (minimum value of b) + c.

In other words, the length of the ram is variable, and the spring of the ram from the work is variable, the tool springing away from its work more at the end of its stroke. This springing takes place mostly in the joint between the ram and its bearings, and cannot be wholly avoided without a change of construction. To remedy the defect, the author proposes a reversed construction of the sliding parts; the two bearings (preferable to a long bearing) to be formed on the ram, so as to make the distances a and b constant, and the long slide being part of the bed of the machine.

The second defect, which is also common to the planer, is in having a 'drop-block' which fits but indifferently between the jaws and against the bottom of its seat. From the necessity of the usual construction, the tool attached to this block will have more or less spring. The remedy is to dispense with the drop-block, and introduce an automatic motion to lift the tool on the return stroke, as has been done, the author has understood, on some large machines.

Regularity of flow in double-cylinder rotary pumps.

BY J. BURKITT WEBB OF ITHACA, N.Y.

THE speaker introduced his subject by exhibiting a number of models of these pumps from the cabinets of Cornell university, which has recently purchased copies (243 in number) of the celebrated models of the Reuleaux collection in Berlin. Class I. of this collection is devoted to these pumps. The speaker then produced and demonstrated a formula for the flow of these pumps, and showed that the regularity of flow depended upon other principles opposite to those which have been given for determining this point. The formula given for the flow was:—

$$\pi[R'^2 + R''^2 - (r'^2 + r''^2)] = \text{Flow for}$$

one revolution, when R' and R'' (generally equal to each other) are the extreme radii of the two revolving wheels; and r' and r'' are the radii (often, perhaps generally, variable) from the point of contact between the wheels to their centres. It was shown that the regularity of flow depends upon $r'^2 + r''^2 =$ constant. R' and R'' may be called the 'piston radii,' and r' and r'' the 'valve radii.' These pumps are

called by Reuleaux 'Kapsel räderwerke,' or 'chamber-crank trains,' according to Kennedy.

List of other papers.

The following additional papers were read in this section, some of them by title only: — A method of testing long plane surfaces, applicable to the alignment of planer-beds, lathe-beds, heavy shafting, etc., by *W. A. Rogers*. The commercial and dynamic efficiencies of the steam-engine; Centrifugal action in turbines, by *R. H. Thurston*. Velocity of the piston of a crank engine, by *C. M. Woodward*.

PROCEEDINGS OF SECTION E. — GEOLOGY AND GEOGRAPHY.

ADDRESS OF C. H. HITCHCOCK OF HANOVER, N.H., VICE-PRESIDENT OF SECTION E, AUG. 15, 1883.

THE EARLY HISTORY OF THE NORTH-AMERICAN CONTINENT.

THERE is a special appropriateness in the association of geography with geology, as indicated in the assignment of sciences to section E; for the latter gives us an account of the origin of every topographical feature of the earth's surface, whether island, continent, mountain, plateau, valley, or oceanic depression. If we would properly understand the significance of the earth's contours, we must unravel the mysteries of geology: so a knowledge of topography is essential to the complete comprehension of the geological features of any country. If a geologist were taken by a balloon to an unexplored part of the earth, he would instantly recognize, from their topographical outlines, volcanic and granitic cones, limestone hills, elevated plateaus of basalt or horizontal sandstones, and special types of orographic structure. Hence the modern geologist first draws the contours of his district before applying the colors of geological age. The existing relief features of the earth have been produced one by one in successive periods; and it is the task of the geologist to discover what were the characteristic physical developments of the several ages. He can delineate a connected historical sketch of the beginning, growth, and completion of a continent. Such histories are rare, because attention has but recently been turned into this direction. One of the first American geologists to frame such an outline is Prof. J. D. Dana, to whom we owe the enunciation of this fundamental truth, — that the first formed land has always remained above water, and has been a nucleus about which zones of sediment have accumulated. We can now recognize this primitive continent, with all its successive stages of growth, upon every geological map.

Time would fail us to present the entire physical history of our continent; and we will therefore confine our attention chiefly to its earlier chapters, noting those points which are under discussion. As we are endeavoring to *advance* science, we must touch upon debatable topics, and hope by friendly discussions to become wiser.

We must assume the correctness of the commonly received opinions concerning the earliest history of our planet, — that it passed through the condition of a nebula, and then of a burning sun, the period of igneous fluidity. By subsequent refrigeration it has become either partially or wholly solid. Not until a crust had formed, and the earth had cooled enough to allow water to remain permanently, was it possible to talk of dry land and ocean. With these premises allowed, it seems to us evident that the material of the earth must be disposed in concentric zones, arranged according to density, the heaviest being at the centre. If the various elements were free to move, as is the case in all natural or artificial igneous fluids, we must expect to find the heavier metals situated beneath the others; and, following the analogy of extra-terrestrial bodies, the central nucleus may be principally iron, like the heavier meteors. Zones corresponding to stony meteors, lavas, the trap family, and granites would naturally succeed in order, the last named being at the surface. This outer zone is also characterized by the presence of much silica and oxygen. The primeval ocean came from the vapors surrounding the igneous sphere, condensed to liquidity as soon as water could remain upon the solid crust without immediate vaporization.

This original crust may have been essentially a plain, and consequently entirely covered by water; for if the land were now levelled off, the ocean would submerge every acre of the continents. As refrigeration progressed, ridges and valleys would form in accordance with that fundamental principle that the outer envelope must conform to the shrunken nucleus; and this contraction gives rise to that tangential force or lateral pressure which has acted through all time. Whether these earliest ridges rose above the ocean would depend upon the amount of elevation. Some authors argue that these ridges follow the course of great circles. If there are causes adequate to produce such results, — or any other world-wide arrangement, — they must have commenced to operate at the very beginning of contraction. Most authors maintain that the very thick strata of the older rocks have been formed just like modern sediments, having been broken off the ledges, and transported into oceanic basins in horizontal attitude. If so, there must have been great mountainous elevations, deep oceanic depressions, and extensive aqueous action; since the thickness of the crystalline schists is greater than that of the strata in the fossiliferous ages. The amount of distortion, crumpling, and faulting of the crystalline rocks is also greater. These same authors hold that the original strata were in all respects like modern sands, gravels, and clays, and that their present crystalline structure is due to metamorphism. No one has yet discovered any uncrystalline pre-Cambrian beds; nor