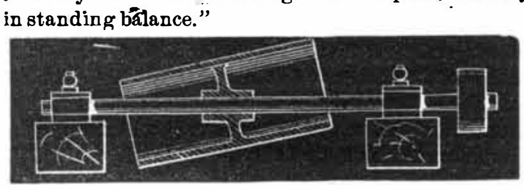
a dangerous element in regard to fires, and is even "a highly ignitable substance."

THE BALANCE WHEEL QUESTION.

We have received a large mass of correspondence on the subject of the inclined balance wheel question, which we set right in our issue of the 25th ult., and, as there promised, we glean out for our readers some of the more interesting letters. We are much pleased with the accuracy and clearness exhibited by many of our correspondents, some of whom are evidently accustomed to reason logically and to express themselves with precision, notwithstanding their unfamiliarity with the labor of writing for the press.

G. B. D. says that, in the case of the balance wheel set at an angle on the shaft: "It is just as much out of balance as two unbalanced pulleys would be when secured to the shaft at a short distance from each other, with their heavy sides one opposite the other. . . . A cheap method of trying an experiment of this kind is to construct a top, as shown in the figure, making it of metal. . . . If this top can be made to run steadily like an ordinary top, then W. must pay the forfeit," otherwise R. loses.

A Canadian friend and subscriber, J. P., after paying the SCIENTIFIC AMERICAN a pleasant compliment which we appreciate fully, shows, by a similar argument, that the wheel would be unsteady, and presents several sketches. We select one, a pulley, shown in the next figure. He says: "An experienced mechanic needs but a glance to see that a cylinder keyed on in that way will not run at a high rate of speed, but may yet be in standing balance."



W. G. B. goes at once to the root of the matter. He asks a question which reveals the misconception, which gave rise originally to error in the solution of this really very simple problem. He asks if Haswell is right in saying that "The centrifugal force of two bodies which perform their revolutions in the same time, the quantities of matter in which are inversely as their distance from the center, are equal to one another."

Haswell *is* right, and another correspondent, H. B., shows why, in the following concise statement: "The centrifugal force is not only proportional to the *vis viva*, but, at the same time, is inversely as the distance from the center."

"The transformed equation is $F = \frac{W.R.}{321\cdot6}\left(\frac{2\times3\cdot1416}{60}\right)^2N^2$, in which R is the radius of the circle described by the revolving body, N the number of revolutions per minute. It shows clearly the centrifugal force to be in proportion to the momentum and as the square of the number of revolutions. As two bodies on the same shaft have the same number of revolutions, a running balance is established when the bodies are in standing balance and revolve in the same plane, as then the centrifugal forces are equal in opposite directions and in the same line, therefore balancing one another.

"A running balance is not obtained in case of a standing balance, if both weights are on different points of the shaft, because then the centrifugal forces, although equal and in opposite directions, cannot balance each other, since they are not in the same line.

"The forces tend to bend the shaft and therefore exert pressures on the bearings which have constant relation to the revolving shaft, but not to the bearings, and, in consequence, shake the bearings or the whole foundation."

TRACTION ENGINES OR ROAD LOCOMOTIVES.

Under the above heading, Professor R. H. Thurston, of the Stevens Institute of Technology, publishes in the *Journal of the Franklin Institute* a very able and comprehensive article, and incorporates therewith the following *resumé* of facts and deductions drawn from experiments recently conducted by him with the Aveling and Porter road locomotives.

1. A traction engine may be so constructed as to be capable of being easily and rapidly manœuvred on the common road an in the midst of ordinary obstructions.

2. Such an engine may be placed in the hands of the average mechanic, or even of an intelligent youth of 16, with confidence that he will quickly acquire, under instruction, the requisite knowledge and skill in its preservation and management.

3. An engine, weighing rather more than five tuns, may be turned continuously in a circle of 18 feet radius without difficulty and without slipping either driving wheel, even on rough ground, and may be turned in a roadway of a width but slightly greater than the length of the locomotive, by proper manœuvring.

4. A road locomotive weighing 5 tuns 4 cwt. has been constructed, which is capable of drawing, on a good road, more than 23,000 pounds up the almost unexampled grade of 533 feet to the mile, at the rate of four miles per hour.

5. Such a locomotive may be made, under similar conditions, to draw a load of more than 63,000 pounds up a hill rising 225 feet to the mile, at the rate of two miles per hour, doing the work of more than twenty horses.

6. The action of the traction engine upon the road is beneficial, even when exerting its maximum power, while with horses the injury to the road bed is very noticeable.

7. The coefficient of traction is, with such heavily laden wagons as were used in the course of the experiments and under the circumstances noted, not far from four per cent on a well made macadamized road.

8. The amount of fuel, of good quality, used may be reckoned at less than 500 pounds per day, where the engine is a considerable portion of the time heavily loaded and during the remaining time running light.

Professor Thurston's deductions may be briefly summarized as follows: The traction power of the engine is equal to that of twenty horses. This amounts to, excluding the weight of the locomotive, seventy-five tuns, while the machine possesses a decided advantage over the animal. The working time of the traction engine may be stated to be ordinarily twenty per cent greater than that of a dray horse, and to be capable of indefinite extension when required. The first cost of steam and of horse power is nearly equal, the difference being in favor of steam, leaving also on the side of the engine the immense advantage arising from its ability to work longer hours when required. The total annual expense of an engine of the above power and capabilities may be reckoned at $2,439 as a maximum figure, including cost of attendance. And, lastly, a steam traction engine, capable of doing the work of 25 horses, may be purchased and worked at as little expense as a team of six or eight horses.

THE SIGNAL SERVICE BUREAU.

The report of the Chief Signal Officer of the Army for the year 1872 contains an immense amount of valuable and practical information regarding meteorological science. Full details are added relative to the progress of the labors of the Government in the establishment of signal stations, the education of observers, and the publication of reports showing that this important service has materially advanced in usefulness and efficiency during the past year. Ten additional stations have been established within the United States, and the total number of points at which observations are now made is seventy-two. From the first station in the Aleutian islands to those upon the British coasts, the reports from both of which are noticed, there intervenes nearly half a circumference of the earth's surface. From the stations on the Aleutian islands comes the first intimation of storms or meteoric disturbances having their origin on the coast of Asia. The Pacific stations report the first appearance on that coast of the disturbances thus traced. The connection is continued by the Rocky Mountain stations, and thus the news travels in advance of the storm.

The organization of a mobilized corps of observers has been commenced. This will be composed of picked men, and its object is to place at the disposal of the government the power of suddenly increasing the number of stations from which reports are to be had in any section of the country which may, at any season of the year, be especially threatened by the storms which seem, at different seasons, to pass more frequently over particular portions of the territories of the United States. It will be possible to occupy, in this way, the stations as stations of report with very great rapidity.

In regard to the accuracy of warnings and predictions, General Myer states that the percentage of cautionary signals verified, by the occurrence of the winds described within a few hours after the display of the signal, is estimated to have been about 70 per cent. The signal, it is explained, is wholly cautionary, for warning of probable danger.

The experiment of a balloon ascent has been tried with fair results. One hundred and fifty-six readings were made, establishing the fact that very delicate instruments may thus be employed.

Arrangements for an interchange of reports have been made with Canada, and a similar course is contemplated with the West India islands. It is believed that many of the cyclonic storms, the indications of which are first felt by the stations of the United States, as then showing the disturbances upon the Gulf of Mexico or near the Atlantic coast, and which storms are afterward to be traced across the States intervening to the lakes or along the Atlantic sea coast, pass over points on these islands from which their presence can be announced. Since January 1, 1872, statements of the changes in the depths of water in the principal western rivers, being in direct relation to the meteoric changes, have been reported daily. It is hoped that a portion of the great problem of the protection of the river commerce from ice and freshets, and of the lower river levees from breakage and overflow, will be solved through the timely warnings that will be given.

The practical results of this branch of the service, with all its errors and imperfections, can be summed, it is believed, in the statement that, since the inauguration of its duties, no great and continuous storm has traversed the territory of the United States, or raged along the length of its lakes, its gulf or sea coast shores, without fair and general premonition, given at the great majority of the points endangered.

ARTIFICIAL FERTILIZATION.

The fructification of soils has its natural pabulum in the sewage of cities, towns and habitations. The devising of means for the utilization of this resource is therefore of paramount importance; but while the problem remains comparatively unsolved, the food required by growing crops must be supplied through the media of artificial fertilizers. These Nature distributes through the globe in the shape of mineral phosphates, consisting of the various kinds of rock guano coprolites, the fossils of marl beds and the minerals of apatite and phosphorite. Before these substances are supplied to the soil, they must not only be finely powdered but converted into forms which are promptly sensitive to the solvent action of aqueous solutions of carbonic and organic acids, very dilute acetic acid, ammoniacal and potassic salts and of the corresponding influences of the soil and plants as exerted during the progress of vegetation. In order to supply the want for methods simple and economical for changing, not merely the physical constitution of the mineral phosphates, but also their chemical temperament, in such a manner as to convert them into fertilizers at once concentrated and potential, Dr. Campbell Morfit has given to the world a work replete with information of the greatest practical value, entitled "Mineral Phosphates and Pure Fertilizers;" it is issued by Van Nostrand of this city, with an elaboration of paper and press work rarely found in volumes of similar description. Its high price, twenty dollars per copy, is its sole defect; but, written by so eminent an authority and appearing at a time when the subject of which it treats is occupying so large a proportion of popular attention, even that drawback will, we are convinced, not prevent the book attaining the wide circulation that it merits.

Dr. Morfit begins with the description of the raw materials, namely: Animal and mineral phosphates of lime, sulphuric acid, hydrochloric acid, crude ammonia liquor, sulphate of ammonia, chloride of ammonia, sulphate of potassa, chloride of potassium, carbonate of potassa, lime and nitrate of soda. In the United States the principal deposit of phosphate is in the neighborhood of the Ashley River, in South Carolina. The material is in the form of hard nodules called marlstones, and the beds are from 40 to 50 miles in extent. In Beaufort county, in the same State, a different variety of phosphate is found distributed over some 1,600 acres. This bed is calculated to yield 10,000,000 tuns.

A chapter is given to the chemical data of the substances employed, and the subject of machinery and the general plan of an establishment for their preparation is minutely explained. To leave nothing unfinished, the letter press is accompanied by twenty-eight plans, large in size and accurately drawn to scale, so that the manufacturer is furnished, not only with full instructions, but with complete drawings from which his machinery may be constructed. The process for refining the crude phosphates of lime, without waste of material and with the reclaiming of other chemical agents found with them, is fully treated upon. The topics of the manufacture of precipitated lime, Columbian lime, and diphosphate of lime, of pure and commercial superphosphate, of Horsford's, Liebig's and other phosphatic baking powders, of pure biphosphate and of the utilization of phosphate alumina precipitate from sewage as a raw material are also discussed at length. The concluding chapters are devoted to the mode of using hydrometers and thermometers, and to the manufacture of various waterproof cements and paints.

RECENT DISCOVERIES IN THE PYRAMIDS.

The Pyramids of Egypt were constructed 4,000 years ago. Mr. Dixon, of England, has for some time been exploring the two remarkable chambers known as the king's and queen's chambers, in the interior of the Great Pyramid. By means of a wire introduced between the joints of the masonry, he found a space, and was thereupon induced to bore into the walls of the queen's chamber, when he discovered a passage way, eight by nine inches in dimensions, evidently a ventilating flue. Its terminus has not yet been found. Within the passage way he found a bronze hook, which is supposed to be the most ancient specimen of bronze now existing. He also found a piece of worked cedar wood and a granite ball, which latter is believed to have been an Egyptian weight. Its diameter is 2¾ inches. As the walls behind which these articles were found were solid on the inner side of the chamber, it is believed that they were placed in the positions where they were found at the time the pyramid was erected.

SILVERING GLASS.

For a long time aldehyde has been employed in the glass silvering process suggested by Liebig; but some difficulties of manipulation have led practical men to prefer other reducing agents. R. Siemens has modified the operation and greatly simplified the reduction of the silver. Dry ammonia gas is passed through aldehyde to produce aldehyde ammonia; 2·5 grammes of aldehyde ammonia and 4 grammes nitrate of silver to 1 liter of water is the proper proportion to take. The nitrate of silver and aldehyde ammonia are separately dissolved in distilled water, mixed and filtered. The object to be silvered must be thoroughly worked to free it of fat, and if it be a globe or bottle, the liquid is poured in as high as it is desired to form the deposit. As soon as the heat, which must be applied, shows 50° C., the separation of the silver begins and soon spreads itself over the whole surface. At first, when the coating is very thin, it looks dark, but soon assumes a metallic luster; when it is a brilliant white, it is time to remove the fluid contents, as the mirror is apt to be injured by too long contact with the aldehyde. Flat objects are laid upon the mixture in the usual manner. In Germany, where aldehyde ammonia can be purchased at a reasonable cost, this process is highly prized. By making his own salt, in the manner described above, the chemist in this country can also avail himself of the method. The simplicity of Siemens' process certainly commends it to favor.

VOLATILITY OF IRON.—It seems that iron is volatile at very high temperatures, the same as gold and platinum. Dr. Elsner, Director of the Berlin porcelain factory, enclosed a small piece of wrought iron in an unglazed crucible and exposed it for several hours to a temperature of at least 3000° C. On removing the cover of the crucible, small needles of metallic iron were easily discerned, clearly showing that iron can be volatilized at high temperatures.