mathematics. That a student succeeds well in Euclid does not argue that he will be a mathematician or even a lover of mathematics. Every teacher of experience knows how often his hopes, built on success in Euclid, have been dashed to the ground when the pupil began analysis. Euclid gives no hint of the mathematics which is to follow, and hence does not seem to fit in as an integral part of the science. Many of the proofs are long and tedious, with no hint whatever as to the method by which they were originated. The traditional limitations surrounding Euclid narrow the field of work by excluding almost all other mathematics, and thus must necessarily reach results that are special. The student who wishes to go on in mathematics finds himself almost totally unprepared for the next step.

Modern synthetic geometry meets all these criticisms. It is thoroughly mathematical, and the student who succeeds in it is assured of success in any branch of the science that he may undertake. Its steps are all logical, but logic is not emphasized as the end to be attained. It is constantly whetting the student's desire for mathematical study by giving him hints of that which is to follow. It also prepares thoroughly for trigonometry and analytical geometry. It is surrounded by no traditions, and so is free to use everything that serves its purpose. Its proofs are simple and direct, its results broad and general. Its symbolism and nomenclature are in harmony with mathematical science, and are at least two thousand years in advance of Euclid. It has a great fascination for the student, and classes are invariably enthusiastic over it. This year, as an experiment, one division of the freshman class in Indiana University studies the modern synthetic geometry, while the other divisions take Euclid. The modern synthetic class is by far the most enthusiastic, and gives strong evidence of the more rapid mental development.

The student who reads modern mathematical works must know the modern synthetic geometry. Modern writers appreciate its power, and use it freely. It is to be hoped that our American schools will give more attention to it. From a mathematical standpoint it is certainly desirable that it may soon entirely replace Euclid. The admirable elementary text-books of Dupuis of Toronto, Smith of Missouri, and Halsted of Texas, which have recently appeared, prove that the subject is growing in interest, and also make its general introduction more easy.

WEIGHTS AND MEASURES IN ENGLAND VERSUS THE DECIMAL AND METRIC SYSTEMS.

BY J. JAMES COUSINS, ALLERTON PARK, CHAPEL ALLERTON, NEAR LEEDS, ENGLAND.

IT is impossible for a comparatively new country like America to conceive the mode by which the English conduct their internal commerce, and the difficulties which exist in trading not only with foreigners but between the different portions of the United Kingdom, owing to the versatility of the weights and measures used in conducting her business, the different values of the varied denominations within the United Kingdom, and the many quantities represented by the same denominations when applied to articles of daily commerce.

If the ingenuity of man had been strained to the utmost to introduce a system of weights and measures calculated to throw difficulties in the way of commercial progress, to perfect a system that no one man has thoroughly mastered, and to place irritating obstacles in the path of education of both pupil and teacher, that end has been thoroughly attained, and, strange to say, it is the system pursued in the educational establishments throughout the kingdom at the close of this nineteenth century, although most of the colonies have set the Mother Country a better example.

Can anything be more absurd than the following? We sell "pickled cod" by "the barrel," "trawled cod" so much "each," whilst "large hooked cod" are sold by "the score," and "crimped cod" "per pound," shrimps by "the stone," soles by "the pair," Dutch smelts by "the basket," and English smelts by "the hundred."

This is the Billingsgate system, but at Grimsby (another important fish market) quite a different style of weights and measures is made use of, and the sale of fish is very much by "the box" and "the last."

A customer once asked a Grimsby fish salesman to let him have a stone of oysters, the reply was "We don't sell oysters by weight, we sell them by measure." "Then let me have a yard," said the buyer. Butter in Ireland is sold by "the cask" and "the firkin;" in England by "the pound" of 16 ounces, by "the roll" of 24 ounces, "the stone," and the "hundred-weight," which is not 100 pounds but 112 pounds.

Analyzing the quantities of the various denominations only makes confusion doubly confounded.

What is a "load?" A load of straw is 1296 pounds, a load of *old* hay is 2016 pounds, and a load of *new* hay 2160 pounds; but my tables do not tell me at what age hay becomes old.

What is a "firkin?" A firkin of butter is 56 pounds, a firkin of soap 64 pounds, and a firkin of raisins 112 pounds. A "hogshead" of beer is 54 gallons, but a "hogshead" of wine is 63 gallons, a pipe of Marsala wine is 93 gallons, of Madeira 92 gallons, of Bucellas 117 gallons, a pipe of port 103 gallons, and a pipe of Teneriffe 100 gallons. Again, what is a stone? A "stone" weight of a living man is 14 pounds, but a "stone" weight of a dead ox is 8 pounds, a stone of cheese is 16 pounds, of glass 5 pounds, of hemp 32 pounds, a stone of flax at Belfast is $16\frac{2}{3}$ pounds, but at Downpatrick 24 pounds, while a hundred-weight of pork is 8 pounds heavier at Belfast than it is at Cork—another injustice to Ireland.

England is slow to adopt new principles, but as more than 400 millions of people are using the metric system, surely it is time she took a step in that direction, a hint that probably may not be thrown away upon the grand American Republic.

In cataloguing the above absurdities of English measurement, I must not omit to inform you what quantities a barrel represents. A "barrel" of beef is 200 pounds; butter, 224 pounds; flour, 196 pounds; gunpowder, 100 pounds; soft soap, 256 pounds; beer, 36 gallons; tar, $26\frac{1}{4}$ gallons; whilst a barrel of herrings is 500 herrings.

One example of the comparative merits of the existing system with the decimal system will suffice.

Reduce 987,654,321 inches into leagues. To arrive at this we must divide these figures by 12 to get them into feet, then divide the product by 3 to make yards of them, next by $5\frac{1}{2}$ to find the number of poles, another division of the product by 40 exhibits the furlongs, then if the brain will stand it, for we have decimals in the quotient, we must divide by 8, which gives us the miles, and lastly by 3 to furnish the leagues, *quid erat demonstrandum;* and, if we have made no mistake, we have arrived at a satisfactory result.

To attain the same end by the decimal system, allowing the same number of denominations but each a decimal, no calculation is necessary, no sums to work out, but as there are six denominations, place the pointer on the left-hand side of the 6, the figures on the left of the pointer, viz., 987, show the number of leagues, whilst the figures on the right of the pointer furnish the fractions of a league, viz., 6 miles, 5 furlongs, 4 poles, 3 yards, 2 feet, and 1 inch.

Yet, can it be believed? the old system is taught in every school in England, and the cruelty inflicted upon the brains and the temper of the young, to say nothing of the loss of time and the cost, cannot fail to lodge a grave responsibility upon the legislature which permits such a condition of things to exist.

NOV. 4.

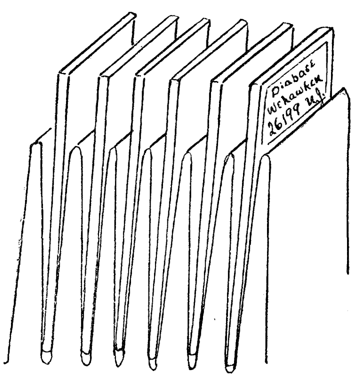
A CHEAP FORM OF BOX FOR MICROSCOPE SLIDES.

BY GEORGE P. MERRILL.

PRESUMABLY no one ever started out with making a collection of slides for the microscope but has wrestled long with the problem as to how they may best be taken care of. In the administrative work of this department the problem early became a serious one. For its satisfactory solution I am indebted to my brother, L. H. Merrill, then assisting me.

As it happened, we had in stock a number of paste-board boxes some 93 millimeters wide, 143 millimeters long, and 48 millimeters deep, all inside measurements. The dimensions of our standard slide are 48 × 28 millimeters. By means of two wooden partitions, some 3 millimeters thick, running lengthwise, each box was divided into three equal compartments, the partitions being held in place by glue reinforced by two small tacks at each end. Heavy Manilla wrapping paper, such as we also had in stock, was then cut into strips 25 millimeters wide and as long as the sheet of paper would allow, in this case about 7 feet. These strips were then bent into a series of folds, as shown in the accompanying illustration, the apices being rounded, not pinched flat. If carefully done, the folds when crowded gently together act as a spring. Two of these folded strips were then placed lengthwise in each compartment, and the slides introduced, standing on end, between the folds at the top. A box as thus prepared readily holds three rows of 50 slides in a row, or 150 altogether.

Each slide is separated from its neighbor in the same row by a double thickness of Manilla paper, which, owing to its manner of folding, acts as a spring, and avoids all possible danger of breakage. When all the compartments are filled, the space between the tops of the slides in any row is but about 2 millimeters; but there is, nevertheless, no difficulty in removing a slide or in getting at it to read the label without removal, since, owing to the yielding nature of the paper, the tops may be readily drawn apart. In this respect the box offers a great advantage over



those with rigid wooden compartments, such as are commonly in use. The first box was made merely as an experiment. It proved so satisfactory that, for the time being at least, it is the form adopted for storing the several thousand slides forming the museum collections.

I have attempted to show the arrangement as above described in the accompanying drawing. In reality the slides are held much more firmly than indicated, since the paper bulges and comes against both the front and back of the slides, the full length of the fold, instead of merely at the bottom. It will very likely strike the reader that a better material than paper might be found. I can only state that after considerable experimenting the paper was, all things considered, found most satisfactory.

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SPONTANEOUS COMBUSTION IN MINES.[1]

BY PROFESSOR ARNOLD LUPTON, YORKSHIRE COLLEGE, LEEDS, ENGLAND.

THE lecturer remarked that most of the difficulties of a mine could be overcome in certain well-known ways: water could be raised by pumping-engines; gas carried away by ventilation, and the danger obviated by safety lamps; but spontaneous combustion, in some cases, could not be prevented, and, when once begun, could not always be stopped, except by filling the pit with water.

Spontaneous ignition of coal was well known to ship-owners and insurance companies, large cargoes of coal being especially liable to take fire upon long journeys. In the same way, a great heap of coal on the surface was liable to take fire, especially if it was small coal or slack. For that reason it was necessary in storing slack not to have the heaps too wide or deep. A heap ten feet deep might not fire, while a heap twenty feet deep of the same coal would be very liable to fire. A small heap of slack laid against the outside of a boiler-flue or steam-pipe would probably take fire in a short time. Heaps of slack and broken coal left in the mine were very liable to take fire, and much smaller quantities would fire in the mine than on the surface, because it was warmer underground, and the superincumbent strata upon the slack and broken coal prevent the heat from escaping. Spontaneous ignition was very frequent in the thick coal-miles of South Staffordshire, Warwickshire, and Leicestershire, and it was necessary that these pits should be watched every hour of the day and night lest a fire, having broken out, should obtain the mastery before it was discovered. If a fire was detected whilst yet smouldering, the heated material is dug out if possible and the place filled with sand. Sometimes the fire was extinguished by pumping water onto it. In some mines water was laid on at a high pressure for the purpose of throwing jets of water onto any fire that may occur. It was usual, however, in mines liable to spontaneous combustion, to separate the district containing the waste heaps of slack or broken coal from the rest of the mine by means of walls or dams of brick and clay and sand, so that the smouldering fire, producing carbonic acid gas, extinguishes itself by its own smoke. Sometimes an apparently solid mass of coal took fire. In this case the apparently solid coal has been cracked and crushed, and air has been able to enter into the cracks to support combustion. In mines liable to this species of accident, the manager has a very anxious time, and his deputies must unceasingly patrol the pit. Sometimes it was impossible to isolate a fire, owing to air drawing through cracks in the pillars of coal surrounding the fire, and the men were beaten back by the flames, and had to abandon the mine. The shafts were then partially filled and covered so as to exclude the air, and in the course of three or four months it generally happened that the fire was extinguished.

The cause of these fires was perhaps not entirely explained. It used to be supposed that the decomposition of the sulphuret of iron, called iron pyrites, produced heat sufficient. This idea was, however, now abandoned by the leading chemists who had studied the question. Sir Frederick Abel and Dr. Percy, in a report to the Royal Commission in 1875 on the "Spontaneous Combustion of Coal in Ships," suggested the decomposition of the coal as the probable cause. Professor Vivian B. Lewes, in 1892, contributed a paper to the Society of Arts, in which he stated, as the result of the work of Richters and himself, that newly-cut coal would absorb oxygen to the extent, in some cases, of three times its own volume. This oxygen produced a kind of slow combustion, and, where the heat could not escape, the temperature of the mine was raised to that of 800° to 900° F., and at this temperature, if there was any air near to the coal, it would take fire.

There were only two ways, apparently, of preventing this spontaneous combustion. One was to cool the heap by ventilation. But the ventilation to be efficient must be equal to that of a coal-heap on the surface, and it was known that a heap of small coal twenty feet thick and thirty or forty feet wide was very liable to take fire; therefore, if the heap of coal in a mine was to be cooled by ventilation, the ventilating roads would have to be not much more than fifteen feet apart, and a cool current of air through each. This, as a general rule, was impracticable; and therefore, as a general rule, the prevention of spontaneous ignition by ventilation was impracticable. The other method was to exclude the air from the mass of coal that was liable to fire by means of walls of soft clay or by walls of brick and mortar and sand, or solid pillars of coal. The portion of the mine so walled off might get very hot, raising the temperature of the mine ten or twenty degrees above the normal temperature of the earth; but it could not take fire if the air was excluded.

[1] Summary of a lecture on the 10th of October last, at the Philosophical Hall, Leeds.