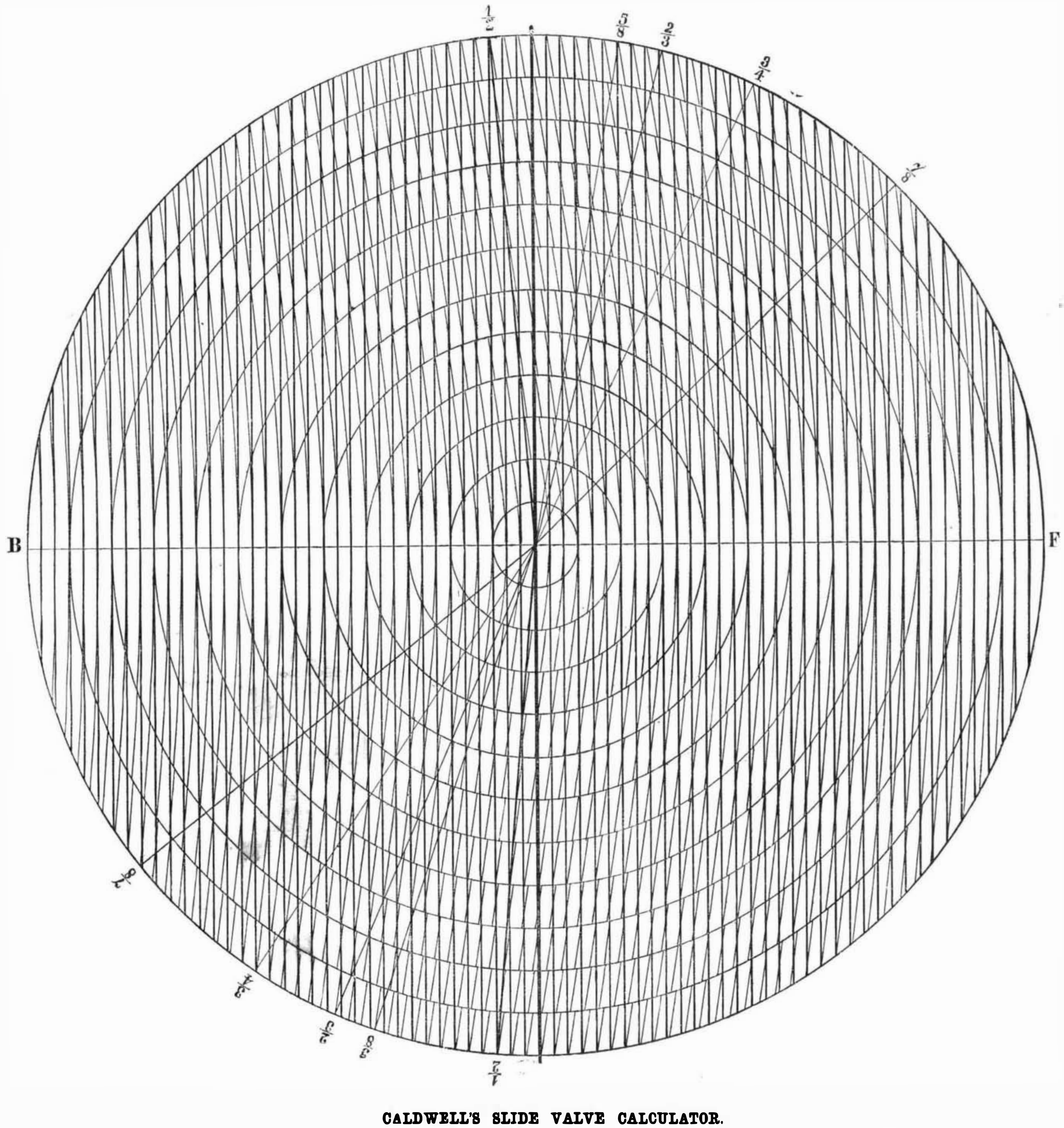
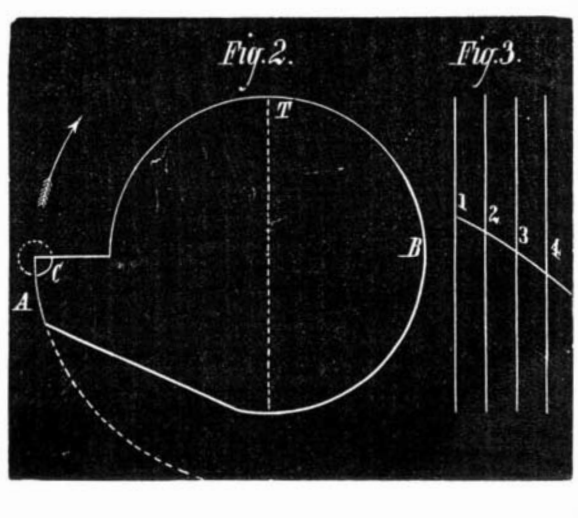
IMPROVED SLIDE VALVE CALCULATOR.

There was privately circulated, at the last exhibition held by the Franklin Institute in Philadelphia, a copy and description of a device by which all slide valve calculations are delineated on a diagram. The application of the graphic method to these intricate calculations is very ingenious, and shows the usefulness of this mode of exemplification in a remarkable manner. The diagram, designed by Mr. John A. Caldwell, Pittsburgh, Pa., is termed the slide valve calculator, and it shows the manner in which a given slide valve, of any dimensions and travel, will perform its functions, and it will also give the dimensions of a slide valve necessary to produce any required result. We publish the diagram herewith.



CALDWELL'S SLIDE VALVE CALCULATOR.

The method of its application is as follows: Cut out a paper template, as shown in Fig. 2. The circle, A, represents the stroke of the engine, one eighth of the full size, and the circle, B, the travel of the valve, of the full size; so that, for an engine having a piston stroke of 24 inches and a valve travel of 2 inches, the circle, A, would require to be 3 inches, and the circle, B, 2 inches in diameter. The quarter circle, C, represents one quarter of the crank pin. After placing the calculator before you in such a position that the letters B and F will read from left to right, pass a pin through the center of the template, shown in Fig. 2, and also through the center of the calculator. Their centers being thus coincident, turn the template until the center of the crank pin stands toward B on the line B F. On the template, and coincident with the perpendicular thick line on the calculator, make the mark shown in Fig. 2 at the point, T, and turn the template in the direction of the arrow until the mark reaches the next vertical line on the calculator, toward F; then theoretically, the valve has opened the steam port $\frac{1}{8}$ of an inch. When, still moving the template in the same direction, the mark on the template has got round to the line, B F, the steam port is fully open, and the crank pin has made one half of a stroke or one quarter of a revolution. The position of the piston in the cylinder may be ascertained by counting the number of sections of the stroke circle contained in the



parallel lines, as shown in Fig. 3, and between the crank pin and the line, B F, on either side. Each of the segments 1, 2, and 3, of the stroke circle represents 1 inch of piston movement.

Moving the template further round, the mark returns; and when the next vertical line is reached, the steam port is closed to the amount of $\frac{1}{8}$ of an inch, the port gradually closing as the template is moved forward until, on the mark becoming coincident with the thick vertical line, the steam port is closed.

It will have been perceived that, so far, the thick vertical line has represented the receiving edge of the steam port, and that the point, T, on the template has represented the receiving edge of the valve; and as the valve had no lap, the crank pin is then to be considered on the dead center line, B F.

We must now assume the thick line to represent the exhaust or inside edge of the steam port, and the mark, T, to represent the exhausting or inside edge of the valve. Proceeding to turn the template round again, when the first vertical line, on the B side of the thick line, is reached, the exhaust port is open $\frac{1}{8}$ of an inch (providing the valve has no inside lap, for, if it had $\frac{1}{8}$ of an inch of inside or exhaust lap, the mark, T, would have just reached the thick line or the edge of the port); and when the mark reaches the line, B F, the exhaust will be open as much as this amount of valve travel will allow. Turning the template again, the approach of the mark, T, toward the thick line represents the closing of the exhaust, until the two become coincident; then the exhaust is closed and the engine has made one revolution, the crank pin being again on the dead center, and the mark, T, at the thick line, from which positions they respectively started.

© 1875 SCIENTIFIC AMERICAN, INC.

A valve constructed thus would read:

Travel of valve	2	inches
Cut off	0	"
Exhaust from end of stroke	0	"
Expansion	0	"
Cushion	0	"
Lap	0	"
Steam port opens	1	"
Exhaust port opens	1	"
Lead	0	"

In other words, our example has been upon a valve without either excess of travel, steam lap, or exhaust lap or lead.

We will now give an example of the use of the calculator for valves having lap:

Diameter of cylinder is 12 inches, stroke 24 inches, ports 12 × $1\frac{1}{8}$, which is equal to one tenth of the piston area. Steam supply to the cylinder is to be cut off at $\frac{2}{3}$ of the stroke, and the exhaust is to commence when the piston has traveled to within 3 inches of the end of the stroke. Travel of valve is $2\frac{1}{4}$ inches, the cushion being a result to be determined. Commencing, then, when the valve is on the dead center line, B F, and (as before) on the B end of it, the valve has to be moved ahead to allow for the lap and give steam when the crank pin is in that position. This is done by making the mark, T, on the template in advance, to the amount of the lap from the thick line toward the F end of the line, B F. If we had not known the requisite amount of lap required to cut off at $\frac{2}{3}$ of the stroke, we would have to try, say, $\frac{5}{8}$ of an inch, and alter it more or less as we found it to cut off too early or too late; but in our experimental case, $\frac{5}{8}$ *plus* $\frac{1}{32}$ of an inch is the requisite lap, and we accordingly make our mark on the template that much in advance toward the F end of the line, B F, of the thick line. If the template be now turned, it will be found that the steam port is opened $\frac{7}{16}$ of an inch; and when the mark has arrived at the identical spot it started from (but on the under side of the line, B F), it will be found that the crank pin stands at the $\frac{2}{3}$ line, and the piston has proceeded $\frac{2}{3}$ of its stroke. The exact distance in inches can be found by counting the curved lines, from F back to the crank pin, along the stroke circle, each space representing 1 inch. It will be found that there are 8 of them, and 8 inches is the distance the piston is from the end of the stroke.

The proper way to find the inside lap is to move the mark around $\frac{1}{8}$ of an inch at a time, and at each movement stop and examine the position of the crank pin to see if it is nearing the desired exhausting point. In this case, $\frac{1}{8}$ of an inch would bring the mark to within $\frac{1}{32}$ of an inch of the fourth line from the thick one, and the crank pin is some distance yet from the third inch from the end of the stroke (the exhausting point). This shows that $\frac{1}{8}$ of an inch inside lap is not sufficient. We then try the addition of another $\frac{1}{8}$ of an inch inside lap, and find that the mark is within $\frac{1}{32}$ of an inch of the third line, and still the crank pin is not at the desired spot. We therefore try the addition of another $\frac{1}{8}$ of an inch, and examine, and then another, in all $\frac{1}{2}$ of an inch, and find that the crank pin wants a little yet; but by moving the mark another $\frac{1}{32}$ of an inch, we find, by counting as before, that the crank pin has arrived at 3 inches from the end of the stroke. Now it is evident that further movement of the mark will result in opening the exhaust. When it has arrived at the line, B F, the exhaust will be fully open; and when it arrives at the same line again (but on the upper side of the line, B F), the exhaust will be closed. We proceed to move it accordingly, but we may as well observe how much said port is open when the piston is at the end of the stroke. By proceeding as before, counting one $\frac{1}{8}$ of an inch after another, we find 6 of them are passed before the piston is at the end of the stroke, showing that the exhaust is $\frac{3}{4}$ of an inch open by the time the crank pin is on the dead center line. We may now see if the exhaust port is going to be fully opened or not. The mark was $\frac{1}{8}$ of an inch from the thick line when the exhaust port began to open, and it will not be fully open until the mark has arrived at the line, B F. Now the space intervening measures $1\frac{1}{4}$ inches, whereas the port is only $1\frac{1}{8}$ inches wide, consequently the valve travels not only over the port, leaving it fully open, but $\frac{1}{8}$ of an inch beyond it, showing the exhaust to be sufficiently free.

Now by moving the mark round to the line corresponding to the opening of the exhaust, namely, $\frac{1}{8}$ of an inch from the thick line, we find that the crank pin stands at $1\frac{3}{4}$ inches from the end of the stroke, as the curved lines show $1\frac{3}{4}$ inches; this, then, is the amount of the cushion. If more cushion is desired, we go over the same ground, after having added a little more inside lap; but this amount, with slight lead, would run well at a piston speed of 300 or 400 feet per minute. Lead would have the effect of opening the exhaust sooner, and of reducing the amount of cushion; but what was lost in this way would be compensated for, so far as the cushioning was concerned, by the admission of live steam, permitted by the lead before the piston had arrived at the end of the stroke, and when the crank pin was consequently on the dead center. The result given by our last experiment would read as follows:

BACK AND FRONT.

	B	F
Travel of valve	2 1-4 inches	2 1-4 inches
Steam lap	21-32 "	21-32 "
Cut off	8 "	10 "
Exhaust lap	17-32 "	17-32 "
Exhausts at	3 "	4 "
Expansion	5 "	6 "
Cushions	1 3-4 "	1 1-2 "
Steam port opens	7-16 inch	7-16 inch
Exhaust opened at end of stroke	3-4 "	3-4 "
Exhaust port opens	Full *plus* 1-8 "	Full *plus* 1-8 "

The B column denotes the back end of the cylinder, and the F the front end; the latter is found in the same way, only the calculator is turned so that the letters B and F will read upside down.

If it is desired to ascertain what effect lead, obtained by moving the eccentric ahead, will have on the engine, we proceed as before; but when the mark, T, has moved forward to the amount of lead required, we move the template no further until we have made a new mark on the template coincident with the line, B F, which new mark will represent the new relation of the crank pin to the old mark; then throughout the operation we employ this new crank pin in place of the old one. By moving the template back to its old position, that is, till the old crank pin is on the line, B F, the new crank pin will denote just how far the piston is from the end of the stroke when the lead commences to act.

By the aid of our illustrations and the given examples in the method of using it, the calculator cannot fail to be understood and appreciated by those who may require to either ascertain what results are being given by the valve of an existing engine, or the proper proportions of a valve for an engine about to be built.

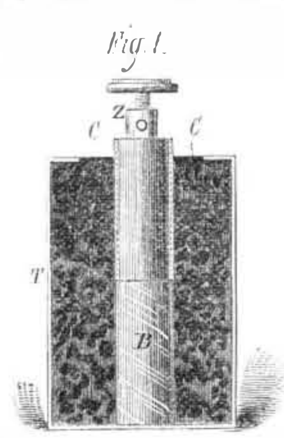
JOSHUA ROSE.

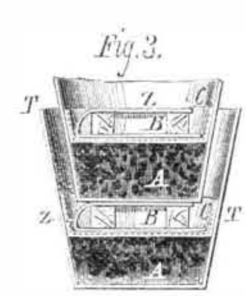
Correspondence.

A Charcoal Battery.

To the Editor of the Scientific American:

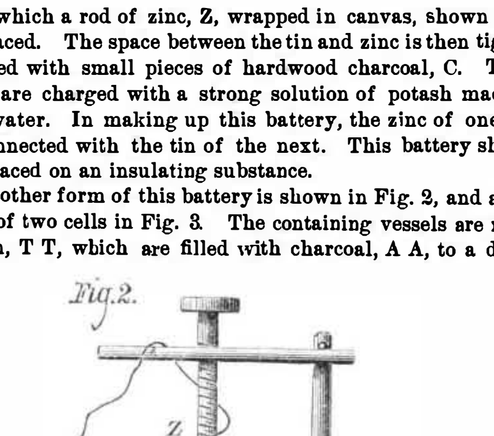
I enclose a sketch of a cheap and durable form of battery of considerable power; and for many purposes of experiment this battery may be used to advantage. The current is steady, and there are no unpleasant fumes given off, as in many acid batteries. In Fig. 1, the containing vessel, T, is made of tin,





into which a rod of zinc, Z, wrapped in canvas, shown at B, is placed. The space between the tin and zinc is then tightly packed with small pieces of hardwood charcoal, C. These cells are charged with a strong solution of potash made in hot water. In making up this battery, the zinc of one cell is connected with the tin of the next. This battery should be placed on an insulating substance.

Another form of this battery is shown in Fig. 2, and a section of two cells in Fig. 3. The containing vessels are made of tin, T T, which are filled with charcoal, A A, to a depth



of one or two inches. A piece of canvas, C C, is spread over the charcoal, and on this a plate of zinc, Z Z, is placed. The blocks of wood, B B, are placed on the zinc; a strip of the latter is bent over the blocks so as to connect the zinc of one cell with the tin of the next. In charging these cells, shown in Figs. 2 and 3, the fluid of one cell must not come in contact with the tin of the next; if it be so, the electromotive force would only be that of one cell. The fluid is kept concentrated by placing on the zinc plate of each cell a quantity of potash.

JOHN J. BLAIR.

Ardtrea, Ontario, C. W.

The Spider's Web.

To the Editor of the Scientific American:

In your issue of July 3, the question is asked: "How does a spider make its web, the lines of which, crossing at the center, are carried, some of them to the surrounding objects, while others are fastened to an outer circular line, made evidently before the outer circular lines of the woof are formed?" Also: "Where does the spider place itself when it ejects the lines which form the spokes of the wheel?"

The extreme outer line surrounding the web, to which the spokes are fastened, is by no means always circular: this depends upon the position of the surrounding objects to which the web is fastened. The spider first extends lines from one point to another by the shortest route possible, inclosing a sufficient space to build its web: then he extends a line across where he intends to have the center of his web. He next fixes the center by fastening a line thereto on the central line, and, carrying the line at right angles or nearly so to the first line, hitches it to the nearest object, whether that be the outer line of the web, or anything to which the web is fastened. It will be observed here that the spider ejects all the spokes of the wheel (except the first line across the center of the web) from the intended center, placing the first lines at right angles or nearly so, and dividing the distance each time a line is extended from the center until a sufficient number are put up, always stretching the lines alternately in opposite directions until the spokes of the wheel are complete. He then places his left forefoot on the center of the wheel, and hitches the first end of the circular line of the woof to one of the spokes of the wheel, and moves round the center, fastening his thread to every spoke as he goes along, measuring the distance from one line to the other by stretching his right hind foot to secure the web to the spoke, with his left fore foot one line toward the center and moving spirally along from one spoke to the other, until he gets his web sufficiently large for his purpose.

Batavia, Ill.

A. M. SPENCER.

The Potato Disease.

To the Editor of the Scientific American:

Having given the potato disease—blight or rot—considerable attention, and made microscopic examinations of the fungus known as the *peronospora infestans* (Berkeley called it *botrytis infestans*), I find that lime is the best cure and preventive. My attention was arrested by the article on page 277, volume XXXII., headed "A Remedy for Potato Blight," referring to the communication of Mr. Lyman Reed, and the process of the action of microscopic parasites attacking the tubers.

It strikes me that Mr. Francis Gerry Fairfield has things a little mixed up. He carefully cleaned the specimens procured by him, and subjected them to heat for 96 hours or more, before he examined them. He finds the ova of the insects on the interior layer of the cuticle of the tubers, and says: "I have no doubt that they commence that *histolytic process* that ends in the destruction of the tuber; but I doubt whether there is any genetic connection between the fungi developed on the stalks in the course of the *degeneration*, and the larvæ in which the *degeneration primarily starts*." The truth of the matter is that these microscopic animalculæ are a secondary product arising in the diseased matter of the tuber. Certain fungi have a nitrogenous substance analogous to diastase, which transforms the starch to dextrin, and finally into sugar, like a ferment, especially under moisture and an elevated temperament, inducing decomposition, forming a *nidus* for the animalculæ. Had he used his microscope to trace the parasitic fungus, he would have discovered the fine threads of the mycelium extending to the tubers, which induces a ferment or gangrenous putrid mass that, like any other animal and vegetable matter, will breed animalculæ in less time than 96 hours. This is easily proved and well known to anyone who has given the subject attention. Consequently, his sage advice "to dip the potato, just before planting, in the solution" (carbolic acid), is, to my mind, all nonsense. When the animalculæ or fungi infest the tuber, it is neither fit for use or planting. However, I may err, and it might be well to see the "copious notes," and "always give Mr. Reed the full honor of the first discovery."

J. STAUFFER.

Lancaster, Pa.

Utilizing the Grasshoppers.

To the Editor of the Scientific American:

The grasshoppers, desiccated and ground, would of course be useful as a fertilizer; but when in this prepared condition, they would form an excellent food for all insect-feeding birds. There is no better food for all young domestic fowls. Containing silicic acid in a soluble state, they seem specially adapted for young birds, promoting the growth of feathers. The young prairie chicken flies when only eight days old. The sharp-tailed grouse and the cock of the plains subsist entirely on grasshoppers up to their maturity; and after that, they prefer grasshoppers to other food. I have found in the depth of winter, at the foot of the Rocky Mountains, the gizzard and stomach of the sharp-tailed grouse filled with grasshoppers, when they had to find the dead bodies of them under six inches of snow.

There exists, in fact, no beast or bird of prey on the western plains which would not partake freely of them, whenever they are to be procured. I found, in the season when grasshoppers were plentiful, the stomach of the prairie wolf, the stomach of the little kit fox (*canis cinereo-argenteus*), and the gizzards of all *falconidæ* and owls filled with grasshoppers. Even by man they have been and are used as food. The inhabitants of the interior of Africa use them extensively, and the Pau-Eutaws or Digger Indians of our own country find them very palatable. I do not, however, suggest them for the latter purpose.

E. WERNIGK

A Theory of Dissolution.

To the Editor of the Scientific American:

The reason given that a solid will be dissolved by a liquid is that the adhesion between the atoms of the solid and liquid is greater than the cohesion of the atoms of the solid.

The reason the adhesion is greater than the cohesion is that the weight or specific gravity of the atom of the solid is less than the specific gravity of the atom of the liquid: and

© 1875 SCIENTIFIC AMERICAN, INC.