some object struck by lightning from a passing cloud, by applying the familiar laws which govern the speed of light and sound; and while thus engaged, I found that, by the application of the same laws, I could also determine, with nearly the same accuracy, the hight of the cloud whence the lightning proceeded.

When a flash is seen, it starts from different parts of a cloud, frequently from directly overhead; and after collecting its complement of volume and force (the work of an instant), it leaps to the earth from a quarter of the cloud often quite distant and unlooked for. Upon seeing a flash, starting, say, overhead, I begin counting seconds. After an interval, perhaps of 7 or 8 seconds, rumbling thunder is heard, first overhead, then in various portions of the cloud, differing in loudness according as the different initial forks of lightning differ in distance; then all following the wake of each electric chain, until, in 15 seconds, it concentrates in the final crash. Distance to the object struck, about 3½ miles; hight of the cloud, about one mile and a half. When an object is struck close by, these sounds proceed in reversed order. The prolonged rumbling sounds, heard before and after a stroke of lightning, are not all reverberations, but are in great part true detonations of the electric fluid while it is gathering up from the different and very unequally distant quarters of the cloud, before its discharge to the ground.

By my method of computation I find storm and thunder clouds to range from two miles high down to the very ground. I submit my plan with the hope that it will be fairly tested. J. M. S.

Lynchburg, S. C.

The Keely Gas.

To the Editor of the Scientific American:

I notice, in an article headed "Gems from the Keely Motor," in your issue of July 24, the following statement: "It is a vapor of so fine a quality that it will penetrate metal, and is lighter than hydrogen." I contend that such a substance would be contrary to the laws of Nature.

It is well known that the molecules of all substances increase and decrease in size in proportion to the specific gravity of the substance, the lighter substance containing the larger molecules. This may be demonstrated by pouring as much water into a glass as it will hold, then taking a liquid of a heavier specific gravity than water, and adding a portion to the water in the glass We find that the quantity added before the glass overflows will be in proportion to the difference between the specific gravities of the two liquids. If you then repeat the experiment, but add a liquid lighter than water, you will find that the volume will be increased and the glass will overflow, the quantity overflowing being exactly the same in volume as that which you added. This is explained in the following way: On filling the glass with water, a portion only was filled, there being vacancies between each and every atom of water; on adding a heavier liquid, the atoms of said liquid, being smaller than the atoms of water, pass between them, filling up the vacancies; and until a sufficient quantity has been added to fill those spaces, it does not increase the volume of water; but on adding the lighter liquid, the atoms of which are larger than those of the water, they do not pass between them, but immediately increase the volume and overflow the glass.

If this be correct, and I have good reason to think it is, it at once proves the impossibility of such a substance as this so-called cold vapor is described to be; for it is plain that it would be impossible for the larger atoms or molecules of the cold vapor to pass between the smaller molecules of metal. Were the specific gravity of the cold vapor heavier than metal, instead of being lighter than the lightest known substance, it would be more practicable.

Monticello, Pa. E. G. ACHESON.

The Remarkable Electric Phenomenon.

To the Editor of the Scientific American:

Regarding the statements relating to the singular electric phenomena described on page 100 of your current volume, as being in some respects opposed to hitherto observed facts, I decided to investigate the case thoroughly, and ascertain in the first place what the facts were, and then see whether they were in accord with previous observations. For this purpose, I sent one of my assistants to the house where the electrical displays occurred, furnished with the proper instruments for making careful and accurate measurements of the resistances of the rods, pipes, and other conductors about the premises.

The first measurement taken was to ascertain the resistance between the two pipes leading to and from the heater. This was found to be less than 0·01 of an ohm, and most of that was probably due to the connections of the galvanometer. Of course this proved conclusively that no sparks ever passed between these pipes, and Mr. Baldwin, the occupant of the house, said that the published statement was wrong in this regard.

The resistances of the supply pipe, overflow pipe, waste pipe, and lightning rod were then measured, with the following results: Resistance of the lightning rod = 161 ohms; of waste pipe = 284 ohms; of overflow pipe = 15 ohms; of supply pipe = 0. The house stands on a hill on the dividing line of a slate and limestone formation, and the lightning rod has been placed in the fissure of the rock to the depth of perhaps 6 or 7 feet, and is therefore partially insulated; and its normal resistance is doubtless much more than 161 ohms, which was found while everything was wet, a rainstorm having come up just before the tests were made. A resistance of 161 ohms in the lightning rod, however, is sufficient, in my opinion, to occasion all the phenomena of discharge which have been observed during heavy storms. The supply pipe is iron, and leads directly to a spring half a mile distant, where the best earth connection in the country is found. Owing to the insulating quality of the foundation upon which the house rests, the house constitutes one side of a leaky condenser, of which the slate and limestone form the dielectric, and the earth the opposite side. When a thunderstorm occurs, the whole house is charged in a greater or less degree; and as the earth connection of the lightning rod is insufficient to carry all the electricity which it receives, the electricity is discharged through every available channel, of which the supply pipe is the best. In light storms, the phenomenon would not be noticed; it becomes very marked in heavy ones.

In this case the supply pipe was the safety valve of the house. The proprietor of the house was advised to connect the lightning rod to the supply pipe by a large copper wire, which will probably terminate the curious phenomena which have been observed.

I trust the time will soon come when lightning rods will be erected by persons possessed of sufficient electrical education as to be able to tell whether they have a resistance of 161 ohms or of 0. Probably no important business at the present time, is as a rule, entrusted to a class of men so utterly ignorant of their duties as this one. In every case where a building supplied with a lightning rod is destroyed by lightning, the parties who put up the lightning rod ought to be prosecuted. A vigorous course of treatment of this sort would soon convince these people that a reasonable amount of study of the laws of electricity is necessary for their own safety as well as that of their patrons.

I wish that every electrical phenomenon which occurs could be promptly and carefully investigated by competent, practical electricians. Why cannot the scientific departments of our colleges undertake this service? It would furnish a fund of accurate information which would prove of very great practical value.

New York city. GEORGE B. PRESCOTT.

Purification of Hen Houses.

Advice like the following, which we find in the *Live Stock Journal*, is always in order:

As the hot season advances, poultry keepers should not neglect the purification of the fowl houses. Proper sanitary measures must be taken, or health and successful poultry raising cannot be expected, nor is it deserved. Lime is an excellent purifier, and, when carbolic acid is added to the whitewash, will effectually keep away vermin from the walls. After every cleaning of the floor it should be sprinkled with carbolic acid; dilution, twenty of water to one of acid. This is one of the best disinfectants and antiseptics known, and is not used as much as it deserves. The roosts should be sprinkled with it every week. This whitewashing should be done twice at least, better three times, a year. The nests of sitting hens should be sprinkled with carbolic acid to keep off vermin; and the coops also, where young broods are kept for a time, should be purified in this way. If a hen gets lousy, the dilute acid will destroy the lice, if put under the wings, and on the head and neck. Wood ashes are excellent to be kept in fowl houses for hens to dust themselves with. They are much more effectual than sand; but sand should also be kept for a bath. Without proper attention to these matters, poultry keepers cannot expect to succeed.

BORING BITS.

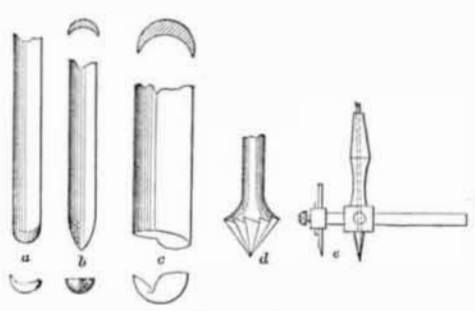
In continuation of our article on augers, published on page 133 of our current volume, we give the following illustrations and description of the various kinds of boring bits in use. The engravings are selected from the pages of Knight's "Mechanical Dictionary."*

In Fig. 1 and succeeding illustrations, various forms of bits are given. The gouge bit *a* (Fig. 1), before the invention of the pod, spoon, and twisted bits, resembled the half of a reed split longitudinally, and had a sharp end like a gouge.

The change to the spoon bit, *b*, was merely giving a conoidal end to the tool, which enabled it to enter more accurately at a given spot. This is the dowel bit used by coopers.

The nose bit or shell auger, *c*, has a long barrel, and the large sizes are used by the pump makers, and called pump bits.

Fig. 1.



Boring-Bit.

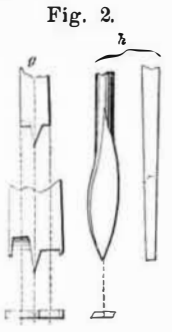
The chamfering bit, *d*, for opening holes so as to admit the conical heads of the ordinary wood screw, consists of a conical reamer with teeth.

The expanding center bit, *e*, consists of a shank and center point, and a chisel-shaped cutter, whose distance from the center is regulated by slipping the bar, like that of a beam compass, in the socket of the head, a set screw maintaining it at its adjustment. This serves for cutting out disks, or for cutting circles for inlaying.

* J. B. Ford & Co., publishers, New York city.

For cutting hard wood, such as the finger and key holes of flutes, bits are employed with a square point and two diametrical cutting lips, *g* (Fig. 2); the smaller one approaches very closely the character of a drill.

Fig. 2.



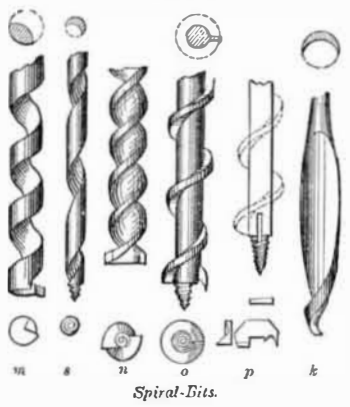
Boring-Bits.

The French bit, *h*, for hard wood, is a drill, and as such is used in a lathe head. The center point and two sides merge into an easy curve, which is sharpened all the way round and a little beyond the largest part.

The German pod bit, *k* (Fig. 3), has a long elliptical pod and a screw point. It makes a taper to the end of the hole unless it is driven clear through.

The spiral ribbon, *m*, is a bar having a half round section. This is twisted so as to throw the flat side to the exterior to form the outside of the cylinder; the inside is not filled up by the metal, but makes a hollow spiral, and the bottom end has a single cutting lip.

Fig. 3.



Spiral-Bits.

The twisted flat bar, *n*, assumes the form of a doubled threaded screw, no vertical vacancy existing in the twist.

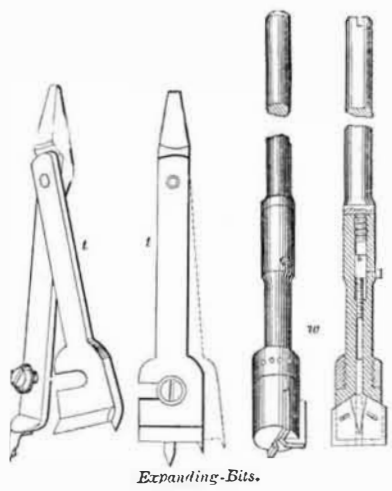
The spiral rib bit, *o*, is known, especially in England, as the American bit and has a cylindrical shaft, around which is twisted and brazed a single fin or rib.

Behind the worm, as in example *p*, may be a small diametric mortise for the reception of a detached cutter which has the nicking point and cutting lip of the ordinary center bit. The cutter is kept in its central position by a square notch which embraces the central shaft of the bit, against which it is forced by a wedge.

The grooved bit, *s*, has a cylindrical stem and spiral groove.

One form of expanding bit, *t*, Fig. 4, has a central portion which has the point, and a hinged portion which carries the scribe and the router. The movable portion is set by a screw, so as to regulate the radius of the hole.

Fig. 4.



Expanding-Bits.

Another form, *w*, has three radial cutters, which are expanded by means of a taper wedge and an axial screw. The latter is operated by a screwdriver, whose end is introduced into the socket, the threaded end of which is the means of securing it to the brace.

A Roman Tunnel in Algiers.

Several civil engineers, engaged with the surveys for a water conduit from Touja to Bougie, have made a very interesting and important discovery. A mountain which was situated in the proposed line of the conduit was to be tunneled for a length of 500 yards; and in searching for the most suitable place the engineers discovered an ancient tunnel 6 feet 8 inches in hight, and 19 feet 7 inches in circumference. It is supposed that this is the same tunnel mentioned in an epigraph found at Lambéoc, according to which the tunnel was built in the reign of Antonius Pius, the plans being proposed by a veteran of the Third Legion, named Nonius Datus. Finding works like this after a time of 2,000 years, we cannot but be greatly astonished at the power, energy, and genius of a nation which produced, with the limited means available at those times, such gigantic structures.—*Stummer's Ingenieur.*

Successful Swimming Across the English Channel.

Captain Webb, after failing in his first endeavor to swim from Dover, England, to Calais, France, has succeeded in his second attempt, and has traversed the distance, some twenty-one miles, in twenty-two hours and forty-three minutes. This is certainly the most wonderful feat of swimming ever accomplished. Captain Webb wore no life-preserving apparatus whatever, but swam without clothes.

It is not difficult to imagine a man possessing muscular power sufficient to sustain such extraordinary exertion, but that it could be exercised during so long a sojourn in the water, the effect of which is to cool the body below its normal temperature, and so largely diminish the vital force, is surprising.