PRACTICAL EXPERIMENTS IN MAGNETISM, WITH SPECIAL REFERENCE TO THE DEMAGNETIZATION OF WATCHES.—No. 3.—[Concluded.]

BY ALFRED M. MAYER.

On the Magnetization and Demagnetization of Steel.—To understand thoroughly our process of taking the magnetism out of a watch one must be in possession of certain facts which have been discovered about the magnetization and demagnetization of steel. These facts I will now give.

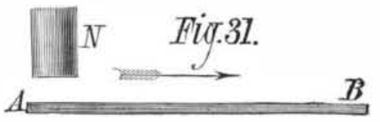

Fig. 31.

Let A B, Fig. 31, represent a piece of steel laid on the table. N is the north pole of a bar magnet, which is held vertically over the end, A, of the piece of steel. Bring the end, N, of the magnet to touch the end, A, of the steel and slide the magnet over the steel, in the direction of the arrow, to the end, B. Slide it off the end, B, and lifting it in the air, again bring N down on A, and repeat the operation. Even after one stroke of the magnet on the steel, the latter will be found to have received a charge of magnetism, which generally increases in strength up to a certain number of strokes of the magnet; after which further strokes of the magnet have no effect in increasing the magnetic charge in the steel. On now taking the steel, A B, to the magnetometer and testing its magnetic condition, as has already been explained in Figs. 7 and 10, you will find that the end, B, of the piece of steel is of S. magnetic polarity. If the bar magnet, N, strokes the steel from B to A, then B will be found of S. magnetic polarity. In other words, it is a general law that the end of the piece of steel *toward* which the magnet slides is of the opposite polarity to that of the end of the magnet which stroked the steel.

It is, however, not necessary for the magnetization of the steel that the magnet should rest on it while it glides over it. If the magnet be strong enough, and if the steel be not too hard, the latter may be magnetized by passing the magnet along the length of the needle and at some distance above it, as shown in Fig. 31

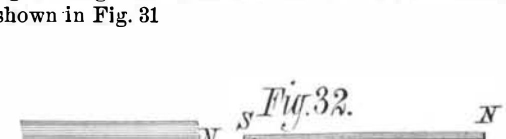

Fig. 32.

Let N, in Fig. 32, stand for the N. end of a magnet, while A B is a piece of steel which has been brought near to the end, N, of the magnet. If the magnet be strong, and the steel of the quality of sewing needle steel, that is, not too hard, you will find on testing the steel, A B, at the magnetometer, that the end, A, which faced the north end of the magnet is of south polarity, while the end, B, is of north polarity. If the piece of steel, A B, had been brought near the south end of the magnet, instead of the north end, then you would have found that the end of the steel which had been nearest the south end of the magnet was of north polarity. In other words, when a steel rod is brought near a magnet it is magnetized, and the end of the steel rod nearest the magnet is of a polarity opposite to that of the end of the magnet toward which the rod points.

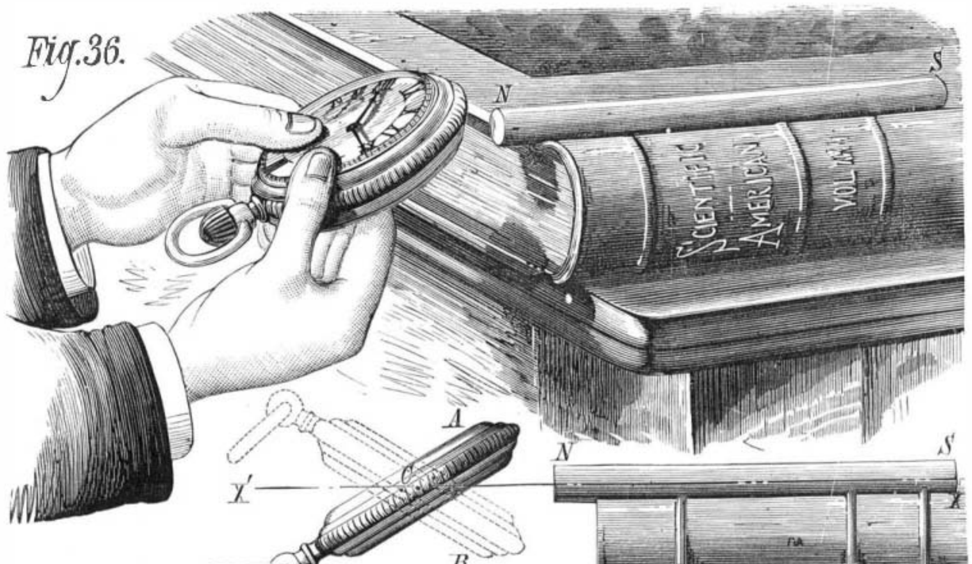

Fig. 36.

DEMAGNETIZING A WATCH.

If, instead of holding the steel rod at a distance from the magnet, we bring it to touch its end, then the magnetic charge given to the steel will be greater than in the former experiment. The polarity given to the end of the steel which touches the magnet is always opposite to that of the end of the magnet touched.

So much for the magnetization of the steel rod. Its demagnetization consists in taking the magnetism out of it, and is effected by operations similar to those just described in magnetization. These processes we had better describe by the aid of Figs. 31 and 32.

In Fig. 31, let A B be a magnetized rod of steel, with its north pole at A, its south pole at B. We have found out that this rod was magnetized, with its poles as just described, by stroking it from A toward B with the north pole of the magnet, N. The reverse direction of stroking will demagnetize it, that is, if the north end of the magnet be drawn over A B, from B toward A, then the magnetism will disappear from the rod, A B; and if the operation be repeated after the magnetism has disappeared we will even remagnetize the rod; but this remagnetization will place its north pole at B and its south pole at A.

It is not necessary, however, that the magnet should touch the steel rod during the operation of demagnetization. It is sufficient, if the magnet be powerful, to pass it over the steel rod at a distance above it and in a direction always opposite to that in which the magnet moved when it magnetized the rod.

In Fig. 32, let A B be a magnetized rod of steel, having its south pole at A and its north pole at B. This condition of magnetism has been given to it by the presence of the north pole of the magnet, N. Now, if we take away the magnet, N, and then bring up to the bar, A B, the south pole of the magnet, we will find that the rod, A B, will be demagnetized. If the rod, A B, be of very hard steel and the magnet not very powerful, it may be necessary for the magnet actually to touch the rod, A B, in order to demagnetize it.

Here it is in order to describe more explicitly the operation of demagnetization. To demagnetize a rod does not require as strong a magnetic action as that which was required to give the rod its present magnetic charge. So, in performing the operations of demagnetization, we should be careful not to give too many reverse strokes to the rod nor to approach it too near to the demagnetizing magnet. It is better to pass the magnet over the magnetized rod at a short distance above it, and after such operation to test its gradually falling magnetic charge at the magnetometer. The critical point is when this residual charge becomes small; for then the danger is that you will not only demagnetize the rod by the next operation, but will actually remagnetize it, with, of course, its poles reversed.

In the course of my experiments on the demagnetization of watches I made a series of novel experiments on the demagnetization of steel rods placed at right angles to the demagnetizing magnet. The steel subjected to experiment was of the hardness of that of sewing needles. These experiments explain some curious facts in our mode of demagnetizing watches, and therefore form a natural introduction to the practice of our process.

The rods of steel on which these experiments in demagnetization were made were formed of pieces of No. 1 sewing needles. The points and eyes of the needles were broken off, thus leaving rods of about two and one eighth inches long. The rat-tail file magnet was used for the demagnetizing magnet.

The manner of experimenting was as follows: The needle was magnetized by stroking it repeatedly with the end of the magnet. It was then placed pointing toward the center of the magnetometer needle and at right angles to the magnetic meridian. In this position the needle produced a certain angular deflection in the needle of the magnetometer. The needle was now placed in an upright position, as shown at *n s* in Fig. 33. The demagnetizing magnet, N S, was mounted on a block which slid between guides, so that the magnet, N S, could be gradually brought up to the needle, *n s*, and during all the time of its approach the axis of the magnet, N S, pointed toward the center of and at right angles to the needle, *n s*. The approach of the magnet to the needle in these circumstances was found to have lowered the magnetic charge of the needle, and this took place even when the greatest care had been taken to have the magnetic axis of the demagnetizing magnet at right angles to the *magnetic center* of the needle, *n s*. The following table will show the manner in which the magnet, N S, demagnetizes *n s* when the former approaches the latter.

After the needle was magnetized it deflected the magnetometer....	22°
After the magnet had been placed ¼ inch from needle	18°
" " " " " " "	18°
" " " " " " "	18°
" " " " ⅛ " "	15½°
" " " " " " "	15½°
" " " " $\frac{1}{16}$ " "	12°
" " " " " " "	12°

Examining the above record of the experiments it will be seen that the approach of the magnet to one quarter of an inch of the center of the needle brought down its magnet charge from 22° to 18°, and that a repetition of this experiment had no further effect in demagnetizing the needle. The same is observed on the repetition of the experiment when the magnet was placed at one eighth and one sixteenth inch from the needle. The total effect on the needle of the presence of the magnet at one sixteenth inch from its center was to lower the needle's effect on the magnetometer from 22° to 18° of deflection. Of course it will be understood that in any one series of experiments the end of the needle was always placed at the same distance from the center of the magnetometer needle.

In another series of experiments the needle had its magnetic charge lowered from 61° to 35° deflection on the magnetometer.

The reader will be careful to observe that I have stated that in these experiments I took every care to have the magnetic axis of the demagnetizing magnet at right angles to the magnetic center (or equator) of the needle. If this could be really done it might be a question whether the magnet would have any effect on the needle. Yet, all of our experiments show that it *always* has an effect of demagnetization. For a long time it has been known that for the demagnetization of a magnet it requires a far weaker magnetic action than that of the magnet which gave it its magnetism; now when the magnet is at right angles to the needle, as in Fig. 33, the north pole, N, of the magnet acts *equally* on the two poles of the needle, *n s*. It tends to repel the magnetism in *n* and hold that in *s*. It may be that the freeing power of N on the needle is greater than its holding power. It is also here to be stated that, in a long series of experiments made exactly as described above, only with the demagnetizing magnet two feet long and the needles one quarter inch thick and six inches long, and hardened to the greatest degree possible before magnetizing them, this large magnet had no effect whatever on these *intensely hard needles*, though every care was taken to get the magnetic axis of the demagnetizing magnet truly at right angles to the axis of the needles and pointing toward their centers.

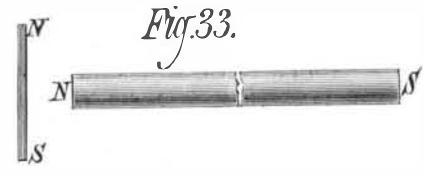

Fig. 33.

We will now describe another series of experiments in demagnetization in which the needle is *rotated* before the pole of a magnet, with the center of the needle on a line in the prolongation of the axis of the magnet. In Fig. 34, N S is the demagnetizing magnet, and *n s* is the needle operated on. The following description of one of the series of experiments will give an accurate idea of all of those made:

The center of the needle, *n s*, was one inch and three quarters from the end of the magnet, N S. After the needle had been magnetized it was placed opposite the magnetometer, and caused a deflection of 61° in its needle. The needle was now placed in a vertical position at right angles to the magnet, N S, and with its center one inch and three quarters distant from the end, N, of the magnet. The needle was now turned around its center so that its south pole went through 90°, and approached the north pole, N, of the magnet. The magnet was now removed and the needle tested at the magnetometer. As might have been expected it produced the same deflection of 61° as it did before the experiment. The needle was again placed in its old position, the magnet brought to the same distance from its center, and the needle again rotated before the magnet; but this time the north pole of the needle turned round 90° toward the north pole of the demagnetizing magnet. After this operation the needle had had its magnetic charge lowered so that it now only produced a deflection of 32·5° in the magnetometer. A repetition of the experiment brought down its magnetic charge to 30°. A third experiment brought it to 27°, while after the fourth experiment its deflection on the magnetometer needle amounted to only 16°. Further experiments had no effect in reducing the magnetic charge. It should have been mentioned above that in all these experiments the needle was really oscillated around its center before the magnet; that is, its *south* pole was always brought before the magnet (this tended to magnetize the needle); then its north pole was brought before the magnet (this tended to demagnetize the needle); then the needle's south pole was again brought before the magnet, and the experiment terminated. Thus we see that the magnet first tended to magnetize the needle, then to demagnetize it, and lastly to magnetize it. Notwithstanding that the needle was subjected to a magnetizing influence from the magnet after its demagnetization it had its magnetism lowered, so much less magnetic force being required to demagnetize than to magnetize a magnet.

In the following series of experiments the needle was placed as in the preceding experiments, and it was rotated through a whole revolution before the pole of the magnet instead of through only a half revolution as in the preceding experiments. Before an experiment was made on the needle it deflected the magnetometer needle 51°. The needle was now rotated before the magnet through a whole revolution, its south pole approaching first the magnet, then passing it and turning over the circumference of the circle till it had made an entire revolution and had come back again to its first position at *s*. in Fig. 34. After the first revolution the needle was demagnetized so that its effect in deflecting the magnetometer needle was only 9°, instead of 51°, the deflection which it caused before it was rotated before the magnet. The whole of this demagnetization was caused by the passage of the north pole of the needle across the N. end of the magnet, N. The passage of the *s*. pole of the needle athwart the N. pole of the magnet could have had no other effect than to magnetize it.

A second rotation similar to the above reduced the deflecting power of the needle on the magnetometer to 5°. A third experiment brought it down to 4°; after which no further rotation had any effect in reducing the magnetic charge of the needle.

ON THE DEMAGNETIZATION OF WATCHES.

The reader who has made for himself the magnetic experiments, which we have so minutely described, or who has even read the accounts we have here given of them, will have no difficulty in seeing the reasons for the various operations which I will now describe in giving an account of the way to take the magnetism out of a watch.

A watch is formed of a case of gold or silver, and glass inclosing brass or nickel plates, between which are a number of steel arbors forming the axles and pinions of the brass wheels. There is also the spring of steel which uncoils itself in the plane of the watch. The older watches have in addition a steel chain which uncoils from the fusee on to a brass barrel inclosing the mainspring. The hairspring, parts of the balance wheel escapement, stem winding apparatus, etc., are also of steel. So we see that there is abundance of material for magnetization in a watch. Fortunately, these parts are formed of steel, which is only moderately hard, and, therefore, as we have already seen, easy to demagnetize.

Of these various parts some have their lengths at right angles to the plane of the watch, like the arbors; others, like the main and balance wheel springs and the nickel (nickel takes a magnetic charge like steel or iron, only feebler) plates inclosing the movements, have their greatest dimension in the plane of the watch. The position of these bodies determines to a great extent the directions of their magnetic axes. By magnetic axis we mean an imaginary line joining the two poles of a magnet. The arbors will have their magnetic axes in the direction of their lengths, whereas plates are most likely to have theirs in the direction of one of their diameters. But we have already seen that no matter in what direction their magnetic axes are in the watch, all of these bodies (thanks to the facts already shown in our experiments) may be demagnetized *by properly oscillating the watch before the pole of a magnet*. How this is to be done I will now show, and in order to shorten what might otherwise be a long story, I will give an account of the process by describing the experiments actually made in the course of demagnetizing an old Tobias fusee watch, which I saturated with magnetism by deliberately placing it on one of the poles of the large magnet of my laboratory in the Stevens Institute of Technology, and thus purposely obtained a very badly magnetized watch to practice a cure on.

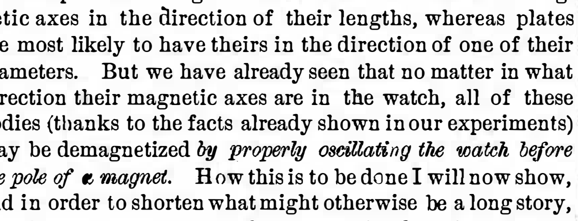

Fig. 34.

The watch is placed quite close to the magnetometer, and with the center of the thickness of the watch about on a level with the center of the needle of the magnetometer, and with the line, connecting the center of the watch, C, Fig. 35, and the center, *c*, of the needle, at right angles to the magnetic meridian; in other words, at right angles to the direction which the needle has when no magnetic body is near it. The watch is then turned slowly around on its center as an axis, and each hour on its dial is in succession brought opposite to the center, *c*, of the magnetic needle of the magnetometer.

The following were the results of such experiments on our magnetized watch. We give them in the form of a table: N. and S. indicate the kind of magnetic polarity at each hour, and the angles show the effect in angular deflection on bringing that hour of the dial opposite the center of the magneto-meter needle:

TABLE I.

Hour.	Ang. of Deflection of Magnetometer.	Kind of Magnetism.
XII.	20°	N.
I.	5°	N.
II.	18°	S.
III.	72°	S.
IV.	56°	S.
V.	22°	S.
VI.	5°	N.
VII.	17°	N.
VIII.	16°	N.
IX.	16°	N.
X.	20°	N.
XI.	24°	N.

When the hour III. was brought opposite the magnetometer needle the fusee axle and the center of the semicircular steel catch of the inner cover of the works were presented to the magnetometer. The strong south magnetism of hour III. was due to the magnetization of these bodies, which deflected the needle of the magnetometer 72°. The strong north magnetic action of hour XI. was due to the magnetized mainspring.

We may now regard this watch as a magnet, having the form of a disk, and with its north magnetic pole at the hour XI. and with its south pole at III. o'clock.

This being the information given by our magnetometer, we are in possession of facts which enable us to take the north magnetism out of eleven o'clock and the south magnetism out of three o'clock.

You have already found, by your experimenting, that when your bring the north pole of one magnet near the north pole of a more powerful magnet, the powerful magnet will take the magnetism out of the weaker one because it tends to make the north pole of the latter a south pole. Similarly the south pole of a powerful magnet will demagnetize the weaker magnet when the south pole of the latter is brought near the south pole of the former.

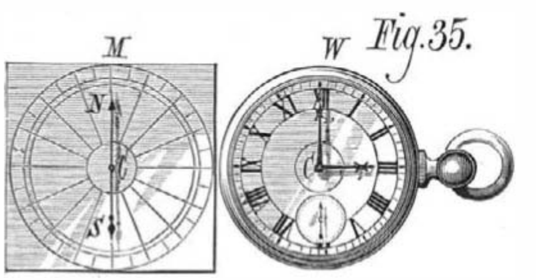

Fig. 35.

You have also found out by your experiments that when a small magnet, made of steel not too hard, is vibrated around its center in front of the pole of a powerful magnet, the small magnet is demagnetized. These facts show how we must proceed in the demagnetization of the watch.

The hour XI. is of the strongest north magnetism of any on the dial; therefore we place this hour opposite the north pole of our rat-tail file magnet, as shown in Fig. 36. The center of the watch, C, is placed so that the prolongation of the axes of the magnet (shown by the dotted line, X X') passes through it. The watch is now vibrated around an axis passing through C and at right angles to X X'. By this operation the watch is successively brought into the positions, A and B, of Fig. 36. After several vibrations of the watch before the north pole of the magnet, I turned the hour III., of strong south polarity, opposite the south pole of the magnet, and vibrated the watch as in the previous experiment. By these vibrations the watch cuts across the lines of magnetic force, and, as we have seen, any magnetism in it is thus taken out. After these operations performed on the hours XI. and III., the watch was again examined before the magnetometer, and the following table shows the effect of the vibrations before the magnet:

TABLE II.

Hour.	Ang. of Deflection of Magnetometer	Kind of Magnetism.
XII.	2°	N.
I.	5°	N.
II.	4°	N.
III.	0°	
IV.	5°	S.
V.	8°	S.
VI.	2°	S.
VII.	4°	N.
VIII.	4°	N.
IX.	2°	N.
X.	1°	N.
XI.	0°	

There is certainly a great difference between the magnetometer deflections of Table I. and these of Table II. It is observed at once that the hours III. and XI., which were respectively of strong south and north magnetism in Table I., are in Table II. marked 0°. This result was not attained, however, at one trial, as might be inferred from our description of the experiments, but after each series of vibrations before the pole of the demagnetizing magnet the magnetic condition of hours III. and XI. was tested. Sometimes their magnetism almost disappeared. Then we found it had changed, or rather inverted, so that hour III. had north instead of south polarity, and hour XI. had south instead of north magnetism. When this happened we had to present hour III. before the north pole of the magnet, the hour XI. before the south pole. After repeated trials I succeeded in demagnetizing hours III. and XI. so that they produced no action whatever, or 0°, on the needle of the magnetometer.

I now again brought the watch before the magnet and vibrated its V. o'clock before the south pole till this south magnetism had disappeared; in other words, produced no deflection whatever on the needle of the magnetometer. I then made an examination of the magnetism of the watch before the magnetometer, with the following results:

TABLE III.

Hour.	Ang. of Deflection of Magnetometer.	Kind of Magnetism.
XII.	1°	
I.	0°	
II.	0°	
III.	0°	
IV.	2½°	S.
V.	2°	S.
VI.	2°	N.
VII.	6°	N.
VIII.	5°	N.
IX.	2°	N.
X.	1°	S.
XI.	2½°	S.

I now demagnetized hour VII. of its 6° of north magnetism by vibrating this hour opposite the north pole of the demagnetizing magnet, and after I had succeeded in this I found that no hour on the dial of the watch when presented to the magnetometer caused a deflection of even one degree, so I considered the watch demagnetized; in which conclusion I was justified, for the watch has kept as good time and with about the same rate as it did before it was magnetized.

The "accident" to which I referred in the first of these articles happened to a valuable watch made with special care by Lange, of Dresden. It was so strongly magnetized that IV. o'clock on its dial produced a deflection of 83° south magnetism on the needle of the magnetometer, and VII. o'clock a deflection of 40° of north magnetism. This watch I demagnetized exactly as has been described, and after its demagnetization, though it had lost a half hour in three hours when magnetized, it kept a rate even more uniform than before its magnetization. Before its magnetization it lost about one second per day; after its demagnetization it has gained from ¼ to ½ second per day, and has a very uniform rate, indeed, as uniform as one could wish for in a pocket watch subjected to daily vibrations on the railway.

New Pencil as a Substitute for Ink.

We do not refer here to the aniline pencils which have been in use for some time, but to a quite different pencil which gives a very black writing, capable of being reproduced by the copying machine, and which does not fade on exposure to light. The mass for these pencils is prepared as follows: 10 pounds of the best logwood are repeatedly boiled in 10 gallons of water, straining each time. The liquid is then evaporated down till it weighs 100 pounds, and is then allowed to boil in a pan of stoneware or enamel. To the boiling liquid nitrate of oxide of chrome is added in small quantities, until the bronze-colored precipitate formed at first is redissolved with a deep blue coloration. This solution is then evaporated in the water bath down to a sirup, with which is mixed well kneaded clay in the proportion of 1 part of clay to 3½ of extract. A little gum tragacanth is also added to obtain a proper consistence.

It is absolutely necessary to use the salt of chrome in the right proportion. An excess of this salt gives a disagreeable appearance to the writing, while if too little is used the black matter is not sufficiently soluble.

The other salts of chrome cannot be used in this preparation, as they would crystallize, and the writing would scale off as it dried.

The nitrate of oxide of chrome is prepared by precipitating a hot solution of chrome alum with a suitable quantity of carbonate of soda. The precipitate is washed till the filtrate is free from sulphuric acid. The precipitate thus obtained is dissolved in pure nitric acid, so as to leave a little still undissolved. Hence the solution contains no free acid, which would give the ink a dirty red color. Oxalic acid and caustic alkalies do not attack the writing. Dilute nitric acid reddens, but does not obliterate the characters.—*Moniteur Scientifique.*

How to Remove Nitrate of Silver Stains from Clothing.

In the manipulation of the nitrate of silver bath solutions in photography the operator frequently receives stains of the salt upon his clothing, which are not very attractive in appearance. The question of their removal has been a puzzle to many. Nitrate of silver, it will be remembered, is the base of most of the so-called indelible inks used for marking linen in almost every household. Stains or marks of any kind made with the above silver solution or bath solution may be promptly removed from clothing by simply wetting the stain or mark with a solution of bichromate of mercury. The chemical result is the change of the black-looking nitrate of silver into chromate of silver, which is white or invisible on the cloth. Bichromate of mercury can be had at the drug stores. It is slightly soluble in water, is a rank poison, and we would not advise anybody to keep it about one's house.

Cheap Wheat.

A late number of the Walla Walla (Washington Territory) *Watchman* says:

The question is frequently asked, What does it cost to raise wheat in the great valley of Walla Walla? After a careful inquiry, we adduce the following answer: It costs about $1 90 per acre to plow, sow, and seed; $1.25 to cut and head, and about seven cents per bushel to thrash and sack it. This includes wages, board, and hired help, and horse feed. A header usually works up from fifteen to twenty acres, and thrashes, with good machinery, clean up from 2,000 to 3,000 bushels per day. Harvest hands receive from $2 to $3 per day and board. The yield this year is larger and heavier than usual, and ranges all the way from twenty-five to sixty bushels to the acre. Wheat, according to the above figures, can be raised and sacked for twenty-four cents a bushel, and is worth to-day fifty cents, which shows conclusively that our farmers have a perfect little bonanza.

The Dominion Exhibition.

The first Dominion Exhibition was formally opened by the Governor General at Ottawa, Canada, Sept. 23, with a large attendance and upward of 10,000 exhibitors. Among the prominent visitors were the Governors of Maine, Ohio and Vermont, with their respective staffs.

Toadstool Poisoning.

Along with the cool, refreshing weather and the occasional cold rains of autumn, come the great mass of toadstools and mushrooms—poisonous and edible, and of all shapes, sizes, textures, colors, odors, and flavors. In every wood, meadow, or pasture where there is sufficient moisture and decaying vegetable substance they are sure to be met with. As autumn is pre-eminently the season of toadstools, so is it also the season in which oftenest occur fatal accidents through eating poisonous species; and doubtless the papers will soon be called on to chronicle, as usual at this time of the year, a few more cases like that which occurred but a few weeks ago in the family of Mr. Frederick Sussik, of Linden, N. J., and in which two children lost their lives and three other members of the family were made dangerously sick, by partaking of certain toadstools that had been mistaken for the common edible mushrooms (*Agaricus campestris*). The Rev. Washington Rodman, who called on the family a few days after the sad occurrence, collected some toadstools, which were identified by Mrs. Sussik and a lady friend as the species that were eaten by the victims of the accident. Through the kindness of Mr. Rodman, we have been able to examine the specimens, and find them to be the quite common *Agaricus vaginatus*, Bull. There seems to be considerable doubt among different authorities as to the qualities of this species of toadstool. Fries regards it as suspicious, Vittadini and others say that it is esculent, and Berkeley states that according to some accounts it is poisonous, but that it is eaten in Russia. Still, the fact of its being eaten in Russia would not go far to prove that it was innocuous, for the Russian peasants, like the Patagonian savages, eat fungi that are regarded as absolutely poisonous by other peoples.

In the two words—"mushrooms and toadstools"—is embraced the whole of the knowledge possessed by the people at large regarding the immense fungus tribe of our country. Taking, as an example, the mushroom type of a fungus, we have in the United States upward of a thousand distinct species, all possessing a general similitude of form; very many of these are edible, and superior in flavor to the common mushroom; others, while not poisonous, are undesirable on account of toughness, bad flavor, or want of flavor; and a large number are dangerous on account of their exceedingly poisonous nature. The fact of the general similarity of form possessed by these plants has caused many to look upon them as mere fortuitous productions—difficult or impossible to distinguish as permanent species; but when once the literature of the subject has been obtained, and the study of these organisms entered upon in earnest, the student will soon perceive that the species, as a rule, are marked with great distinctness and immutability, rendering them as easily recognizable as those of flowering plants. In view of the fact that we have such a large number of edible species, in addition to the common mushroom, it may be pertinent to inquire whether there is any sure way of distinguishing them from the poisonous kinds. We may answer that there is no royal road to such a knowledge; there is one way, and only one way, by which edible fungi can be discriminated from noxious ones with absolute certainty, and that is by acquiring a knowledge of the individual species, either by the study of books, or under the guidance of an experienced fungologist. One might as well lay down a code of rules for the discrimination of wholesome from poisonous fruits and vegetables, as for fungi. Indeed, people do occasionally mistake aconite and poke roots for horseradish, or fool's parsley for parsley proper; but we have no general rules drawn up to meet such cases. In many books—cookery manuals, popular science works, encyclopedias, etc.—certain general rules are given for ascertaining whether a fungus may be eaten with impunity or not; they are so exquisitely absurd, however, that botanists simply smile and never think of refuting them. Perhaps one of the most important of these rules is that esculent species never change color when cut or bruised. But the meadow mushroom (*Agaricus arvensis*) turns yellow when broken; the red-fleshed mushroom (*A. rubescens*), when bruised or broken, becomes sienna-red, the orange milk mushroom (*Lactarius deliciosus*) turns from bright orange to dirty green when cut or broken; and these are among our common and justly esteemed edible species. Another rule is that such toadstools as deliquesce, or speedily run into a dark watery fluid, should be avoided. This at once shuts out two of our commonest, and, to our mind, most delicious species—the maned coprinus (*Coprinus comatus*) and inky coprinus (*C. atramentarius*), the former of which we have gathered in great abundance on the Battery and in Central Park. Still another rule very commonly relied on is that if a fungus be pleasant to the taste, and its odor not offensive, it may be safely eaten. But this is not only a fallacious but an exceedingly dangerous guide. It is very true that some acrid fungi are irritant poisons; yet one of our best edible species (as its specific name implies), *Lactarius deliciosus*, when eaten raw, causes a very unpleasant tingling of the mouth and tongue; and the same sharp taste also characterizes several other excellent fungi. It is farmore important to remember the fact that a toadstool may have a pleasant odor and taste, or in fact be nearly destitute of either, and yet be most virulently poisonous. The fly agaric (*Agaricus muscarius*) has no acridity, and indeed, to our own taste (for we once had the temerity to chew a little of it to ascertain the fact), it is perfectly insipid, yet its extremely poisonous properties have been known for centuries. It should be known that toadstools may be irritant, narcotic, or narcoto-irritant poisons, and that while it is possible to recognize an irritant by the taste, a narcotic may be nearly tasteless. Finally, to refer to one more canon, which has been repeated time after time in all kinds of books, the fallacy of the possibility of distinguishing an edible from a poisonous fungus by the use of tin or silver spoons has been so often exposed, that it is hardly necessary to do more than remark that any one who relies on such a test merely runs the risk of furnishing a subject or subjects for the coroner. The ultimate composition of toadstools has been pretty well ascertained, but our knowledge of the proximate constituents is as yet quite meager, being confined to comparatively few species. From the fact that each poisonous fungus does not produce its own special symptoms, but that all the differences observed can be reduced to varieties in the degrees of action on different systems of the animal organism, it is possible that the same poisonous principle, modified by other noxious principles coexisting and varying in different species, pervades each and all. This active principle was separated in 1806 by Letellier, and named by him *Amanitine*. More extended researches were made in 1869 by Profs. Schmiedeberg and Koppe, of Strasbourg, and in their memoir they have called the same substance *Muscarine*, from the specific name of the fungus upon which they experimented—*Agaricus muscarius*. This principle, which is regarded as an alkaloid, is obtained as a tasteless, amorphous black mass, the physiological action of which has been well ascertained. Its chemical properties, however, are not so perfectly known. In addition to this, these plants contain a number of acids, some of them peculiar to fungi, and perhaps having irritant properties, such as *polyporic, fungic*, and *boletic* acids; and this we might expect from the very nature of these organisms. We know that flavoring plants absorb carbonic acid and exhale oxygen during the day and reverse the process at night; and we know further that the leaves of certain plants which are bitter become acid at night through the oxidation of the products formed in them during the day. Inasmuch as toadstools, like animals, absorb oxygen continuously, and exhale carbonic acid, it is reasonable to suppose that acidity would be a predominating characteristic. Indeed we find this to be the case. The poisonous properties of fungi, like the properties of flavoring plants, such as the opium poppy, tobacco, hemp, etc., vary with climate, and probably also with the season; and for this reason, perhaps, the common edible mushroom, which is esteemed a safe and delicious article of food in most countries, becomes noxious in Italy, and its sale forbidden by law. Some persons are liable to be affected even by those species which are usually regarded as innocent; such instances may be considered as due to personal idiosyncrasies. As above stated, the poisonous principle (muscarine) seems to be the same, or nearly the same, in all noxious species of toadstools, inasmuch as a close study of numerous cases has shown that they all have a similarity of action. They all act more or less on the intestinal canal and heart, and apparently also on the brain. The usual symptoms are uneasiness in the stomach, vomiting, purging, and a feeling of constriction in the neck, want of breath, giddiness, fainting, prostration, and stupor. Sometimes the intestinal symptoms are most prominent, sometimes the cerebral ones. Often an affection of the salivary glands is a prominent symptom. The most extraordinary action of muscarine is on the heart. One curious point about nearly all cases of poisoning of this kind is the very small quantity of the fungus which is so deleterious. Happily, through the investigations of Prevost of Switzerland, Brunton of England, and Schiff of Italy, we now know the proper antidote to the poison, and the fact should be known (although it does not seem to be) by every physician living in the smaller cities and villages, just where cases of poisoning by these plants generally occur. The symptoms above enumerated being opposite to those produced by belladonna, datura, and other solanaceous plants, the experimenters just mentioned were led to investigate the capabilities of these to act as antidotes to poisonous fungi, and with successful results. Dr. Brunton recommends (*British Medical Journal*, Nov. 14, 1874, p. 617) in cases of poisoning by toadstools, that the stomach be emptied by proper emetics, and then atropia injected subcutaneously. But the antidote may also be given by mouth in the form of tincture of belladonna or solution of atropia (*Liquor atropiæ*, Ph.B.). The dose for subcutaneous injection should be about $\frac{1}{100}$ of a grain, or about one minim of solution of atropia, repeated if necessary until the dyspnœa is relieved. Professor Schiff, pursuing the same line of investigation still more recently, indorses the treatment proposed by Dr. Brunton, and further recommends the use of stramonium in substances or as an alcoholic extract, or of its alkaloid *daturia*. Still more recently Dr. Ringer (*Lancet*, March 2, 1878) has shown that another solanaceous plant, the *Duboisia myoporoides*, of Australia, is also a perfect antidote to the poisonous principle of toadstools, but the belladonna treatment, proposed above by Dr. Brunton, will perhaps prove the handiest for our own physicians.

From the facts stated in the former part of this article, it will seem that the gathering of toadstools for food purposes cannot be safely recommended to the inexperienced in such matters. It is to be regretted that nature has placed so many stumbling blocks in the way of a popular acquisition of a knowledge of these cryptogams; for the edible species, of which we have a large number in this country, would prove wholesome and pleasant articles of food, their great value in this respect being due to the fact that they have an astonishing resemblance to animal food. Of all vegetable productions they are the most azotized—that is, animalized—in their structure. Chemistry demonstrates that they yield the several component elements of which animal structures are made up; and many of them, in addition to sugar, gum, resin, the peculiar acids above mentioned, and a variety of salts, furnish considerable quantities of albumen, adipocere, and osmazome, the principle which communicates its peculiar flavor to meat gravy. Notwithstanding this, it is better that the would-be mycophagist should confine his gastronomic proclivities to the ordinary articles of food in common use, than to run the risk of committing *felo de se* by partaking of fungi that have not been selected for him by experienced hands. Better, in fact, to adopt the wise precautions of a certain young lady, who remarked that she "never partook of these dainties till she had seen the effect they produced on somebody else."

Since the foregoing lines were written, another fatal case of toadstool poisoning has occurred, the victim in this case being a student at Stamford, Conn. We have long been desirous of knowing with what toadstool or toadstools people are constantly killing themselves in this country, and we would feel obliged if physicians who have cases of poisoning of this kind under their care, would send us for identification specimens of the fungi which were the cause of the accident.

A New Pipe Line.

The Parker *Daily* published the following: For some time past surveys have been in progess along the line of the New Jersey Central Railroad, but the object has been kept a secret. A theory has been advanced, and it appears to be very plausible, to the effect that they are preliminary to the continuation of the great oil pipe line to the seaboard. This line, recently put in operation to Williamsport, has proved a great success, and it seems but natural that there should be a desire to carry it directly to the market. It is stated, in connection, that the railroad company has offered the Singer Sewing Machine Company $1,000,000 for their property at Elizabethport, as an inducement for that company to remove to Plainfield. If the transfer is made the sewing machine works will be converted into an oil refinery. This movement is probably for the purpose of breaking down the Pennsylvania Rail road Company should the latter succeed in getting the right of way for their road from Point of Rocks to Claremont, the preparations of which are being carried on vigorously. The Central Railroad and the Standard Oil Company make a very strong combination, and the fight will be waged bitterly on both sides.

Large Crank Shafts.

At the late meeting of the Institution of Mechanical Engineers, at Glasgow, a paper was read "On the Forging of Crank Shafts," by Mr. W. L. E. McLean, of the Lancefield Forge. The author gave an interesting account, well illustrated by diagrams, of the methods of forging large crank shafts generally in use, and especially of the building-up system, which had for many years been adopted at the Lancefield Forge, an establishment which, as is well known, has a high reputation for this class of work.

In the discussion that followed, Mr. Jamieson believed that at no very distant day the Atlantic steamship service would be such that it would be possible to leave Great Britain early in the week and arrive at New York at the end of it; but this of course would necessitate the employment of larger vessels and more powerful engines. He had had considerable experience in the building up of large shafts in several pieces, and the firm with which he had lately been connected (Messrs. J. Elder & Co.) had constructed in this way a shaft weighing 56 tons, this being a three-throw shaft and built up of fifteen pieces. Within the next ten years, shafts weighing 100 tons would, he considered, probably be required, and he believed that the proper way to construct such shafts was to build them up, a shaft so built up involving much less loss of time for repairs or renewal, in the event of failure, than would be the case with the old shafts.

Spontaneous Combustion of Stuffed Silks.

According to the *Färber Zeitung* the authorities at Vienna, in consequence of the frequent cases of spontaneous combustion, have decreed special arrangements for the packing and transport of weighted silks. [We should strongly advise railway companies and other public carriers to place such silks in the class of dangerous goods, to be carried only at extra freight and under special arrangements. Fire insurance companies should also be aware of the special risk run when such goods are stored up in shops and warehouses.]—*Chemical Review*.

A Saw Accident.

A singular accident and narrow escape is reported from Bay City, Mich. It is stated that while a Mr. Farmer was standing in front of a six foot revolving circular saw, at Bradley's mill, one of the teeth of the saw flew out and struck Mr. Farmer in the breast. He escaped with his life only because the tooth happened to strike and embed itself in his gold watch, which was of course sadly damaged. The best way is to keep clear of circular saws, especially those having inserted teeth.

A PRE-HISTORIC CLAMBAKE.—In excavating for the Jacksonville (Fla.) water works, recently, there was found, twenty-eight feet below the surface, an ancient clambake. In a bed about six feet by four in area, the clam and oyster shells, many with gaping mouths, were arranged as for a modern clambake, intermixed with hardened sand, charcoal, and fragments of decayed wood.