pulley, D, on the main shaft round a pair of guide pulleys, A, to a cone pulley, E, on the drill spindle. The arrangement of the guide pulleys is novel. They are mounted on an inclined slide, along which they can be moved by a screw, and they are so arranged on this slide that as they move lengthwise they are tilted sideways, so as always to present a fair lead to and from the particular step of the main pulley which they may be opposite. Each guide pulley has five grooves, corresponding to the five steps of the cone on the drill spindle (see detached view), and the angle of the slide is such that the band is kept uniformly tight.

There are three different methods of feeding the drill. It may be forced down by the screw, P, or by applying the hand to the lever, N, or the counterweight, B, may be transferred to the other end of the lever and the feed be controlled by withdrawing the screw, F. By means of the stop screw, *a*, any number of holes may be drilled exactly to the same depth.

The machine is provided with a treadle, but fast and loose pulleys can be fitted to it, as shown in dotted lines.

Practical Uses of the Electro-Magnet.

The following description of the practical employment of the electro-magnet is taken from the Pittsburg *Press:*

"S. T. Wellman, the superintendent of the big steel works at Cleveland, conceived the notion some time ago that a large electro-magnet, suspended by a chain from a crane, could be employed very profitably for lifting masses of iron. Not being an electrician, he did not see his way to carrying the thing out practically. Mr. Berry, an electrical engineer of Pittsburg, being on the spot, volunteered his advice and superintendence. Together they brought the thing to completion, and it is now working with great perfection.

"For the construction of the electro-magnet to be experimented with, two bars of soft iron were taken, each being fourteen inches long and three inches in diameter. They were wrapped with a multitude of strands of No. 14 B. & S. gauge covered wire. To combine the two separate magnets thus formed into one, they were linked together on top by a third soft iron bar, square in the cross section.

"For trial of the magnet at portative work it was suspended by a rope from a pneumatic crane. Rope was used, as it was found that a chain became magnetized and did not act very well. The current power sent through the wire to induce the magnetism was that of 5½ to 6 amperes. It was found that a weight of 800 pounds could be lifted up handily, and, by shutting off the current and lowering the magnet, deposited anywhere very easily. . . . At one part of the factory where this electro-magnet has been put up, fourteen or fifteen Polacks have been wont to be kept employed at this work. They are now in the position of Othello in the matter of occupation, the magnet picking up two or three billets at a time and depositing them in a car.

"If the thing works permanently, as it appeared to be working when Mr. Berry left Cleveland, it looks as if one boy would be able to do the work of a gang of men. His duties will be those of lowering the magnet from the crane on to some billets, turning on the current, swinging the magnet around to the top of a car, cutting off the current, and bringing the crane back to its first position. The crane used is one of a very superior class, being adapted to turning in any possible direction almost, at a slight movement from a pneumatic valve.

"The turning off and on the electric switch, of course, would require no expenditure of energy that would be worth speaking of at all. It is intended to construct an electro-magnet of softer and more appropriate iron than that of which the first experimental one was made. The amount of current, also, will be arranged so that only a portative capacity of 150 pounds or so, at the poles of the combined magnet, will be produced."

Parasites on Live Stock.

At the end of the winter, colts, calves, and older stock are very apt to be crowded with these objectionable parasites. They thrive best upon poor animals, and are supposed to be bred by old, worn out, and miserable creatures. However this may be, there is no doubt that they find a suitable home in the dirty matted hair in the late winter or early spring months, and on a sunny day may be seen literally in millions, every hair having nits upon it. One reason of so much rubbish accompanying them is that in the course of their development from the egg to the mature louse the skin is cast several times.

To get rid of them is not always easy, as the length of coat and accumulation of dandruff or scurf makes a waterproof covering that resists many remedies which in themselves are certain destroyers if only brought into contact with the parasites.

A sunny day should be chosen, and the early part of it, when a bountiful washing with soft soap and hot water should be undertaken, so as to clear the skin of grease and dirt before applying the remedy. Stavesacre is an effectual destroyer of lice if prepared by boiling ½ pound with a gallon of water and brushing well into the coat with a hard brush.

Tobacco juice is also much in request for the purpose, and can be procured from druggists at a very low rate, as it is imported now free of duty, or only a nominal duty, and the old expensive plan of boiling or infusing good shag tobacco is not necessary. By the way, very few people avail themselves of the governmental privileges of growing sufficient tobacco for this and fumigating purposes, though they might easily do so.

Paraffin is sometimes used, but is a very dangerous remedy, occasionally being absorbed and causing the death of the animal, and not unfrequently causing a blister, and much unnecessary pain, and subsequent blemish.

There is another kind of louse from which horses suffer, which, if once seen, can never be forgotten—we refer to poultry lousiness. It will sometimes happen that a horse stabled with fowls will become affected and literally tear himself to pieces with them unless promptly treated with one of the foregoing remedies, either of which is as effectual against these as against the ordinary louse.

In washing or applying any remedy, it should always be commenced near the eyes and worked backward, as if any other plan is adopted the besieged retreat into the mane and ears, and many escape altogether, like the rats that are left just to keep up the breed after the rat catcher has gone.

It is always well to repeat the dressing and keep the animals moving about till dry, or they may lick off more lotion than is good for them, or stand about and get chilled.—*Chemist and Druggist.*

A DEVICE FOR PROTECTING GARMENTS.

The vest protector shown herewith has been patented by Mr. Benjamin Ives, of St. Paul, Minn. It is an apron of felt or other suitable material, having a binding on its upper edge, in which, near opposite edges of the apron, are formed holes for receiving an S-shaped hook, by which the protector may be supported from the edges of the vest pockets, for protecting garments against wear by contact with the edges of desks and counters.

IVES' VEST PROTECTOR.

Dynamite—Its Uses and How to Handle It.

Although dynamite has been in use for considerable time, from the number of inquiries from every part of the globe relative to its ingredients, its explosive force, and how to handle it with safety, we conclude but few comparatively know but little about it. The following, from the *Indian Engineer*, published at Calcutta, gives the information which many are seeking to know.

Dynamite consists of some porous absorbent mineral saturated with nitro-glycerine. Several substances have been tried as absorbents of the glycerine, but the most satisfactory is the *kieselguhr*, an infusorial earth, composed of the silicious shells of extremely small vegetable organisms, and it is of this that Nobel's dynamite is made. It absorbs about three times its weight of the glycerine, and resembles putty in appearance. Thus, a given quantity will contain 75 per cent of the real explosive, and its blasting power compared with pure nitro-glycerine is, of course, represented by the same ratio. In order to explode it, it is necessary to obtain the temperature of 360° Fahrenheit. It freezes in the same way as glycerine, and when in this state must be carefully handled. Nitro-glycerine has an expansive force ten times that of an equal weight of powder. It is highly dangerous to place dynamite on or near fire stoves, steam pipes, or any highly heated metal. Dynamite must never be put into warm water to thaw it, as the water would free the nitro-glycerine, when it is most dangerous. It ought always to be put into a water-tight vessel, and then have the vessel put into warm water. It should never be exposed to the direct rays of a tropical sun. When loading it, a wooden rod or squeezer should be used to push home the cartridge, *never a metal one*, and the charge should gently and firmly be pushed down, and not rammed or pounded.

If dynamite has to be loaded into tins, avoid smelling it, as it gives a sickly, nervous headache for several days. Never squeeze the primer containing the detonator, but lower or push it gently till it rests on the charge. For tampings, and or water should be used. In the event of a misfire, never attempt to draw the tamping. If water tamping has been used, put a fresh primer and detonator on top of the charge. If other than water tamping has been used, bore a fresh hole. The detonator must be very carefully handled. If one exploded in the hand, the hand would be shattered. When putting in the fuse, cut off the end of it square, and put it in firmly, but gently. Dynamite can be burnt with safety, and simply fizzes up harmlessly. It exercises its force in the direction of most resistance. A single cartridge attached to a rail will break it; a 4 oz. cartridge will break a 35 lb. railway rail in two. The charge varies from a few cartridges to as much as may be necessary.

Dynamite is generally packed up in dealwood boxes containing 50 lb. Each box contains five separate packages of 10 lb., and in the package ½ oz. and 2 oz. cartridges are mixed. They are all the same power, but the ½ oz. cartridges are called primers, and used for exploding charges. The detonators are long copper caps, filled with a heavy charge of chloride of mercury. They must be kept quite dry, and always separate from the dynamite. It is sold in boxes of 200 caps. The fuse used is of various sorts. The most useful is the black fuse sold in coils of 24 feet. It burns at the rate of a yard a minute.

A School for Fire Horses.

At 58 Lawrence Street, Harlem, is the famous training school for all the fine, intelligent horses of the New York Fire Department. Here, says the New York *World*, the green horses are brought and trained to jump from their stalls at the first sound of the alarm gong and rush out to their stations, where they stand ready for the lightning-like adjustment of the harness, and quivering with impatience for the great doors to be thrown back, that they may whirl the ponderous engine or hose carriage out into the street. Veterinary surgeon Joseph Shea, who ranks as a captain in the department, is in command of this equine kindergarten, and is ably assisted by Foreman Lawrence Murphy, Firemen Patrick Haley and Thomas Clark.

About sixty perfectly trained horses are turned out from this school yearly. Captain Shea does not attend to the training as much as to the buying and matching of the animals. He goes at regular intervals to Bull's Head, buys those horses that his judgment tells him are what he requires, and, sending them to the school, leaves them in the hands of Foreman Murphy and his two assistants. It astonishes one to find how rapidly this training is accomplished. The average horse understands his new duties pretty thoroughly at the end of two days, and the least intelligent of them never takes longer than a week to learn the ropes. After thoroughly testing the green animal to find if his "wind" is in perfect condition, he is put in a stall and led backward and forward to his station before the engine some dozen times or so to accustom him to ducking his head to get under the collar and harness. Then he is left in his stall and coaxed to come forward under the harness himself by kind words and rewards of candy and apples. He is then taught to come forward at the clang of the gong, and after a little practice at this his education is complete, and he is transferred to one of the regular fire houses.

The system of training here is entirely that of kindness, and recourse to the whip is never necessary. The horses seem to like the work, and grow as enthusiastic over it as one of the old volunteer firemen. Of course horses that do this kind of work have to be both strong and speedy. Three hundred dollars is the average price paid for them, and they must be between sixteen and sixteen and one half hands high, weigh from 1,200 to 1,450 pounds, and be from four to six years old. Their usual length of active service is about five years. They are then auctioned off, and bring from $50 to $150.

This institution is also a kind of "hors-pital," and the fire horses that fall ill with distemper, or pinkeye, or become lame, are sent here to be nursed back to health. Captain Shea is fond of perfectly mated teams, and takes a great deal of extra trouble in transferring horses from one station to another, in order that, as nearly as is possible, every team in the department may be perfectly matched in size, appearance, and working qualities. The old chemical fire engines are used in the school for the horses to practice running with, and four of them have been racked to pieces since the establishment of this institution, March 23, 1882. The one now in use is the old Morrisania engine, and it looks as if it were on its last legs, or, more correctly speaking, on its last wheels.

This school was started merely as an experiment, and as such was provided with what was thought to be temporary quarters in an old engine house. It has proved a big success, but nothing has been done to improve the accommodations. The building is too small for the amount of work done there, and is in need of repairs. The general opinion of the firemen is that there should be nearly double the number of teachers there, and accommodations for twenty instead of seven horses, so that in the spring, when the going is always heavy and many horses ill from the hard work of the winter, there would be absolutely no danger of running short of trained animals. M. Surat, who came from France some years ago to study the methods of the New York Fire Department, was particularly struck with the equine training school, and when Chief Gicquel and President Purroy visited France a year, ago they saw in Paris a school on exactly the plan of this one, but fitted up more completely.

Atmospheric Electricity.

At a recent meeting of the Royal Meteorological Society, the president (Dr. Marcet) delivered an address on "Atmospheric Electricity." He first alluded to Franklin's experiments in America in 1752, in which he succeeded in obtaining the electricity of a storm cloud by conducting it along the string of a kite sent into the cloud. De Romas in Europe repeated the experiment, and having placed a wire within the twine his kite was attached to, obtained sparks of 9 feet or 10 feet in length. The characters of the two kinds of electricities were next described, the vitreous or positive, which was produced by rubbing glass, and the resinous or negative, obtained by rubbing sealing wax or other resinous substances; and it was shown by bringing suspended balls of pith within the influence of these electricities, that electricities of different kinds attract each other, and those of the same kind repel each other. De Saussure's and Volta's electroscopes were next described, pith balls being used in the former and blades of straw in the latter for testing the pressure of electricity. With the object of measuring the force of electricity, Sir W. Thomson's electrometer was mentioned, in which the electricity is collected from the air by means of an insulated cistern letting out water drop by drop, each drop becoming covered with electricity from the atmosphere, and running into the cistern, where it is stored up, and made to act upon that portion of the instrument which records its degree or amount. The atmosphere is always more or less electrical, or, in other words, possessed of electrical tension, and this is nearly always positive, while the earth exhibits electrical characters of a negative kind. The effects of atmospheric electricity were classed by Dr. Marcet under three heads: 1. Lightning in thunder storms. 2. The formation of hail. 3. The formation of the aurora borealis and australis. He explained how clouds acquired their electrical activity by remarking that clouds forming in a blue sky, by a local condensation of moisture, became charged with positive electricity from the atmosphere, while heavy dark clouds rising from below nearer to the earth were filled with terrestrial negative electricity, and the two systems of clouds, attracting each other, would discharge their electricity, giving rise to flashes of lightning. In some cases a storm cloud charged with positive electricity would approach the earth, attracting the terrestrial negative electricity, and when within a certain distance shoot out a lightning which would apparently strike the earth, but it would just as well have struck the cloud, only there was nothing in the cloud to sustain any damage, while on the earth there were many objects that lightning would destroy, to say nothing of its effects upon animal life. Thunder is the noise produced by the air rushing in to fill up the vacuum made by the heat of the lightning flash. There may be sheet lightnings, zigzag or forked lightnings, and globular lightnings. The latter are particularly interesting from their assuming a spherical form. Illustrations were given of objects struck by lightning, the most remarkable being, perhaps, the clothes of a working man which were torn into shreds while the man himself was not seriously injured.

Dr. Marcet next proceeded to show a flash of lightning, which he produced by throwing on a white screen the image of an electric spark 2 inches or 3 inches in length, enlarged by means of the lens of an optical lantern; forked lightning, 6 feet or 8 feet in length, with its irregular, zigzag course, was most clearly demonstrated. After alluding to the protecting power of lightning conductors and their construction, Dr. Marcet explained the formation of hail and of waterspouts, and exhibited an instrument by Professor Colladon, of Geneva, for showing the formation of waterspouts. He concluded his address with a few remarks on the aurora borealis and australis, the formation of which was illustrated by De la Rue's experiment, which consisted of successive discharges of electric sparks through a partial vacuum while under the influence of a powerful magnet. Electric sheets of light were seen assuming the form of bands, and possessed of a certain rotating motion.

In connection with this meeting a most interesting exhibition of instruments was arranged in the rooms of the Institution of Civil Engineers. The exhibition was devoted chiefly to instruments connected with atmospheric electricity. There were various forms of electrometers, including those formerly in use at the Greenwich and Kew observatories. Numerous patterns of lightning conductors were exhibited, together with models of churches, houses, chimney shafts, and ships, showing the various methods of protection. The postal department showed a number of lightning protectors used for telegraph purposes. Many objects damaged by lightning were exhibited, including lightning conductors, telegraph apparatus, portions of rafters, trees, etc., also the clothes of a man torn off his body by lightning. An interesting collection of meteorites and some alleged thunderbolts were shown, the latter being of an amusing character. There were also several new meteorological instruments exhibited, which had been brought out during the past year.

One of the special features of the exhibition was a most valuable and interesting collection of over fifty photographs of lightning flashes. Many of these were taken during the great thunder storm which occurred in London on August 17 last year, while others were taken in various parts of the world.

The exhibition also included a large number of photographs of damage by lightning, and photographs of clouds and meteorological instruments, as well as records of atmospheric electricity, etc.

The Yellow River of China.

The Yellow River, from the enormous rapidity of its volume when swollen by melted snow, is the worst of offenders. Its new bed, even in twenty-five years, has risen far above the plain, and as the dikes grow from hillocks into hills, from mere walls into ranges of earthworks like fortress sides, hundreds of miles long, the effort overtaxes the skill of the engineers and the perseverance even of Chinese laborers. The ablest engineers in India were beaten by the Damoodah, though it is, compared with the Hoang-Ho, like a trumpery European stream, and though the labor available could hardly be exhausted. The truth of the matter is that, in all such cases, the upper sections of the dikes cost too much for complete repair, and tend to be inadequate; and when the Yellow River, gorged with water from the mountains till it forms in reality a gigantic reservoir, averaging a mile broad, from 300 to 500 miles long and 70 feet deep, all suspended in air by artificial supports, comes rushing down in autumn, the slightest weakness in those supports is fatal.

On September 27, the river was at its fullest, its speed was at its highest, there was almost certainly a driving wind from the west, a bit of dike gave way, the rent spread for 1,200 yards, and—our readers remember, for Charles Reade described it, the rush into Sheffield of the Holmfirth reservoir. Multiply that, if you can, by 2,000, add exhaustless renewals of the water from behind—five Danubes pouring from a height for two months on end—and instead of a long valley with high sides which can be reached, think of a vast, open plain, flat as Salisbury Plain, but studded with 3,000 villages, all swarming as English villages never swarm, and you may gain a conception of a scene hardly rivaled since the deluge. The torrent, it is known, in its first and grandest rush, though throwing out rivers at every moment at every incline of the land, had for its center a stream thirty miles wide and ten feet deep, traveling probably at twenty miles an hour—a force as irresistible as that of lava. No tree could last ten minutes, no house five, the very soil would be carried away as by a supernatural plowshare, and as for man—an ant in a broken stop cock in a London street would be more powerful than he. Swim? As well wrestle with the Holyhead express. Flee? It takes hours in such a plain to reach a hillock three feet high, the water the while pouring on faster than a hunter's gallop. There is no more escape from such a flood than there is escape from the will of God, and those Chinese who refused even to struggle were the happiest of all, because the quickest dead. Over a territory of 10,000 square miles, or two Yorkshires at least (for the missionaries report a wider area), over thousands of villages—3,000 certainly, even if the capital is not gone, as is believed—the soft water passed, silently strangling every living thing, the cows and the sheep as well as their owners; and for ourselves, who have seen the scene only on a petty scale, we doubt whether the "best informed European in Pekin" is not right when he calculates the destruction of life at 7,000,000.—*The Spectator* (*London*).

A Novelty in Voting.

Messrs. Richard H. Dana and Morrill Wyman, Jr., have prepared for the committee on election laws of the Massachusetts legislature a ballot which is, says the *Nation*, in many respects, the best measure of the kind we have yet seen.

Their bill opens with a provision that all ballots shall be printed and distributed at public expense. Upon that point there is no longer any division of opinion, everybody conceding the wisdom of taking from the political organizations the dangerous and corrupting control of the ballots which have been so long in their hands.

Each ballot "shall contain the name, residence (with street and number in city elections), and party or political appellation of every candidate whose nomination for any office to be specified in the ballot has been duly made," the names to be arranged in alphabetical order, except that presidential electors are to be arranged in a separate group. The provision for distributing the ballots to the election officers at the polls is so specific and so interesting as an effective means for preventing forgery of the official ballots that we give it in full:

"Section 14. The secretary of the commonwealth shall send the proper ballots, specimen ballots, and cards of instruction printed by him, to the several city and town clerks, so as to be received, one set at least forty-eight hours before the day of election, the other set sent separately so as to be received at least twenty-four hours before the day of election. These ballots, specimen ballots, and cards shall be sent in separate sealed packages clearly marked on the outside for the polling place for which they are intended, and the number of ballots inclosed. The ballots, specimen ballots, and cards of instruction printed by the city clerks shall each set be packed in separate sealed packages clearly marked on the outside for the polling precincts for which they are intended. The city and town clerks shall send to the several officers of each precinct or to the selectmen of the town before the opening of the polls on election day, in the manner in which the ballot boxes are required to be sent, one full set of the packages of ballots, specimen ballots, and cards intended for that polling place, keeping a record of the number of ballots sent to each polling place. The second set shall be retained until they are needed for the purposes of voting. At the opening of the polls in each polling place the seals of the packages shall be publicly broken and the packages opened and the books of ballots handed to the ballot officers hereinafter provided for by the precinct officer or the selectmen of the town presiding at such polling places. The cards of instruction shall be posted in each place provided for the marking of the ballots, hereinafter provided for, and not less than three such cards, and also not less than five specimen ballots, posted in and about the polling place outside the guard rails, before any ballot is delivered to any voter."

When the voter receives his ballot, after he has shown that he is entitled to vote, he must go alone into a compartment and check with a cross in the margin of the ballot the names of the candidates for whom he wishes to vote. Then he must fold his ballot so that the official indorsement on the back will be visible, and, coming from the compartment, deposit it in the ballot box. No ballot without the official indorsement can be received by the officers in charge of the ballot boxes, and if any such should get in, it must be thrown out in the counting. Any voter who allows his ballot to be seen by any person with the apparent intention of letting it be known how he has voted or intends to vote, or any person who interferes or attempts to interfere with any voter while marking his ballot, or who attempts to ascertain in any way how he has voted, shall be punished by a fine of not less than $5 or more than $100.

Adulterated Lard.

BY STEPHEN P. SHARPLES, STATE ASSAYER, MASSACHUSETTS.

In the interest of pure food the testimony of Mr. N. K. Fairbanks and Mr. Webster, before the Committee on Agriculture of the United States Senate, should have wide circulation.

They testified that "all of the lard on the market marked 'Prime Family Refined Lard,' 'Choice Refined Lard,' and other brands of this nature is mixed with more or less beef stearin and cotton seed oil."

As it is well known that cotton seed oil is a semi-drying oil, having strong siccative properties at the temperature of 212° F., this admixture unfits the lard for many uses.

It is impossible to make good biscuits with such a compound, as they rapidly become rancid.

The above gentlemen represent two of the largest firms in the so-called "refining" business in Chicago.

The refining of lard consists solely in adulterating it with cotton seed oil and oleostearin.

These mixtures may be easily detected. The usual tests for detecting cotton seed oil in olive oil answer every purpose. Bechi's test, as given in the *Analyst*, gives good results. Lard is without action on the solutions used. Nitric acid of 1·35 specific gravity gives only a faint color with pure lard, with lard adulterated with cotton seed oil it gives a color more or less intense, varying with the quality and quantity of the oil used. For the beef stearin the best test is that proposed by Dr. Belfield, of Chicago, as follows: The suspected lard is dissolved in ethylic ether, so as to form a nearly saturated solution. This is best done in an ordinary five inch test tube, which should be about two-thirds filled with the mixture. The top of the tube is then loosely stopped with cotton wool, and it is placed in a quiet place, at a temperature of about sixty degrees, and allowed to stand until crystals commence to form. These crystals are removed from the tube with a dipping tube and placed on a microscope slide; they are quickly covered with a thin cover glass, pressed enough to flatten the grains, and then examined with a quarter inch objective.

Pure lard gives large flat plates with well defined oblique terminations. These are sometimes in radiated groups, but often occur singly. Beef fat always crystallizes in radiating tufts, often resembling wheat sheaves, and the crystals are either pointed or else have nearly square terminations. They are always, however, much more slender than the lard crystals.

Watering lard has almost become one of the lost arts. Only one sample from nearly a hundred examined had any marked amount of water. This one, however, had over forty per cent. It was kept in combination by means of an alkali.—*The Analyst.*