DAVIS' QUILTING FRAME.

The engraving shows a new and valuable attachment for all family sewing machines. By its use one lady can make a full size quilt within two hours, a heavy comfortable in one hour, can also quilt children's winter cloaks, bonnets, dress skirts, and coat linings, and do all manner of quilting, from the largest size quilt to the smallest cloak. It is easily understood and operated. The lining of the article to be quilted is rolled up on one of the outside rollers, and the top of the quilt is rolled up on the top outside roller, and when the cotton or wool is to be placed on the lining, the top roller is lifted out of its place and laid back on the machine table, and the cotton placed on the lining, and then the top roller is returned to its place; these operations are repeated until the quilt is finished.

This quilting frame is manufactured by the Davis Quilting Frame Co. Further particulars can be had from the inventor, Mr. Henry T. Davis, 182 and 184 West Houston Street, New York city.

Antiquity of Wheat.

President Charles Barnard, in an article in the *Century* for January, says that the wheat plant is one of the oldest in cultivation. The Chinese recorded its culture as early as 2700 B. C., and it is one of the prehistoric plants, remains of wheat seeds being found in the ruins of the houses of the lake dwellers. While there are several races of wheat, and while these have been crossed, producing hybrids, it has retained its true character, and been entirely independent of other plants since its culture began. Compared with wheat, rye is a modern plant. It is not figured on any Egyptian monuments, and seems to have been first cultivated in the Roman empire about the beginning of the Christian era, though it may have been known somewhat earlier in Russia and Tartary. While these two commercial plants have been cultivated side by side for centuries, the first plants appearing to be true hybrids between them bore seeds this year in this country. Wheat and rye may have been crossed before, yet there appears to be no record of anything like the results here obtained.

Art of Making Butter.

Under this title the Patent Office has lately granted a patent to Lyman Guinnip, of Chicago, Ill., for the following:

Take, say, one gallon of cream, keep it in temperature of 60 deg. to 64 deg. for 36 hours, or so that it will clabber; take another gallon of cream, keep in same temperature for 24 hours; put both into a churn, and churn one minute. Then turn out one-third of the mixture and put one pound of butter into this one-third and stir well and let it stand, while you continue churning the two-thirds remaining until seeds of butter appear; then add or put in eight pounds of butter and churn four minutes; then return the one-third which you had previously taken out, and churn the whole until butter is made. If you desire to color the butter, this should be done just before you cease churning.

To make butter from milk only, you follow the same process, and keep the proportions the same. I use no chemicals whatsoever, and make the butter pure and sweet from milk or cream only. The butter put into the churn, if it be of an inferior quality, will come out vastly improved, the rancid part disappearing with the water of the milk.

DAVIS' QUILTING FRAME.

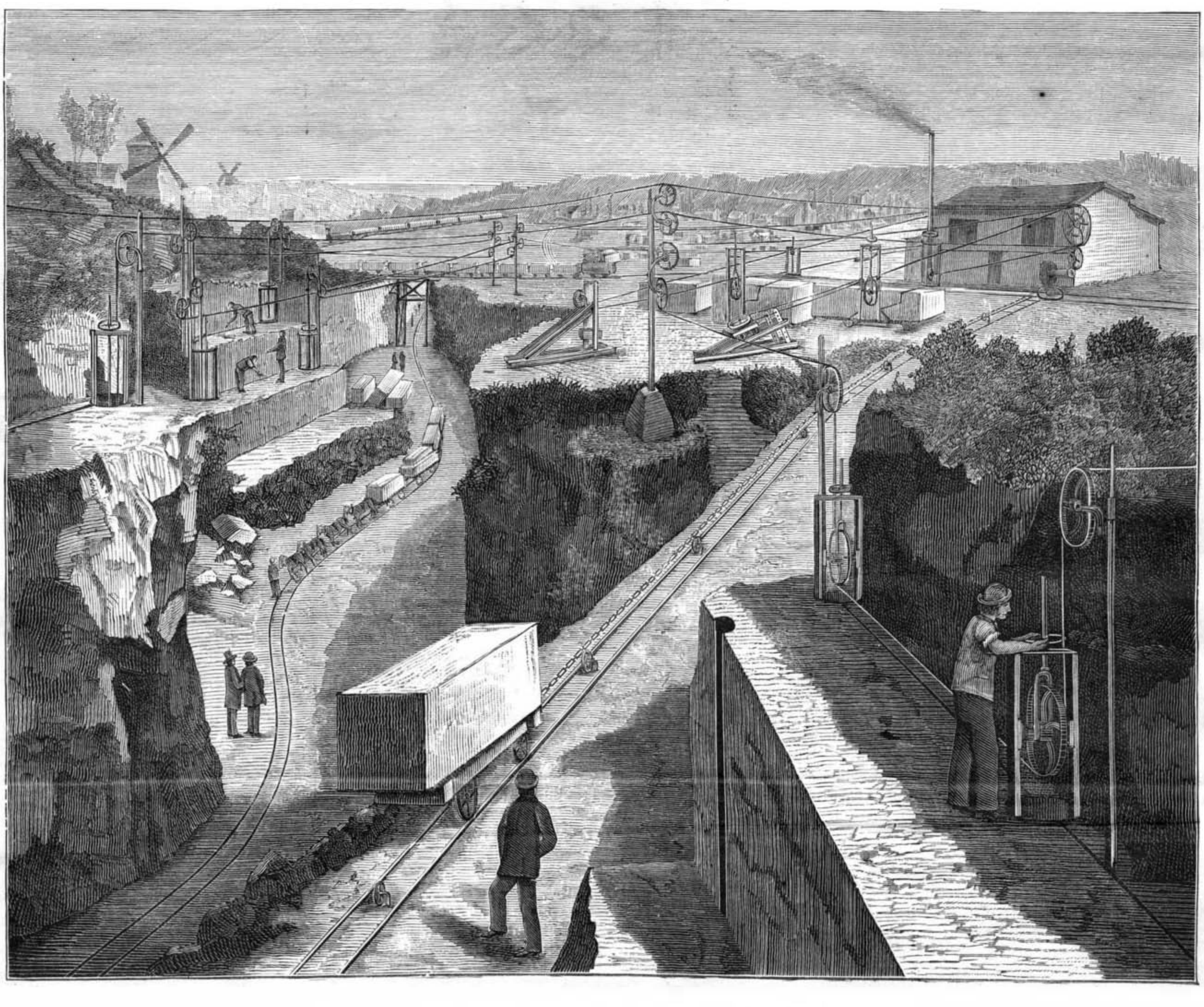
THE HELICOIDAL OR WIRE STONE SAW.

The sides of solid bodies, whatever be the degree of hardness, and however fine the texture, possess surfaces formed of a succession of projections and depressions. When two bodies are in contact, these projections and indentations fit into one another, and the adherence that results is proportional to the degree of roughness of the surfaces. If, by a more or less energetic mechanical action, we move one of the bodies with respect to the other, we shall produce, according as the action overcomes cohesion, more or less disintegration of the bodies. The resulting wear in each of them will evidently be inversely proportional to its hardness and the nature of its surface; and it will vary, besides, with the pressure exerted between the surfaces and the velocity of the mechanical action. We may say, then, that the wear resulting from rubbing two bodies against each other is a function of their degree of hardness, of the extent and state of their surface, of the pressure, of the velocity, and of the time.

According as these factors are varied in a sense favorable or unfavorable to their proper action, we obtain variations in the final erosion. Thus, in rubbing together two bodies of different hardness and nature of surface, we obtain a wear inversely proportional to the hardness and state of polish of their surfaces. Through the interposition of a pulverized hard body we can still further accelerate such wear, as a consequence of the rapid renewal of the disintegrating element.

The gradual wear effected over the entire surface of a body brings about a polish, while that effected along a line or at some one point determines a cleavage or an aperture.

The process usually employed in quarries or stoneyards for sawing consists in slowly moving a stone saw backward and forward, either by hand or machinery, and with scarcely any pressure. Mr. P. Gay, of Paris, has, however, devised a new process, which is based upon the theoretical considerations given above. His *helicoidal saw* is, in reality, an endless cable formed by twisting together three steel wires in such a way as to give the spirals quite an elongated pitch.



APPLICATION OF GAY'S STONE SAW IN A MARBLE QUARRY.

The apparatus in its form for cutting blocks of stone into large slabs consists of two frames, placed several feet apart, each formed of two iron columns, 7½ feet in height, fixed to cast iron bases. The upper part of the frame supports a transmission composed of gear wheels and a pitch chain. Along the columns of the frame, which serve as guides, move pulley carriers. The pulleys are channeled, and receive the cable, which serves as a helicoidal saw. The carriages are traversed by screws, which are fixed between the columns. The extremity of the axle of the pulley to the right is threaded, and actuates a helicoidal wheel, which transmits motion to the wheel. The transmission, completed by the wheels and the pitch chains, is designed to move the saw vertically, through the simultaneous shifting of the carriages. A tension weight, through the intermedium of pulleys, permits of keeping the saw taut. A reservoir, at the upper part of the frame, contains the water and sand necessary for sawing. The feeding is effected by means of a rubber tube, terminating in a flattened rose, which is situated over the aperture made by the saw. A small pump, over the reservoir, raises water. The sand is put in by hand.

A system of rails and ties supports the carriage, upon which is placed the block of stone to be sawn. When one operation has been finished, and it is desired to begin another, it is necessary to raise the pulley carriers and the saw. In order to do this quickly, there is provided a special transmission, which is actuated by hand, through a winch.

The work done by this saw is effected more rapidly than by the ordinary processes, and certain very hard rocks, usually regarded as almost intractable, can be sawed at the rate of from one to one and a half inches per hour.

For sawing marble into slabs of all thicknesses, the arrangement described above may be replaced by a system consisting of two drums having several channels to receive as many saws, or two corresponding series of channeled pulleys, independent of each other, but keyed to the same axles. When the pulleys have been properly spaced by means of keys, the whole affair is rendered solid by a bolt. The extremity of the axles forms a nut into which pass vertical screws. These latter are connected above with cone wheels, which, gearing with bevel wheels keyed to the shafts, secure a complete interdependence of the whole. The ascending motion, which is controlled by endless screws and the helicoidal wheels, is in this way effected with great regularity.

The power necessary to run this kind of saw is less than $n \times \frac{1}{4}$ H. P., on account of the number of passive parts. The most interesting application of the helicoidal saw is in the exploitation of quarries. Our engraving represents a Belgian marble quarry which is being worked by Mr. Gay's method.

Tubular Perforators.—Mr. Gay has rendered his saw completer by the invention of a tubular perforator for drilling the preliminary well. It is based upon the same principle as the Leschot rotary drill, but differs from that in its extremity being simply of tempered steel instead of being set with black diamonds. A special product, called metallic agglomerate, is used instead of sand for hastening the work.

The apparatus consists of an iron plate cylinder, 27½ inches in diameter, and of variable length, according to the depth to be obtained, and terminating beneath in a steel head of greater thickness. This cylinder is traversed by a shaft, to which it is keyed, and which passes through the center of the aperture drilled. This shaft is connected with the cylinder through the intermedium of cross bars, and transmits thereto a rapid rotary motion, which is received at the upper part from a telodynamic wire that passes through the channel of the horizontal pulley. This latter is supported by a frame consisting of three uprights, strengthened by stays, fixed to the ground.

In order that the cylinder may be given a vertical motion, cords, fixed to a piece loose on the hub, wind round the drum of a windlass, after passing over the pulleys.

The rapid gyratory motion of the cylinder, along with the erosive action of the metallic agglomerate, rapidly wears away the rock, and causes the descent of the perforator. During this operation a core of marble forms in the cylinder. This is detached by lateral pressure, and is capable of being utilized. The tool descends at the rate of from 20 to 24 inches per hour, or from 8 to 10 yards per day in ordinary lime rock.

Our engravings, for which and the above particulars we are indebted to *Le Genie Civil*, show the application of the system to quarry working, where all of the various saws and drills are operated by a single engine, with which they are connected by wires as represented.

THE lowest recorded temperature, 393° below zero F., has been produced by Olszewski, by vaporizing liquid nitrogen under low pressure.

Rattlesnakes and Their Peculiarities.

BY HENRY GUY CARLETON.

There has been more fiction than truth written about the rattlesnake, and by the public at large he is as little understood or appreciated as are those larger and more fanciful ophiological curiosities said to be sometimes discovered by convivial gentlemen in their boots. He is simply known to be a bold and bad reptile, with a musical tip to his tail; is popularly supposed to warn thrice before striking once; and, according to paragraphs widely disseminated by the daily press, infests remote ravines and caves in miraculous numbers, and is there slaughtered by the natives partly for fur and partly for his oil, which is said by old women and other eminent medical authorities to possess curative virtues in an invaluable degree. It is likewise asserted that the rattle is a sort of calendar, by which the snake reckons up his age, he promptly adding one button each New Year's day that finds him alive. In reality, he grows two or three rattles a year, if he wishes them. Also, it is claimed that the only refuge for the victim of a rattlesnake's bite is a violent state of intoxication. This recipe is clearly of homeopathic origin, for the venom of the real snake which did the biting must evidently be supposed to be counteracted by that of the imaginary serpents which the demijohn will assist the bitten gentleman to discover. Whisky, however, is an excellent remedy, taken either before or after the bite.

In truth, the rattlesnake is quiet and unobtrusive, minding his own business, and merely asking to be let alone. In the early summer he thaws himself by liberal exposure to the sun, and soon shakes off the torpor of his long sleep, and proceeds to fatten up. Later in the season he seeks the shade, and is not averse, on hot days, to lying at full length in water of pleasant temperature, especially in pools abounding with frogs, where he may combine bathing with luncheon. His rule of diet is simply to eat all he can get, his favorite edibles being birds, frogs, and field mice, which he steals upon and catches with great dexterity.

Birds which nest in trees are safe from his ravages, unless curiosity or accident brings them within his reach, but those which nest in low bushes or on the ground fill him with dinner and satisfaction. If the parent bird is alert and discovers him, the rattlesnake compensates himself by cheerfully devouring the eggs or the brood. Generally, the mother that is or is to be resents what she justly considers an impertinent intrusion, and once within striking distance is added to the bill of fare. All birds hate the rattlesnake, but nearly all will foolishly undertake to fight him, and this is the foundation of the absurd theory that the rattlesnake "charms" his prey. A snake has no more power to charm a bird than a rabbit has to play the fiddle. I have several times been a witness of encounters between snakes and birds, and each time have been convinced that the bird was endeavoring to frighten the snake from her nest, or to punish him for his larceny.

We all know that birds are not cowards. I have frequently seen two or three small finches attack a hawk or an eagle, and make his life a burden to him, even going so far as to perch on his back and make him a bald eagle, whether that was his species or not. An English sparrow will cheerfully undertake to thrash a bird four times his weight, and even the mild-mannered dove will fight the intruder who enters her cote, be he cat or man. A bird's confidence of flight makes her rash in regard to snakes. She sees a rattlesnake near her nest, and at first takes wing; but on observing the lethargic quality of her opponent, proceeds to sit on a convenient twig and scold. Meanwhile the snake has lazily invaded the nest. Having exhausted all the profanity she knows, and emboldened by the snake's sluggishness, the bird comes nearer, wings outstretched and quivering, feathers ruffled, and beak open—all symptoms of anger, not fear. The snake slowly gathers for a spring, and remains perfectly still. Each moment of his inaction serves to make the bird more aggressive, and tempts her nearer. At last the dead-line is reached, there is a lightning-like straightening of the hideous folds, and the poor little misguided warrior feels the stab of those dreadful needles whose touch is death. If she had had as much horse-sense as pluck in her pretty pate, she would have taken the matter philosophically and gone off and laid more eggs, and laid them in a high tree, instead of staying for a row. But ladies are the same the world over, whether in feathers or not. One thing is certain—when a snake captures a bird, he does it less by his own prowess than by the natural tomfoolery of the bird, and he certainly effects nothing by "charming."

Another picturesque error regarding the rattlesnake is the supposition that when spoiling for a fight he coils himself up like a doughnut or a halyard on board of a man-of-war. The snake simply gathers himself in irregular folds, like a series of superimposed S's. It is also alleged that he can spring to immense distances—ten feet, may be—and so attack his victim in midair. This is another lie. A snake can at best strike at three-fourths of his own length, and rarely accomplishes that in actual warfare. I attacked an eight-foot rattlesnake in Texas with a four-foot stick, and got decidedly the best of it. It is also preposterous to state that a rattlesnake rattles thrice before he strikes. Let an apostle of this creed step on an able-bodied rattler, and then argue his theory. I have seen a rattlesnake in July lie in the shade and rattle steadily for an hour. He was either amusing himself or perhaps taking a music lesson, for he did not see me, and there was no other enemy in sight, and I am sure he had no intention of biting himself. Again, in New Mexico, I have known a rattlesnake to strike a horse without emitting the least note of warning.

The common or "banded" rattlesnake, *Crotalus durissus*, inhabits the entire country south of the 46th parallel. He is generally inoffensive, except when he has reason to believe that he is in danger, or is actively attacked, when he defends himself as best he knows how. As I said before, his prey is in the main small birds, mice, and jumpers, but he finds chipmunks, squirrels, and even rabbits palatable, although more difficult to acquire a proprietary interest in. I helped once dissect a rattlesnake with an immense lump amidships, which proved to be a full-sized and half-digested jackass rabbit. The snake's neck was not two inches in diameter, and I leave others to explain how he wrapped himself around that rabbit.

The water rattlesnake, *Crotalus adamanteus*, is a native of the Carolinas and Florida, and is of greater weight and size, often attaining a length of 9 feet. His favorite practice is to lie in the tepid pools of that region, and scare fishermen. He is a rapid swimmer, as indeed are all rattlesnakes, but is lazy on land. It is said that the alligator, although possessing almost as little sense as a Fenian, is intelligent enough to let the water rattlesnake alone, and indeed I have seen the two sharing the same log in a swamp, taking a social sun bath together.

The largest rattlesnakes are in Texas, on the lower Rio Grande, where they sometimes attain a length of 12 feet, and are heavy in proportion. The smallest are the "horned" rattlesnakes of Arizona, New Mexico, and Southern California, which seldom reach a length of two feet. They have two little excrescences over the eyes, and are full of devilment. They have rattles, but seldom use them, preferring to lie half hidden in the sand until stepped on, when they remonstrate. The sand or "desert" rattlesnake is also small, and pretends to be on neighborly terms with the prairie dog, whose burrows he occupies. I have reason to believe that when the rattlesnake inserts himself in the bosom of a prairie dog's family, he does so on fraudulent grounds, and is unwillingly entertained. The prairie dog carries no life insurance, and cannot afford a quarrel, and the snake is mean enough to take advantage of him.

There is a little, brown, and very comical owl who likewise takes up residence with the prairie dog, but he makes at least a show of earning his rent by remaining at the entrance and acting as janitor, politely bowing to everybody who passes. Neither snake, dog, nor owl seems to mind the other's presence, but are exceedingly sociable. The strange companionship is explained thus: The prairie dog's burrow is the only shelter afforded the snake from the intense heat of those arid plains; and as the dog always sinks a well on his premises, it is the snake's only means of getting water, and I have demonstrated to my satisfaction that rattlesnakes speedily perish without it. In return for this hospitality, the rattlesnake takes charge of the census, and thoughtfully prevents the prairie dog from accumulating a larger family than he can conveniently support.

The horned rattlesnake is endowed with the power of moving forward, backward, or sideways with equal facility. It is related that a German naturalist went to Arizona, and one day came across a horned rattlesnake sunning himself on the edge of a prairie dog's burrow. The naturalist had no stick, but was frantically eager to secure the snake, which was retreating down the hole. So he pulled him out by the tail, and then sprang back to avoid unpleasant consequences. The snake again started down, and again was dragged out by the tail. This time the snake cocked one eye at the naturalist, worked his under jaw in a significant manner, and went down tail first. The naturalist went home.

The rattlesnake's sole means of offense and defense is his pair of fangs, which are two slender, needle-like teeth, jutting from the upper jaw just under the eye. In structure, they resemble the point of a hypodermic syringe, but are not quite as useful. A small channel perforates the tooth, conducting the venom from the gland and sac in which it is engendered to within about the tenth of an inch from the point. The point is of pure enamel, is hard, and of proverbial sharpness. When the snake is feeling pleasantly, the two fangs lie flat against the roof of his mouth; but when he opens his countenance for business, they are erected by a set of muscles provided them, and stand at right angles to the jaw. Thus in position, the snake drives them home by darting his head forward, and by a powerful compression of the temporal muscles the venom is injected deeply into the wounds. In rattlesnakes of ordinary size, 3½ or 4 feet, the fangs are about three-fourths of an inch in length, but I had a pair given me in Texas which measured nearly two inches.

The venom is a thin, clear fluid, resembling serum, of a slightly bluish cast in some specimens and yellowish in others. Its specific gravity is slightly greater than water, in which it is freely soluble. Placed in alcohol, a portion dissolves, and is harmless. The rest coagulates in stringy masses like albumen, and is the poisonous element. Heat coagulates the entire mass easily, and a slightly musky and disagreeable odor is emitted. The venom contains saline matter and phosphates, forming groups of crystals under the microscope, which also detects globules of fatty matter. Acetic acid dissolves it, and keeps its properties unimpaired for years. I accumulated quite a quantity of the venom some years ago, and tried a number of experiments to determine its physiological and chemical properties. It was neutral with both litmus and turmeric. Placed in contact with fresh blood, however, it became rapidly acid, emitted a musky odor, and coagulated fibrin rapidly. It also acted as a putrefacient. I divided a fresh liver, and injected a drop of rattlesnake venom in one half. Exposed under similar conditions, this piece was putrid in a few hours, while the other was untainted for over a day. These two actions give a hint of its deadly quality. First, it acts as an irritant; secondly, coagulating the fibrin and choking up the capillaries, it will produce local thrombosis and act as a mechanical poison; and, thirdly, by its putrefacient effect induce general pyæmia or gangrene in the wounded limb. Thus, also, it can be seen why alcohol is indicated. By stimulating the heart, the blood will flow too rapidly to coagulate, or those filaments of fibrin partially formed will be forced through into larger channels, where they may be redissolved, and the tendency to putrefaction will also be neutralized and checked. The danger from irritation alone is comparatively slight, but even this is lessened by the stimulant.

I rusted several needles with nitric acid, and then gave them a coat of venom, to try some experiments with animals. A mouse, on being punctured in the leg, died in less than a minute, there being but one spasmodic convulsion. Rabbits, a few seconds after the wound was given, gave one wild leap and fell struggling, death ensuing in three or four minutes, the breathing being labored and irregular, as though by paralysis of the pneumogastric nerve. I buried an abundantly coated needle in the thigh of a cur. He emitted a little yelp of surprise, then trotted off unconcerned. Suddenly he stopped, as though he had forgotten something, then tried to proceed, but his hind quarters sagged and refused to move. I approached. His eyes were bloodshot, fixed, and staring, hair erect, lips retracted, and tongue protruding. His respiration was labored and irregular, and he emitted a cry that was half moan, half howl, as with mingled pain and terror. Suddenly he went into a convulsion, which recurred at short intervals for twelve minutes, when he died. Cats behaved more violently, frothing at the mouth and giving vent to terrible cries, death not coming to their relief for thirty minutes or more.

On frogs the effect was electric; the luckless batrachians simply stretched out, quivered, and yielded up the ghost. A goldfish turned belly up in four minutes, and in eleven minutes was dead. A rattlesnake was dosed, and after eight minutes of active contortions gave but feeble signs of life for one hour and ten minutes, and then was still. Post mortem examination showed an anæmic condition of the brain and an engorgement of the ventricle with dark clots, but no other signs. Applying the stethoscope to a dog strapped down and punctured, I found the action of the heart to be at first violent, but regular, and then irregular and weak. Four drops, administered to a dog internally, seemed to have a marked sedative effect, but the symptom soon passed away. I was encouraged by this into taking one drop myself, diluted largely with water and taken through a tube. I fancied there was a slight increase and irregularity of heart action, and certainly muscular relaxation sufficient to produce a marked perspiration, but the effect was temporary. If this experiment should be repeated, I would caution the experimenter to be sure he has no abrasion on lip, tongue, or palate, and that his teeth and gums are sound, or he may have to record symptoms not in the above catalogue of my experience.

I concur in the belief that, admitted to the circulation, rattlesnake virus paralyzes the heart, but I believe the effect is first rather cerebral than directly cardiac. I have no doubt embolism occurs in many cases where the poison has reached a large vein and is carried directly to the heart, exercising its coagulant power there; but this is the exception, and not the rule. At all events, ammonia is indicated, and, in conjunction with a liberal use of alcohol, I believe it to be the best remedy which can be applied. To lance the wound promptly, after tightly binding the injured limb above the wound, would be efficacious in lessening the danger; but in any case whisky and ammonia in small doses, frequently repeated, will be a necessary resort.

I have seen the Apaches on the Tulerosa Reservation, in New Mexico, take a deer's liver, induce a rattlesnake to strike it repeatedly, allow it to get putrid, and then smear their arrow heads with it, but unless freshly used the virus so applied would have no effect. Exposed to air, it quickly loses its properties, particularly when in contact with serum or fibrin.

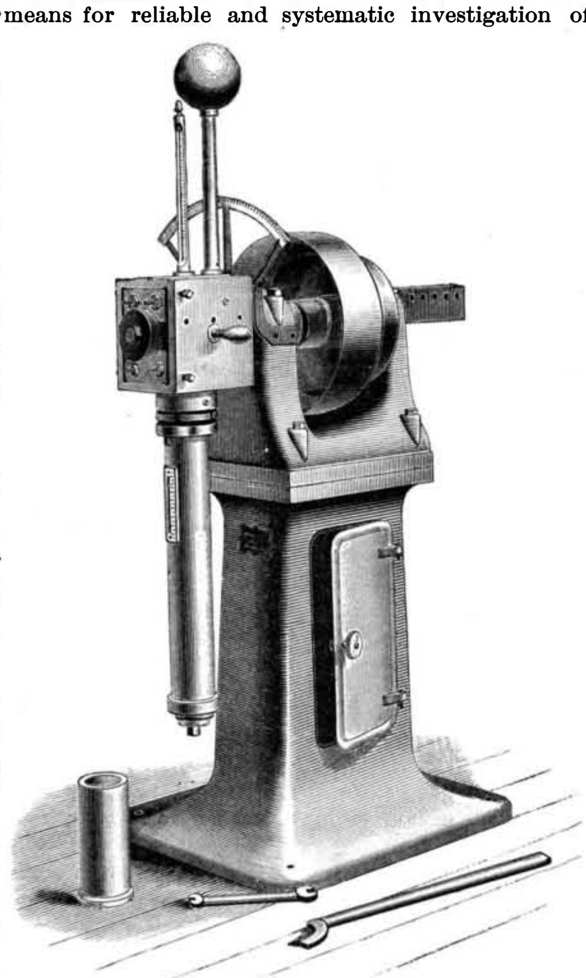
In quantity, the venom injected by a large and active rattlesnake is about four minims, or two for each fang. He can strike twice or thrice in rapid succession with deadly effect, but soon the glands are unable to keep up the supply, and he will require some minutes to recuperate. Snake charmers usually sear the glands with a hot iron, leaving the fangs intact, but only capable of making a slight flesh wound. Too much care cannot be exercised in dissecting a rattlesnake's head, for the glands secrete for some time after death, and a little of the virus goes a long way.

During the hot days of August and September, the rattlesnake is indolent and very ill tempered. This is the season when they are supposed to be blind, but it is laziness, and not ophthalmia, which induces them to wait till they are trodden upon before moving. This is also the time when they lie in the grass near streams to avoid the heat and waylay the frolicsome frog. I suppose trout fishermen know this, for I notice they always carry a bottle of antidote.

In New Mexico and on the Staked Plains in Texas, where the nights are cool, it is the rattlesnake's sociable custom to crawl between a traveler's blankets and snuggle close to him till morning. Numbers of them are killed in camp every year by soldiers campaigning in that section; but as the rattlesnakes never abuse hospitality by biting the sleeper, few accidents happen. Still, there are men who, when out on a hard march, prefer to sleep alone.

THURSTON'S STANDARD RAILROAD OIL TESTING MACHINE.

This machine has been specially designed to provide means for reliable and systematic investigation of



THURSTON'S STANDARD RAILROAD OIL TESTING MACHINE.

the value of the various lubricating oils used in railway service, and for all purposes for which it is essential to reduce to a minimum the friction of bearing surfaces under heavy pressures; securing economy in power required, and determining the best, and consequently the *cheapest*, oils for lubricating purposes.

Additional advantages secured in this machine are those due to rigidity and careful fitting of the separate parts, while the whole machine is arranged with special reference to convenience of operation.

The journal, which is Master Car Builders' standard, 3¾ inches diameter, is a hardened steel sleeve, ground perfectly cylindrical.

The boxes in which this journal runs are of phosphor bronze, and are designed for internal water circulation.

A late improvement includes a thin lining of phosphor bronze or other metal ordinarily used, which can be accurately weighed before and after a test, thus determining the percentage of wear for any given metal and mileage. The linings are made perfectly interchangeable, and can be renewed at any time, or special linings of any other metal or alloy may be inserted, using the same water brasses.

Pressures up to 9,000 pounds are obtained by the use of a heavy helical spring secured within a 4 inch wrought iron pendulum tube. By a convenient taper key adjustment (not shown in the cut), the pressure may be easily and quickly relieved for removal of the pendulum and brasses, for inspection of the latter or of the journal, without release of pressure of the spring by the ordinary means, the latter being, obviously, a tedious operation.

The standard water brasses may be replaced by the ordinary brasses used in freight or passenger service, if desired, giving actual conditions, in this respect, under which the test may be conducted.

Friction at the surface of the journal is indicated on a graduated arc, conveniently placed above the pendulum.

The tendency of friction between the surfaces of the journal and brasses is to rotate the heavy pendulum; hence to give as great a range as possible, and thus render this function an important adjunct, and also to enable the observer to note small variations of resistance, a form of compound pendulum is adopted, as shown in the illustration.

A standard thermometer, graduated 40° to 350° Fah., and Centigrade to correspond, is inserted to indicate, as nearly as possible, the exact temperature of the surfaces in contact. A positive automatic revolution counter is attached, registering up to 1,000,000, affording ready means for determining the comparative mileage run during any investigation.

Speeds corresponding to rates usual for train service, either freight or passenger, are obtained by the use of a countershaft having two pairs of tight and loose pulleys, 10 inches diameter, 6¼ inches face, and 18 inches diameter, 4⅝ inches face, respectively. A two grade cone, 4¼ inches face, gives ample belt efficiency for the four speeds thus obtained. The countershaft should run 150 and 430 revolutions per minute.

An extra journal sleeve of wrought axle iron, wrenches, and countershaft complete, furnished with each machine.

As a valuable office hand-book covering this important subject, we would refer to Professor R. H. Thurston's "Friction and Lost Work in Millwork and Machinery," published by John Wiley & Sons, New York.

This improved testing machine for lubricants is now built by the Pratt & Whitney Company, of Hartford, Conn.

The Metzdorff Pianoforte Improvements.

For many years, pianoforte manufacturers have experimented in the construction of instruments which will mechanically facilitate the transposing of music, so that any given piece may be conveniently played in any desired key, while the player would still use the same keyboard. Such devices heretofore have not been sufficiently perfected, consequently have never obtained wide recognition, although musicians and instrument makers are well aware of the importance and value of a good practical invention of this character. The difficulties hitherto experienced are obviated, it is claimed, by a recent invention of Mr. Louis Metzdorff, of Concepcion, Chili, who has made use of the left pedal, as now found in the pianos of some of our best manufacturers, to raise the hammers and other parts of the action, so as to leave the keys in a vacant space beneath, and permit the lateral adjustment of the keyboard as required. The keyboard is also lengthened for additional keys, and it is so devised that these additional keys are moved under or out from the hollow side parts of the piano case by laterally moving the keyboard in either direction, to the extent of a whole octave, either up or down the scale.

The application of this invention to the instrument does not interfere with or impair the usefulness of any of the many other modern improvements which have imparted to the piano its extraordinary and comprehensive power as an interpreter of musical ideas. The Metzdorff improvements aim to widen the sphere of usefulness of this noble instrument, by adapting it to any varied degrees of musical culture, so that compositions may be more widely brought within the scope of singers whose voices may not cover the scale in which a score had been originally written. It also applies with equal advantage to accompanying other instruments, such as the violin, flute, etc., by adapting itself to their pitch.

Mr. Metzdorff has obtained a patent on this improvement in the United States and several other countries, and now aims to arrange for its general introduction. Further particulars can be obtained by communicating with Messrs. J. Parker Read & Co., *Tribune* Building, New York, who have for exhibit a piano with this invention applied.

Error in the Balance.

A current of air may be produced if an evaporating fluid in a beaker is placed upon one scale. The error may amount to 0·4 mg. A source of error, less common, but sometimes more serious, is electric action produced by friction of the balance case and consequent attraction of one scale pan. T. E. Thorpe (*Journal Chem. Soc.*) calls attention to small daily fluctuations of the zero point.—*R. Hennig.*