SCIENTIFIC AMERICAN

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

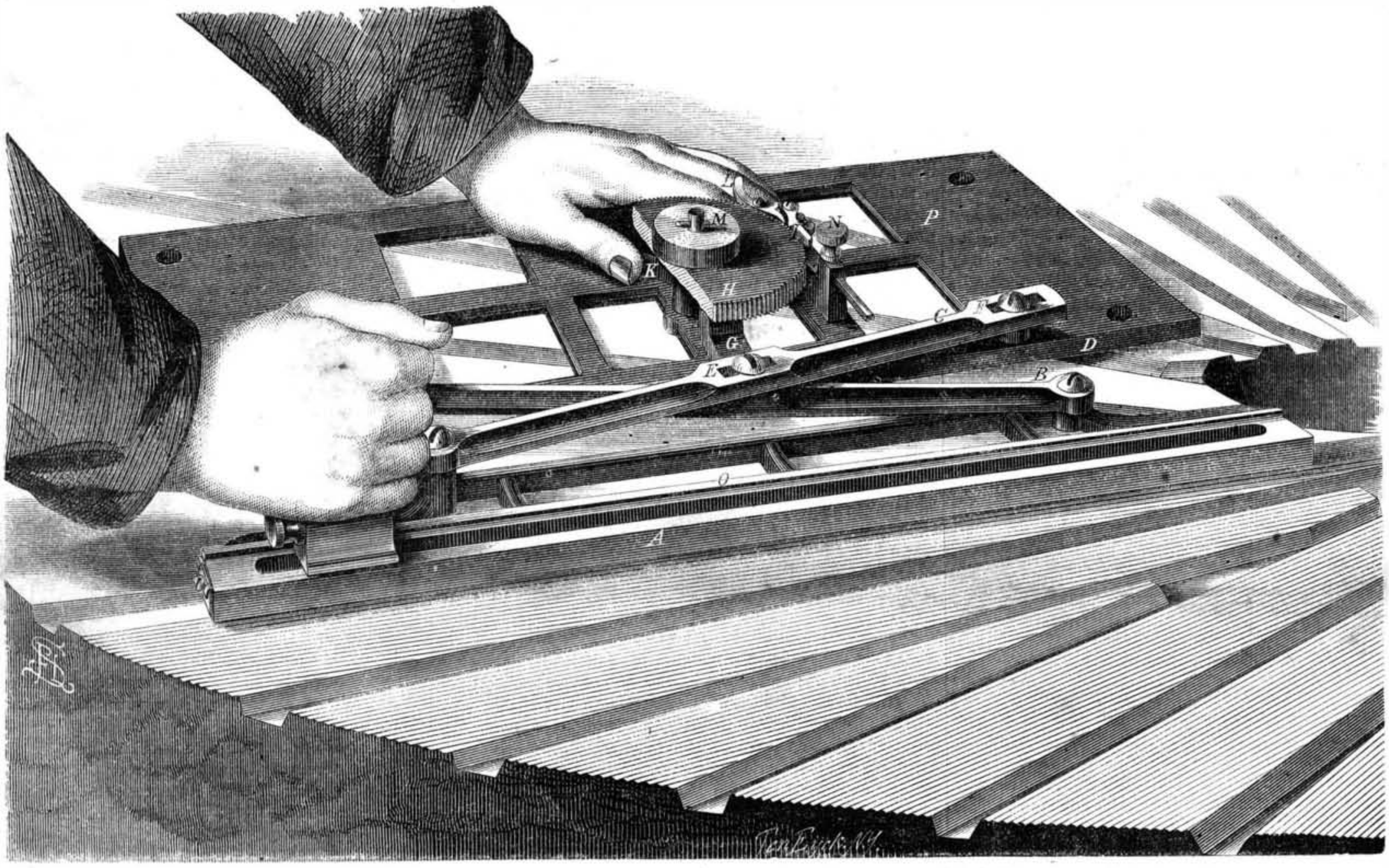
Vol. XXI.---No. 22.
[NEW SERIES.]

NEW YORK, NOVEMBER 27. 1869.

$3 per Annum.
[IN ADVANCE.]

Dressing Millstones by the Use of the Diamond.

In an article, entitled "Diamonds and their Uses in the Mechanic Arts," published on page 49, current volume, we promised our readers an illustration and description of a very effective machine for dressing millstones by the use of the diamond, invented by Mr. John Dickinson, of New York city, and patented by him in America and Europe, for which a medal was awarded at the International World's Fair, held at London in 1862.



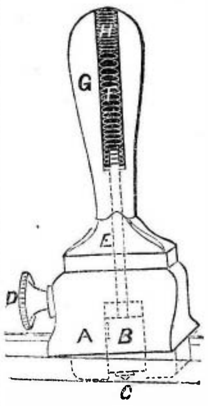
JOHN DICKINSON'S PATENT PROTECTOR AND GUIDE FOR DRESSING MILLSTONES WITH THE DIAMOND

Millers who may be unacquainted with the nature of diamonds or their durability, it is reasonable to suppose, will be somewhat skeptical and incredulous as to the practicability of using them successfully as an economical application in dressing the lands of millstones. But if they would take the trouble to investigate their history and the purposes for which they are, and have been employed, besides that of ornaments, they will learn that they were used before the Christian era, and up to the present age, for making lines of any depth or form, and for carving faces and figures in relief upon the hardest class of stones, such as the onyx, and others which are almost as hard as the diamond itself. Again, diamonds are now being used successfully for drilling, sawing, planing, turning, shaping, carving, and dressing stones or other hard substances.

Diamonds set in an ordinary stem or ferule, were tried many years ago in Europe (and recently in this country) for producing lines upon millstones, and the millers were perfectly satisfied that the finest and most effective dress was attained by merely gliding the diamond lightly over the stone. The use of diamonds for this purpose was abandoned, however, from the difficulty in keeping them in their setting, and the liability of their being broken by over pressure. It was universally conceded, that if the diamond could be set sufficiently firm in an instrument, so constructed as to regulate the pressure and protect it, it would eventually in a great measure supersede the pick.

After many experiments and trials, Mr. Dickinson has succeeded in constructing the important improvements, illustrated in our engravings, the success of which is attested by those using the machine for over six years. The main difficulty he found was in educating millers to the proper handling of the diamond, and overcoming prejudices against any innovation upon the old mode of dressing with a pick. From their habit of seeing so much stone displaced, it had become an idea or conviction with them that such displacement was actually necessary or unavoidable, and it has taken some time to convince them of the contrary.

The large engraving exhibits Mr. Dickinson's patent graduated guide. A double rule, A, is connected to a straight edge, D, by two transverse arms, B and C; the arm, C, having slots, E and F, cut in the center and the right-hand end to accommodate the motion in drawing the arms in a direct line with each other toward the straight edge, D, which is done by the revolution of a small roller in a spiral cut in the wheel, H. This roller is screwed on a projection, G, attached to the middle of the lower arm, B. The wheel, H, has also cut on its edge graduated teeth in which a pawl, I, is made to catch, propelling the wheel around when actuated by the thumb-piece, K, with the pressure of the thumb of the left hand, and it is sustained in its position by a pawl, L, as the pressure is continuously repeated. The box, M, contains a spring which throws the double rule, A, back to its former position when relieved from the pawl, L. On a raised ledging of the bed-plate, P, there is a graduated scale with figures, to enable the operator to set his distances as he may require between each line, which is done by a short sliding bar, secured by a screw, N. O is a raised ledging on the inner rule which guides and steadies the protector in its motion. The spiral movement described is attached to the bed-plate, P (the latter being planed level), and is adjustable upon the face of the stone as may be required.



In using this guide, the operation is very simple, and requires but little practice, the guide being so constructed as to produce the distances between each crack mathematically correct. It can also be set by the scale so as to obtain any number of cracks to the inch from eight to forty-eight.

When using this instrument the palm of the left hand is pressed firmly upon the bed-plate, P, on which the movement is fixed, and, after having marked with the diamond as often as required, the thumb-piece, K, is pushed by the thumb of the left hand as far as it will go, then immediately relieved.

This pressure is repeated until the back of the double rule touches the straight edge, D, when the forefinger of the left hand presses the pawl, L, and the spring in the box, M, then instantly extends the double rule to its first position.

The small diagram shows the construction of the "protector." A represents the stock or protector in which is inserted a steel bar, B, containing the diamond, C. A is a shifting guard upon which the protector is made to slide between the double rule or tramway. This guard is adjustable and secured in its position by a thumb screw, D. E is a rod which is pressed upon the bar, B, containing the diamond, C, by a spring, F, which pressure is increased or diminished by a screw, H, at the top of the handle, G, in accordance with the nature of the burrs and depth of dress required.

This protector is drawn through the double rule or tramway, the same as a pencil in ruling a slate. The operation is so simple that a boy could operate with it blind-folded.

Any person of ordinary skill can dress a pair of burrs by following the directions. The lines produced upon the lands of a burr are fine, perfect in shape and regular on each edge, totally different from the cracks made by a pick, which are naturally coarse and irregular. In the usual mode the pick produces a stellated fracture, thereby weakening or disintegrating the stone as far as the fracture extends. Thus the edges of the crack, weakened by the blow from the pick, soon crumble away wearing the face of the stone as the particles thus detached are thrown out.

The line cut by the diamond upon a glassy surface which has never been disintegrated by a blow from a pick is clear and distinct, having its edges sharp and fine, with no disposition to crumble, being perfect to the edge of the crack, thereby insuring a sharp corner or cutting edge perfectly straight and equal. Stones dressed after this mode, either hard or soft, open or close, will, it is claimed, run longer and perform a greater amount of work, and also will become more perfect as the bruises occasioned by the pick are removed. It is not intended for dressing out the furrows.

There is no crushing contact of the stones with the wheat, the sharp edges of the cracks actually cutting, or shaving up the grain, although brought very close together. Stones running clear of each other produce a clear whistling sound, differing from that obtained by any other mode of dress. On the starting of the stones they commence to do their work effectively, producing no middlings, and the flour comes from them with its nutritive properties unimpaired. There is no perceptible moisture generated in the operation of grinding, and much less power is required to produce a superior article of flour.

It is further claimed that after putting the furrows in proper order, the lands of the burrs can be kept so by the labor of from one to two hours every four days; and that burrs have been run satisfactorily with this dress over six days and nights without taking them up, and have performed half as much more work with less power and in the same time.

It is claimed to be much easier to keep the burrs in face on this system. The use of the pick is entirely dispensed with, except in dressing the furrows and high glossy spots on the face, which must be taken off with a sharp pick.

Mr. Dickinson claims that by this method of dressing stones not less than three pounds more flour per bushel is obtained than is possible with the old dress, and of better quality, devoid of grit. The saving in labor, time of the mill, cost of picks, and quantity and quality of flour in the aggregate must be a very large item, sufficient in itself to constitute a difference between a successful and unsuccessful business. Without dispensing with the services of the operative millers, it will lighten their labors, and enable them to keep their burrs in good condition.

These claims are attested by numerous testimonials, from practical millers in various sections of the country. We have personally witnessed the operation of this invention, and have formed a most favorable opinion of its merits. The sales of this machine have been somewhat retarded by the reluctance of millers to impart their knowledge of its value to others, and their prejudices against any innovation upon established customs; but latterly the demand has so much increased that, together with the demand for carbon points, cutters, and tools for working stone and for other mechanical purposes, Mr. Dickinson has found it necessary to enlarge the facilities of his establishment, and proposes, we believe, to organize a stock company to develop the uses and extend the manufacture of the carbon points and cutters. Some of these tools will form the subject of a descriptive article in a future number.

Mr. Dickinson expresses confidence that when the diamond millstone dressing machines are more universally known, they will be generally adopted throughout the world. Many of them have already been in use six years, and have not cost over ten dollars for diamonds or repairs.

The prices of the machines vary in accordance with the size of the diamond set in the protector. Some mills having larger, harder, and more burrs than others, require larger diamonds.

Those desiring any further information relative to the uses of diamonds, will find Mr. J. Dickinson able and willing to impart it, at his office, 64 Nassau street, New York city. Any person addressing him by letter in regard to tools, should be particular to state the precise purpose for which they want them.

AMMONIACAL GAS-ENGINES.

[By. F. A. P. Barnard, L.L.D., Commissioner to the late French Exposition.]

If hot-air engines and inflammable gas engines fail as yet to furnish power comparable to that which steam affords, without a very disproportionate increase of bulk, and for high powers fail to furnish it at all, the same objection will not hold in regard to the new motors now beginning to make their appearance, in which the motive power is derived from ammoniacal gas. The gas, which is an incidental and abundant product in certain manufactures, especially that of coal gas, and which makes its appearance in the destructive distillation of all animal substances, is found in commerce chiefly in the form of the aqueous solution. It is the most soluble in water of all known gases, being absorbed, at the temperature of freezing, to the extent of more than a thousand volumes of gas to one of water; and at the temperature of 50° Fah., of more than eight hundred to one. What is most remarkable in regard to this property is, that, at low temperatures, the solution is sensibly instantaneous. This may be strikingly illustrated by transferring a bell-glass filled with the gas to a vessel containing water, and managing the transfer so that the water may not come into contact with the gas until after the mouth of the bell is fully submerged. The water will enter the bell with a violent rush, precisely as into a vacuum, and if the gas be quite free from mixture with any other gas insoluble in water, the bell will inevitably be broken. The presence of a bubble of air may break the force of the shock and save the bell.

This gas cannot, of course, be collected over water. In the experiment just described, the bell is filled by means of a pneumatic trough containing mercury. It is transferred by passing beneath it a shallow vessel, which takes up not only the bell-glass but also a sufficient quantity of mercury to keep the gas imprisoned until the arrangements for the experiment are completed.

The extreme solubility of ammoniacal gas is, therefore, a property of which advantage may be taken for creating a vacuum, exactly as the same object is accomplished by the condensation of steam. As, on the other hand, the pressure which it is capable of exerting at given temperatures is much higher than that which steam affords at the same temperatures; and as, conversely, this gas requires a temperature considerably lower to produce a given pressure than is required by steam, it seems to possess a combination of properties favorable to the production of an economical motive power.

Ammonia, like several other of the gases called permanent, may be liquefied by cold and pressure. At a temperature of— 38°·5 C., it becomes liquid at the pressure of the atmosphere. At the boiling point of water it requires more than sixty-one atmospheres of pressure to reduce it to liquefaction. The same effect is produced at the freezing point of water by a pressure of five atmospheres, at 21° C. (70° Fah.) by a pressure of nine, and at 38° C. (100° Fah.) by a pressure of fourteen.

If a refrigerator could be created having a constant temperature of 0° C., or lower, liquid ammonia would furnish a motive power of great energy, without the use of any artificial heat. The heat necessary to its evaporation might be supplied by placing the vessel containing it in a water bath, fed, at least during summer, from any natural stream. Such a condenser could not be economically maintained. A condenser at 21° C., however, and an artificial temperature in the boiler of 38° C., would furnish a differential pressure of five atmospheres, with a maximum pressure of fourteen. By carrying the heat as high as 50° C. (122° Fah.), a differential pressure of eleven atmospheres could be obtained, with an absolute pressure of twenty.

These pressures are too high to be desirable or safe. Moreover, condensation is more easily effected by solution than by simple refrigeration, and hence, in the ammoniacal gas engines thus far constructed, the motive power has been derived, not from the liquefied gas, but from the aqueous solution. The gas is expelled from the solution by elevation of temperature. At 50° C. (122° Fah.) the pressure of the liberated gas is equal to that of the atmosphere. At 80° C. (176° Fah.) it amounts to five atmospheres, and at 100° C. (212° Fah.) to seven and a half. At lower temperatures the gas is redissolved, and the pressure correspondingly reduced.

In the ammoniacal engine, therefore, the expulsion and resolution of the gas take the place of vaporization and condensation of vapor in the steam engine. The manner of operation of the two descriptions of machine is indeed so entirely similar, that but for the necessity of providing against the loss of the ammonia, they might be used interchangeably. The ammonia engine can always be worked as a steam engine, and the steam engine can be driven by ammonia, provided the ammonia be permitted to escape after use. The advantage of the one over the other results from the lower temperature required in the case of ammonia to produce a given pressure, or from the higher pressure obtainable at a given temperature. These circumstances are favorable to the economical action of the machine in two ways. In the first place, they considerably diminish the great waste of heat which always takes place in the furnace of every engine driven by heat; the waste—that is, which occurs through the chimney without contributing in any manner to the operation of the machine. This waste will be necessarily greater in proportion as the fire is more strongly urged; and it will be necessary to urge the fire in proportion as the temperature is higher at which the boiler, or vessel containing the elastic medium which furnishes the power, has to be maintained. In the second place, that great loss of power to which the steam engine is subject, in consequence of the high temperature at which the steam is discharged into the air, or into a condenser, is very materially diminished in the engine driven by ammoniacal gas.

For instance, steam formed at the temperature of 150° C. (302° Fah.) has a pressure of nearly five atmospheres (4·8). If worked expansively, its pressure will fall to one atmosphere, and its temperature to 100° C. (212° Fah.) after an increase of volume as one to four. If, now, it is discharged into a condenser, there is an abrupt fall of temperature of 50°, 60°, or 70°, without any corresponding advantage. If it is discharged into the air, this heat is just as much thrown away. In point of fact, when steam of five atmospheres is discharged into the air at the pressure of one, considerably more than half the power which it is theoretically capable of exerting is lost; and when, at the same pressure, it is discharged into a condenser, more than one quarter of the power is in like manner thrown away. And as the expansion given to steam is usually less than is here supposed, the loss habitually suffered is materially greater.

The ammoniacal solution affords a pressure of five atmospheres at 80° C. (176° Fah.), and in dilating to four times its bulk, if it were a perfectly dry gas, its temperature would fall below 0° C. But as some vapor of water necessarily accompanies it, this is condensed as the temperature falls and its latent heat is liberated. The water formed by condensation dissolves also a portion of the gas, and this solution produces additional heat. In this manner an extreme depression of temperature is prevented, but it is practicable, at the same time, to maintain a lower temperature in the condenser than exists in that of the steam engine. It must be observed, however, that owing to the very low boiling point of the solution it is not generally practicable to reduce the pressure in the coudenser below half an atmosphere.

The advantages here attributed to ammoniacal gas belong also, more or less, to the vapors of many liquids more volatile than water; as, for instance, ether and chloroform. Engines have therefore been constructed in which these vapors have been employed to produce motion by being used alone, or in combination with steam. The economy of using the heat of exhaust steam in vaporizing the more volatile liquid is obvious. But all these vapors are highly inflammable, and in mixture with atmospheric air they are explosive. The dangers attendant on their use are therefore very great. Ammonia is neither inflammable nor explosive, and if, by the rupture of a tube or other accident, the solution should be lost, the engine will still operate with water alone.

The action of ammonia upon brass is injurious; but it preserves iron from corrosion indefinitely. It contributes, therefore, materially to the durability of boilers. A steam engine may be converted into an ammonia engine by replacing with iron or steel the parts constructed of brass, and by modifying to some extent the apparatus of condensation.

CAPTAIN ERICSSON ON THE ROTATION OF THE EARTH.

Among the papers read at the meeting of the United States National Academy of Science, held at Northampton last month, was one by Captain Ericsson, which the author stated was an extract from an "Essay on Solar Heat" upon which he is engaged.

It appears that certain investigations relating to solar heat, undertaken chiefly with a view of ascertaining accurately how far the dynamic energy of the radiant heat of the sun can be made subservient in producing motive power, led him to consider, among other important practical manifestations of solar energy, the abrasion of the earth's surface caused by the flow of rain water, in its course to the sea. In other words, the effect produced on the rotation of the earth by the mere change of position of the enormous masses of matter detached by the flow of rain water, irrespective of any expenditure of force called for on account of friction in transit.

It is evident, he says, that the effects resulting from the change of position of the matter abraded, are twofold as regards the earth's axial rotation. In the first place, the matter is brought nearer to the earth's center, which approach tends to increase the rotary velocity of the earth, since the weight transferred moves in a less circle at the base than at the top of the hight from which it extends, consequently calling for the extinction of a certain amount of *vis viva*. The increase of rotary velocity imparted to the earth from this cause is, however, almost inappreciable. Secondly, the abraded matter, besides its change of position relative to the earth's *center*, will, in its course towards the sea, either approach the equator or recede from it. In the former case the change will cause a retardation, while in the latter it will augment the earth's rotary motion round the axis.

In order to arrive at some practical idea of the amount of retardation due to this cause, Captain Ericsson has chosen the Mississippi as his example. He has made choice of this river for the following reasons: It has been thoroughly surveyed, and it comprises in its field every variety of soil and climate, its source being among snows and lakes, frozen during a great portion of the year, while its outlet is near the tropics. How completely the Mississippi basin represents the average of the river systems of both hemispheres will be understood from this fact, that although the rain gages at its northern extremity show only thirteen inches for twelve months, those of the southern extremity reach sixty-six inches with every possible gradation of rain-fall in the intermediate space. In addition to this important circumstance, the basin covers 21° of latitude and 35° of longitude, or 1,460 miles by 1,730 miles. It has been shown by the official reports prepared by Humphreys and Abbott in 1861 that the average quantity of earthy matter carried into the Gulf of Mexico, partly suspended in the water and partly pushed along the bottom of the river by the current, amounts for each twelve months to 903,100,000,000 of pounds. This enormous weight of matter is contributed by numerous large branches, and upwards of one thousand small tributaries. The mean distance along the streams by which the sediment is carried, in its course to the sea exceeds 1,500 miles; but the true mean which determines the amount of force acting to check the earth's rotation is far less. Now the center of the Mississippi basin rotates in a circle of 15,784,782 feet radius, and its velocity round the axis of the globe is 1147·90 feet per second. The mouth of the river, on the other hand, rotates in a circle of 18,246,102 feet radius, with a circumferential velocity of 1,326·89 feet per second. It will be seen, therefore, on comparing these velocities, that an increased circumferential velocity of very nearly 179 feet per second must be imparted to the sedimentary matter during its course from the center of the basin to the mouth of the river.

The question here presents itself, where is the motive energy to come from to impart the increased velocity acquired during the transit? The author states that the earth must supply the needed force. In other words, an amount of the earth's *vis viva* corresponding to the force required to generate the augmented speed will be extinguished. It has been stated above that the annual discharge of earthy matter at the mouth of the Mississippi is 903,100 millions of pounds. It has also been shown that there is an increase of velocity of 179 feet per second, a rate acquired by a fall through 500·6 feet. If, then, we multiply 903,100 millions by 500·6, we prove that the amount of energy to be given up by the earth in order to impart the stated increase of rotary velocity to the abraded matter exceeds four hundred and fifty-two trillions of foot pounds annually. But the formation of 30,000 square miles of delta, over which the Mississippi now runs, has required ages, during which the earth has been unceasingly deprived of *vis viva*.

The next point to be considered is whether there exists sufficient compensatory force to make good the immense amount of dynamic energy expended. The mean rate of discharge into the Gulf of Mexico exceeds 38,600,000 pounds per second; and, as has been already shown, there is an increase of circumferential velocity so considerable that a fall through 500·6 feet is necessary to generate the same. Therefore, the amount of *vis viva* of which the earth is deprived every second by the waters of the Mississippi and its tributaries, will be 19,323,000,000 foot-pounds, or 35,133,000-horse power. What provision do we discover for making good this stupendous drag on the earth's rotation? The water precipitated on the Mississippi basin come chiefly from the Gulf of Mexico, raised by the heat of the sun. The gulf being situated *south* of the outlet of the river, the aqueous particles possess, at the commencement of the ascent, a greater circumferential velocity than the basin, and hence tend to impart motion to the atmosphere during their northerly course. On purely dynamic considerations, that motion and the motion of the aqueous particles ought to restore to the earth the loss of *vis viva* sustained, provided solar influence be not present. But solar influence is present; the atmospheric currents do not move altogether in accordance with static laws, but are controlled and perturbed by the heat of the sun—an *outside* force competent to disturb and destroy terrestrial equilibrium. Hence it is found that in place of an easterly motion of the atmosphere tending to restore, by its friction against the surface of the basin, the loss under consideration, the sun is frequently expending a vast amount of mechanical energy productive of