Correspondence.

Mining Precautions.

To the Editor of the Scientific American:

Let mining companies be compelled by law to put down bore holes, from the surface of the ground, at greater or less intervals over the entire course of the mine. The holes would not be very expensive to put down, and could be sunk with any prospecting well or oil rig. They should be large enough to contain a tube two or three inches in diameter, with good valves at each end. It seems to me that this plan would do away with part of the risk that miners undergo from being imprisoned by a cave-in.

The holes could also be used for aiding the regular ventilating of the mine. IRVING BOARDMAN.

Elmira, N. Y., February 8, 1886.

Collisions at Sea.

To the Editor of the Scientific American:

Having long been an attentive reader of your valuable journal, I have followed with unusual interest the suggestions offered from time to time by Mr. E. Reynolds in nautical matters. His last appears in the SCIENTIFIC AMERICAN of April 17; and as I have spent the best part of thirteen years at sea, in merchant sailing vessels as well as in steamers and men of war of six different nations, I hope that I will be able to contribute my mite toward lessening the greatest of all perils at sea. Mr. Reynolds is perfectly right in asserting that the greatest danger lies in the uncertainty of which most masters of sailing vessels become possessed on the approach of a steamer. How often have I heard the command from my captain, I having the wheel at the time: "Keep her off a little," "Keep her off another point," though we in our sailing craft had the right of way beyond dispute. Rapid communication at night at a safe distance between the approaching vessels is therefore the goal to be attained. Let me propose the following:

In the United States Navy they are using with great success "Very's signal lights" for night signaling; the apparatus consisting in a pair of brass pistols and a sufficient number of cartridges in green and red, which are fired from the pistols, ascending from 60 to 100 yards into the air and giving a brilliant light, red or green, during ascent and descent. Time of light, 60 to 80 seconds; cost of the whole apparatus, probably $20. Now, let every sea-going vessel be provided with this apparatus, and establish, through the same means by which "the rules of the road at sea" were made international, the following three simple rules:

1. One red light fired means: "I am going to keep my course."

2. One green light fired means: "I am going to starboard my helm."

3. Two red lights fired simultaneously, the lights ascending from the bow of the vessel at an angle of from 15 to 30 degrees, means: "I am going to port my helm."

As the lights which I have seen fired during a four years' cruise in Chinese waters always ascended much higher than the headlight of a steamer is usually fixed above the water line, and as those headlights are supposed to be visible at a distance of five nautical miles, it is safe to presume that communication at night between approaching vessels may be commenced at a distance of five miles. A more perfect code of night signals may be easily constructed from the combination of these red and green lights; but I think, for the purpose of letting the other vessel know distinctly what one intends doing, the above three rules would be sufficient. I have seen these lights fired in all conditions and in all kinds of weather at sea, and they stood the test very well; and as the outlay for the apparatus is not worth mentioning in comparison with the lives and millions' worth of property yearly lost through the inability to communicate during night time at sea, the above plan may be well worth considering. HUGO L. R. LEHMANN.

Fort Lewis, Colo., Company B, 22d U. S. Infantry.

A Mile of Coal Cars.

A correspondent wants to know how much coal there may be in a mile of loaded coal cars. In reply we can say that a 5 ton car or coal jimmy is 11 ft. 6 in. in length from bumper to bumper. An 11 ton car is 22 ft. 1 in. A car holding from 14 to 16 tons of anthracite is 24 ft. 2 in. A gondola of 20 tons capacity is put at 27 ft. 4 in. A large gondola with 25 tons capacity is 32 ft. in length. Now, then, for the quantity. There will be 460 of the jimmies to the mile, and that means 2,300 tons of coal, perhaps. There will be 240 of the double jimmies, and that means perhaps 2,640 tons. There will be 218 of the large cars, and that may mean 3,270 tons. Of the gondolas there will be 193 cars, and this may mean 3,840 tons. Then of the larger ones there are, say, 160 cars, which will equal in capacity 4,000 tons. All this goes to show that when you see or hear of a mile or two of cars standing loaded, it really does not mean so very much coal.—*Coal Trade Journal.*

The Force of a Blow.

An interesting discussion has been going on in our pages for some weeks concerning pile driving. For the benefit of our younger readers it may be well to explain what it is all about. It turns on a question often asked, namely, What is the force of a blow? It is a remarkable circumstance that this question seems to constitute a *pons asinorum* for a very large number of persons, although the solution of the problem presents no difficulties of any kind to those capable of understanding a few very simple physical laws. As, however, we know that the whole problem is a vexation of spirit to many students, and that even engineers of larger growth have quite failed to understand it, we propose here to give such an explanation of it as will, we hope, suffice to clear up all obscurities and render its solution perfectly easy.

To simplify matters, we shall assume that the blow with which we have to deal is caused by gravity; that, in a word, it is due to the arrest of a falling weight, such, for example, as the monkey of a pile driver; but our readers will, we think, have no difficulty in understanding that a blow is a blow, no matter how dealt—whether it be delivered on a target by a shot projected from a 100 ton gun or with a tiny hammer on the head of a tin tack. In their nature both blows are the same; they only differ in degree. A falling body cannot do more work when its progress is arrested than has been done on it in lifting it up to the height from which it has fallen. Thus, for example, let us suppose that the monkey of a pile engine weighs one ton, and that it falls 4 feet on to the head of a pile; then the work in the monkey cannot be either more or less than equivalent to four foot tons. A foot ton is simply an arbitrary unit. The proposition may be expressed in various ways. Thus, the work in the monkey at the moment it touched the head of the pile would be sufficient to raise the monkey up again to the point from which it fell; or to raise a weight of 4 tons a height of 1 foot; or to raise 1 pound through a height of $2,240\times4=8,960$ feet; or to raise a weight of 48 tons through a height of 1 inch, and so on. It is essential that this little matter of equivalence be clearly understood. To drive it home still further, we may say that a horse power is equivalent to lifting a weight of 33,000 pounds through a height of 1 foot in a minute. But the result would be the same if 1 pound was raised 33,000 feet in a minute. We may, in short, go on ringing the changes how we please between weight and height. The result will invariably be the same, one element in the calculation being always diminished as the other is increased. Now, it is clear that if our monkey were employed to raise 1 ton through a height of four feet, it must exert a force or push of 1 ton throughout the distance 4 feet. If it did not, it would not move one ton at all, for it would be overbalanced. If it were called upon to raise 4 tons through a height of 1 foot, then it must exert a push of 4 tons through a distance of 1 foot; if to lift a weight of 48 tons, then it must exert a push of 48 tons through a distance of 1 inch, and so on. Bearing this in mind, there will be no difficulty in understanding the following simple rule: *The force of a blow is measured by dividing the whole distance x passed through by the monkey before impact by the distance y passed through after impact, and multiplying the weight by the quotient.* Thus, let the monkey weigh 1 ton, let the fall x be 48 inches, let the pile descend 1 inch$=y$ at each blow, then the force of the blow—or, in other words, the push or effort exerted by the monkey on the top of the pile—will be $\frac{48}{1}=48$, and $48\times1=48$ tons. If the fall was 20 feet, or 240 inches, then the effort would be 240 tons, and so on. It must be understood that this is the mean or average force of the blow. Its initial effort may be much greater and its terminal effort may be much less, because at the instant of impact the monkey is moving at its full velocity, while at the moment when the pile ceases to descend it will have no motion at all, and consequently will exert no push, except that due to its weight. With this aspect of the question, however, the student need not now concern himself. It will be seen that the force can be varied by altering either the distance passed through before or after impact. For example, the monkey weighing 1 ton and falling 48 inches, let the pile descend only ⅛ inch, then $48\times8\times1=384$ tons; and this leads to an important deduction. If y becomes infinitely small, the force of impact will become infinitely great. We are led thus to the ancient problem, If an irresistible force encounters an insurmountable obstacle, what will happen? No such condition can by any possibility occur in practice. Some movement must take place after impact.

If our readers have followed what we have said, they will see that to ask how to calculate the force of blow, giving only the weight and the fall, is to put an absurd question. Three factors are in all cases necessary, namely, the weight, the height of fall, and the distance through which the body which receives the blow moves. In practice it is by no means easy to ascertain the latter with precision; and the energy in the falling body can be expended in more ways than one. For example, when the head of a pile is struck, two effects take place simultaneously—the monkey is shortened and so is the pile. The elastic rebound of each immediately takes place, and the monkey jumps up from the top of the pile. Again, the top of the pile becomes highly heated. In very dry weather the top of a pile has been known to take fire under the blows of a light monkey rapidly repeated. The elasticity of the pile plays an important part in influencing the rate of its descent. A monkey weighing 100 pounds, falling a height of 50 feet, will have stored in it on impact $50\times100=5,000$ foot pounds, and if the progress of the pile were 1 inch, its driving force would be $600\times100=60,000$ pounds. A monkey weighing 1,000 pounds, and falling 5 feet, would also have 5,000 foot pounds of work in it, and would exert a driving force of 60,000 pounds over a space of 1 inch; but it does not follow that the former would be equally effective in driving the pile. On the contrary, the lighter monkey striking the pile with a higher velocity might be much the less efficient of the two, because the force of the blow would not be transmitted through the pile, but would be expended in compressing the top of it, probably in shattering the wood. We do not propose to go here into any questions concerning modulus of elasticity, which would only serve to complicate a statement which we desire to keep so simple that it may be understood by those who only possess the most elementary mathematical knowledge; but this article would, on the other hand, be manifestly incomplete if we did not say something further concerning the respective values of light and heavy monkeys and hammers and high and low falls.

When a pile is struck on the top, what is known as a wave of compression passes through it; and this wave requires time for its passage. Such a wave is set up in all columns when stress is suddenly brought on one end. Thus, for example, if the muzzle of a fowling piece containing a column of air is plugged up with a cork, or with snow or mud, the barrel may be burst when the weapon is fired, simply because, while the pressure at the muzzle is yet too small to move the cork, the pressure at the breech end is great enough to burst the barrel. The wave of compression will not reach the muzzle till the breech has been burst. In the same way the detonation of a lump of dynamite on a rail will break it, the action being so sudden that the wave of transmission of pressure has not time to pass through the air surrounding the dynamite, and the air really plays almost the same part as a block of steel round the explosive. The effect of a heavy ram falling a short distance on a pile head resembles a push, in a sense, and gives time for the transmission of the effort throughout the whole pile; but when a light monkey falls, the effect may be confined to the top of the pile, which is shattered. In order to make this quite clear, we must take into account the element time, concerning which we have said nothing yet.

The velocity with which a monkey strikes a ram is calculated by extracting the square root of the height of fall in feet and multiplying it by 8. Thus, let the monkey fall 4 feet; the square root of 4 is 2, and $2\times8=16$ feet per second. If the monkey fall, as stated in our last example, 50 feet, then we have 7 as the nearest whole number square root, and $7\times8=56$ feet per second as the velocity with which the monkey would strike the pile. If this speed was greater than that at which the wave of transmission could pass through the pile, then little or no effect would be produced in the way of causing its descent; nearly the whole of the work would be done in compressing the top of the pile or in shattering it, and the driving effect would be *nil.* This, it will be seen, is the aspect of the question now being discussed by Mr. Donaldson and "Scrutator," and there is plenty of room for discussion, because very little seems to be really known concerning a great many practical points connected with pile driving. The efficiency of the pile driver is affected by the length, weight, and material of the pile, the condition of its head, and the character of the ground in which it is being driven. The effect of the element time is not sufficiently well understood. About, indeed, the only thing fully recognized is that a heavy monkey falling from a moderate height is, other things being equal, much more efficient than a light monkey falling from a great height.—*The Engineer.*

Thunderstorm in a Clear Sky.

Capt. Anderson, of the British bark Siddartha, which lately arrived in New York, reported a peculiar thunderstorm on April 27, while on the northern edge of the Gulf Stream. The sky was quite clear at the time and the sun shining brightly, although there appeared to be a thin mist about the ship. Suddenly there appeared a vivid flash of lightning, accompanied by violent thunder. The compass was caused to vibrate perceptibly for a period of 15 minutes.