vous system; and he promises to demonstrate that all the symptoms of brain disease—such as paralysis, anæsthesia, amaurosis, aphasia, insanity, convulsions, and the rest—are produced by the same mechanism, whether they arise from an irritation in any part of the trunk or limbs, or from an irritation in any part of the *meninges* or of the brain itself.

AMERICAN AND ENGLISH RAILWAYS.

A few months ago the London *Times* editorially instituted a comparison between English and American railways. It took the somewhat paradoxical ground that,as Scotland had the worst possible climate, and therefore educated the most perfect gardeners, and as France has the least material for the kitchen, and therefore turns out the most perfect cooks, so America, having the worst possible railroads, has the most perfect system of management, and the safest. An American editor suggested that under such circumstances the wise thing for the English to do would be to spoil a few of these railways, in order to bring their safety up to the American standard.

Recent accidents have brought out the correspondents of the *Times* on the same subject; and as there is a popular impression that everything in England is safer than in our own country,it may interest our readers to see what Englishmen say on the subject of railways,English and American. "Traveler," in a late number of the *Times*, starts out with the declaration that "English and American railways present at one point a marked and,to us Englishmen,a humiliating contrast." He then proceeds to show that, while Americans have established over running trains a control which is almost perfect, the English still maintain the rude and ineffective methods which were in use at the very dawn of railway traveling.

"When the driver of an English train sees danger before him, he shuts off steam. His fireman begins in haste to turn a lever. The guard, warned of impending peril, makes his way as quickly as possible to a similar lever at another part of the train. In ten to fifteen seconds, the combined efforts of fireman and guard have applied the brake to fourteen wheels, probably one fourth of the number on the train. Ordinarily the feeble action of our brakes is cut short by a shattering collision, and the death or injury of many of the passengers." Such is the English traveler's testimony as to his own country. Of the American roads, he says: "In presence of similar danger, the American driver touches slightly a little handle which stands up before him. In less than two seconds every wheel in the train is grasped by a powerful brake; and before the train has traversed a distance greater than one and a half times its own length, it is brought to a stand."

There is a slight inaccuracy in this statement. Car wheels are usually in groups of four or six, and the brake is applied to two wheels in each group. On the English roads the train is a string of small cars or carriages, and only a portion of these are provided with brakes. Our plan is more "democratic," but more safe; and if the non-exclusiveness of the American railway cars can be an objection, that difficulty is met by palace cars, in which an extra price is charged.

THE FRICTION OF SLIDE VALVES ON THEIR SEATS.

"Mechanic" writes:

"If we have a simple metallic plane, enclosed in a chest charged with steam, moving on a plane seat, without ports in either: Would any more power be required to move this valve than when the chest was not charged with steam pressure? If more power would be required, how much? And if a port were cut through the seat, leaving a portion of the same valve beneath, equal to the area of the port, exposed to the simple atmospheric pressure, how would the valve be affected in the matter of the power required to move it under these new conditions"?

And the same mail brings us a similar enquiry from N. D. S., another subscriber. In reply to these and other communications which we are continuously receiving upon the same subject, we would say as follows: The coefficient of friction for cast iron is 24, that is to say, if two cast iron surfaces are in positive contact, every 100 lbs., weight of the top one will require 24 lbs. to slide it upon the other. The weight of the top one is made up by the weight of the iron added to whatever amount of vacuum there may be between the two surfaces. Suppose for instance a slide valve is 10 inches by 5, and therefore contains 50 square inches of area, and that it weighs of itself 10 lbs.; if then it is surfaced truly, and beds upon an horizontal surface so as to exclude the air, it will be pressed to its seat, first by its own weight, and secondly by the atmospheric pressure of 15 lbs. per square inch, making a total of $(50 \times 15) + 10 = 760$ lbs. If, however, the plate stood edgewise, as in the case of engines having the slide valve on the side instead of on the top of the cylinder, it would have the atmospheric pressure only pressing it to its seat, that is to say, in this case 750 lbs. If we consider the valve of an ordinary 16 inch cylinder engine to measure $8\frac{1}{2}$ by 14 inches, and allow a pressure of 130 lbs. per inch in the steam chest, there would be, supposing the valve to bed perfectly to its seat, a pressure of 15,470 lbs. forcing the valve to its seat; and the whole pressure upon the piston being 26,442 lbs., the friction of the valve would entail a loss of about 58 per cent of the power of the engine.

It is to these considerations that are due the numerous efforts to produce valve-balancing devices. As a matter of fact, however, the pressure to the seat will be in precise proportion to the area of the valve in positive contact with the seat, and this is the point that sets all calculation at naught; since it is impracticable to ascertain, under ordinary circumstances, what amount or proportion of the valve beds sufficiently to its seat to exclude the steam from between them. A writer in the *Railroad Gazette*, of July 28 last, says upon this subject:

"A valve may be made to bed sufficiently to be steamtight without being so perfect a fit as to induce undue pressure to its seat; and there is good reason to believe that, under ordinary conditions, a locomotive slide valve never fits so closely as to induce the pressure due to a flat, true, and smooth surface. Scrape a valve face to its seat as truly as we may, the steam fills the hollows of the scraper marks,and thus relieves the valve of a very large proportion of the pressure due to its area. It would appear that the scraper marks are soon worn down, and hence the valve then beds perfectly to its seat, and this undoubtedly would occur if the wear upon all parts of both the valve and the seat faces was at all times equal, and the conditions were constant; but such is not the case. The bridges between the cylinder ports wear a little the most, and wear hollow in their lengths, for the reason that the wearing surfaces, upon which the valve beds, standing at right angles to the top and bottom of the bridge, are greater and hence suffer less abrasion. Then again inequalities in the texture of the metal, and other causes, in themselves trivial, form in the aggregate the causes which operate to prevent the equal abrasion of the seat and valve face at all parts of the surfaces; and hence it is that, when a locomotive comes to be repaired, we find those faces worn considerably out of true, as might be expected, not only from the variation in the amount of contact on different parts of the surfaces, but also from the irregularity in the speed at which the valve travels while such contact is taking place."

Of more consequence than the above considerations, however, is the fact that the form of a slide valve is continually changing. During the process of the cooling of a casting after the metal is poured, the surfaces lose their temperature in advance of the internal metal, and their crystaline formation takes place more rapidly; those surfaces become rigid sooner than the inner metal, and therefore resist the strains produced in the cooling and crystaline formation of the latter. There is then upon the surface of all castings a tension which is relieved in precise proportion as those surfaces are cut away; hence as the edges and face of a valve are planed,a re-formation takes place, which throws the face out of true. This is remedied in surfacing the valve; but when the valve is placed under steam,the increase in its temperature induces a more complete re-formation: so that, surface a valve as true as we may, we find that it does not bed true to its seat when it is first placed under steam, nor indeed until it is worn down to that degree of practical truth obtainable under the conditions of its wear. If we now turn to the cylinder, we find that a large proportion of its surface area has, by the boring and planing, been relieved of its tension, inducing in it also a re-formation, first, during its manipulation, and secondly, when placed under steam; so that we may scrape up the valve and seat surfaces as truly as possible, but we cannot hope to make them fit sufficiently close to keep a vacuum between them when heated to the temperature due to the steam pressure. It would appear, however, that, after the re-formation had once completely taken place, the valve would wear to a close fit; but the pressure of the steam, and hence the temperature of both the cylinder and the valve, is continually changing, not only because of variations in the boiler pressure but also by reason of the action of the link motion in giving more or less steam to the cylinder. The irregularity of the shape of both the cylinder and the valve causes their expansion and contraction to vary under different temperatures, operating to alter the fit of the valve to its seat. The valve also, as it wears thinner, undergoes continuous change of form, so that it springs more from the pressure due to the steam.

From these considerations we cannot define the pressure of a valve to its seat further than by saying that it cannot be less under any circumstances than that of the area of the valve exhaust port multiplied by the pressure of the steam, because that amount of pressure cannot be balanced by any want of contact between the valve face and the seat. Of the amount of force necessary to move a valve under any given pressure to its seat, we can form no estimate, because that again depends upon the fit of the valve to its seat. If the faces permit of a film of steam beneath them, they will glide, one over the other, much more easily than if they are steamtight.

AN OPPORTUNITY FOR INVENTORS.

One of the most fruitful sources of discomfort and disease of the eyes is their use in a fluctuating light. Artists, whose professional success hinges on healthy vision, are very careful to have the studios face the north,for their own comfort in working quite as much as for the advantage of a uniform light for estimating the effect of their lines and colors. But all persons who work with their eyes cannot command a north light. The pupils in our schools, the readers in our libraries, the writers in offices, typesetters, and fine workmen in every department are forced to take such light as they can get, often with rapid changes from glare to gloom. No one need be told how exasperating such changes are, or how injurious they may become to eyes constantly taxed for nice perception. Particularly injurious are such sharp and sudden variations of light to the sick, more especially to the patients in ophthalmic wards.

The problem is to devise a system of inexpensive blinds, which shall automatically open and shut with the varying intensity of sunlight, so as to admit a uniform amount of light into our reading rooms, offices, workshops, hospitals, and so on. An ingenious person who is able to meet the requirements of the case might make a good thing out of it for himself as well as for the public.

The motive power should be the sun, whose rays are to be admitted or excluded according to their force and brillancy. The apparatus might be a system of lightly moving blinds worked by a thermo-electric current, generated by the action of the sun's rays on a thermopile. In such a case the motion of the blinds could be made directly proportional to the brightness of the sun, and the light admitted perfectly equalized. Or the immediate source of motion might be a battery of selenium bars, that metal being electrically sensitive to light.

These are merely suggestions which any experimenter can improve upon. The field is a new one

Trial of a New Coffer Dam.

The coffer dam invented and patented by Mr. J. E. Walsh, of this city, and illustrated and described by us on page 287 of our volume XXXII, was submitted to a public trial on Tuesday, September 13. A large number of officials and engineers were present to witness the operations. The sides and ends of the structure (which is called the Centennial) enclose a water space of over 4,000 square feet, with solid timber walls, 15 feet wide, and built double, with the space between them divided into compartments. The walls are fitted with keels, so the dam, when it is lowered into the mud, rests steadily, the keels in the mud making a perfectly watertight joint all round.

When the valves in the walls were opened to admit water, the dam began to sink slowly and steadily; and when water level was reached and the valves closed, additional water was pumped in to sink her. When the weight of the structure and the water ballast brought her to rest on the bottom, the full power of the pumps was applied to empty the interior of water, and the bed of the stream was soon laid bare. Large numbers of fish were deprived of their element, and workmen descended into the mud to keep the foot valves of the pump clear. The water inside the dam was 23 feet deep when pumping commenced; and the dam sustained the pressure of this depth without any leakage being apparent. Commissioner Salem H. Wales, President of the Dock Commission, and many members of the engineering profession present expressed themselves as perfectly satisfied with the trial, and complimented Mr. Walsh on his invention, and on the substantial and efficient manner in which his ideas have been carried out in the coffer dam under trial.

Tensile Strength of Cement.

La Compagnie du Gaz Parisien, previous to constructing some large gasometers near Paris, experimented on the different materials to be used in their construction; among others, on the cement which was to be used for the vertical walls of the reservoirs (*cuves*), with the following results: The cement used was Portland cement of Pouilly in Burgundy. It was found that a brick of pure cement six weeks old, which had been kept in water during that time, broke under a tensile strain of 170 lbs. to the square inch (12 kilogrammes per square centimeter); that a brick six months old, which had also been kept underwater, broke under a strain of 441 lbs. to the square inch (31 kilogrammes per square centimeter); that cement hardens more rapidly, when exposed to the sunlight and fresh air, than when affected by humidity; but that this is at the expense of the tenacity and impermeability of the product: hence masonry walls should be sprinkled regularly until the cement has set; that the degree of fineness has an effect on the setting of cement, and consequently upon its ultimate tenacity, for it is a rule that the tenacity is in inverse proportion to the rapidity of the setting; that a mortar made of two parts sand to one of cement broke under a strain of 277 lbs. to the square inch (19 kilogrammes per square centimeter), while a mortar of equal parts of sand and cement broke under a strain of 427 lbs. to the square inch (30 kilogrammes per square centimeter). The effect of sand upon the shrinkage was shown by the facts that pure cement was defaced by cracks a little more than a foot apart; when mixed with equal parts of sand, the cracks were little more than a yard apart; when three parts of sand to one of cement were used, there were no cracks at all: hence it was this mixture that was used in constructing the reservoirs.

Fire near the Centennial Buildings.

A fire recently broke out in Shantytown, as the Philadelphia papers call the wooden structures adjacent to the Centennial grounds. They are located on the broad avenue opposite the Main Building. These wooden structures were thickly clustered together near the gates; and before the fire could be got under control, $80,000 worth of property was destroyed, including some twenty small hotels, restaurants, etc. The heat was sufficient to blister the paint on the gates of the Exposition grounds, and warm up the interior of the Main Building.

The New Bergen Hill Tunnel Completed.

The new Delaware, Lackawanna, and Western Railroad tunnel is completed,and will be ready for use as soon as the *débris* is removed, which will not be later than November 1. It is 4,270 feet long, has six shafts varying in depth from 75 to 90 feet, and cost $1,000,000. The filling of the road bed from the eastern end to the river, across the meadows, where stone ballast has sunk to a depth of sixty feet before reaching a solid foundation, has been a source of great perplexity and expense, requiring much engineering skill