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SURGERY VS. PHRENOLOGY.

For a long time, the popular pseudo-science of phrenology received little encouragement from the advancement of exact knowledge in the department of cerebral physiology and pathology. Indeed its pretensions were quite uniformly repudiated by the better class of students of the brain.

Their joy, however, is likely to be of short duration. That most acute observer and experimental investigator in the department of cerebro-spinal physiology and pathology, Dr. Brown-Séguard, is delivering a course of professional lectures in London, calculated not only to knock the last shadow of a prop out of the foundation of phrenology, but to compel a practical revolution in the views now generally accepted by physiologists and physicians with regard to the physiology and pathology of the brain.

His argument runs in this wise: When we witness a loss of function in connection with a lesion of a part of the brain, we are naturally led to suppose that the lost function has its seat in the part we find altered. So too, though in a less degree, we are disposed to admit that, if certain muscles contract involuntarily when a certain part of the brain is irritated, the part thus irritated contains either the nervous center or the conductors usually employed by the will in moving those muscles.

But such reasoning is erroneous, and the conclusions thus arrived at are essentially wrong: as wrong as it would be to suppose the central power of laughter to reside in the sole of the foot, because laughter results from the tickling of that part; or to infer that the seat of intelligence is in the intestinal mucous membrane, because its irritation by a worm may cause insanity; or that the same membrane contains the centers for voluntary movements and the perception of tactual, visual, and auditory sensations, because paralysis, convulsions, anæsthesia, loss of sight, deafness, etc., appear in consequence of intestinal irritation.

In the present state of knowledge of physiology, no one would admit the correction of such conclusions: but to Dr. Séguard they are not a bit further from the truth than the conclusion that the left third frontal convolution is the seat of the faculty of expressing ideas by speech, because when that portion of the brain is diseased the faculty of speech is often disordered or lost: or that the upper parts of the two convolutions bordering on the scissure of Rolando on one side are centers for the voluntary movement of the two limbs on the other side, because these limbs will sometimes be paralyzed when there is disease in those parts.

The fault with all such reasoning lies in a failure to distinguish between the effects of two possible unlike causes—irritation extending to other parts, and loss of function in the part disabled. For example, when Majendie observed that the senses of sight, hearing, and smell, as well as those of taste and touch, on one side of the face were lost when the trigeminal nerve of that side was divided, he and others after him inferred that the real nerve of those senses was the trigeminal. But subsequent experiments and observations have shown the observed effect to be due, not to a cessation of the function of that nerve, but to irritation causing an arrest of the activity of all the special sensorial nerves.

Similarly at fault are the conclusions that have been drawn from the effects of irritation of parts of the cortical substance of the brain by galvanism or disease in animals and in men. The movements incited by such irritations arise, not because the psycho-motor centers for such movements are there located, but because of irritations transmitted to other parts of the brain. Proofs of this position Dr. Séguard draws from a wide range of clinical and experimental evidence of two sorts, the first showing that the alleged functional centers can be destroyed without destroying the function attributed to them; the second sort showing the complete absence of uniformity in the effects of local irritations. The same lesion in the same place may be followed either by an immediate effect, or by effects of the most widely varying character, when due to irritation: when due to the loss of special function, the effects of a lesion must be always present and invariably the same. Accordingly, no special function can be admitted to belong to a part of the brain if there is a single known case of a persistence of the supposed function when the part, if considered as a conductor, has been cut across, or, if looked upon as a central organ, has been entirely destroyed.

For instance, Flourens thought he had found the focus of life, the only origin of the supposed vital force, in the medulla oblongata; for in all his experiments, any injury to this organ, however slight, was quickly followed by death. But Dr. Séguard succeeded in removing the medulla oblongata entirely from certain living animals, with no other

effect than the slow apparition of a lasting epilepsy. The theory that the function of life is localized in that organ consequently had to be abandoned: the sudden death, which occurs in almost all instances when the gray matter at the nib of the calamus is injured or taken away, being attributable rather to the effect produced, by the irritation of the neighboring parts, on other parts of the nervous centers and on the heart. The nervous center for respiratory movements has also been located in the medulla oblongata. But having been able to make a transverse section of that organ, below the level of the supposed respiratory center, without producing a stoppage of respiration, Dr. Séguard feels justified in concluding that it is not so restricted, and that, when respiration is stopped by the division of the medulla oblongata, the stoppage is owing to the arresting influence of irritation on the nerve cells above and below the section, not, as hitherto supposed, to the separation of the respiratory center from its bonds of union with the respiratory muscles.

Evidence, clinical and experimental, not less cogent than the foregoing, is presented in these lectures in curious abundance and variety, disproving the localization of any function in any special part of the brain, whether according to the scheme of phrenology or any other. The drift of the evidence is summed up in the following revolutionary propositions:

- 1. A lesion in one half of the brain may produce symptoms either on the opposite side or on the corresponding side.
2. A very small lesion, whatever be its seat, can produce most extensive and violent symptoms.
3. A lesion occupying the same extent on the two sides of the middle line of the brain may produce symptoms only or chiefly on one side of the body.
4. Symptoms may appear suddenly from a slowly and gradually developing lesion.
5. Symptoms may appear slowly from a suddenly produced lesion.
6. The greatest variety of symptoms may proceed from a lesion in the same part of the brain.
7. The most various parts of the brain can give rise to the same symptoms.
8. Permanent lesions may produce symptoms by attacks, just as they produce epileptiform seizures.
9. Symptoms may cease suddenly or rapidly notwithstanding the persistence of the lesion.
10. Symptoms of brain disease may appear from an irritation of visceral and other peripheral nerves.
11. Considerable lesions anywhere may exist without the appearance of symptoms.

Unless the numerous cases, which Dr. Séguard cites at length in proof of these assertions, can be shown to be mis-observed or misinterpreted, a radical overturning must ensue in our notions of cerebral physiology, as well as the final destruction of phrenology.

The learned lecturer does not rest with the destruction of current beliefs. He endeavors to harmonize the physiology of the brain with clinical observation, to make theory tally with fact, but in doing so his caution shows in striking contrast with his boldness in the work of demolition. He suggests: 1. That as regards localization of function, a great many facts lead to the view that the nerve cells endowed with the same function, instead of forming a cluster so as to be in the neighborhood of each other, are scattered in the brain, so that any part of that organ can be destroyed without a cessation of their function. It makes no difference whatever whether the distance between nerve cells employed in the same function is a small fraction of a millimeter or very much greater, as in either case their communication with each other must take place by conductors (nerve fibers), the length of which is unable to interfere with the function.

2. Each half of the brain is a complete brain originally, and possesses the aptitude to be developed as a center for the two sides of the body in volitional movement as well as in all the other cerebral functions. Still very few people develop very much, and perhaps nobody quite fully, the powers of the two brains: on the contrary, in most persons only one of these two primarily similar organs acquires great power for certain actions, and the other for other actions.

3. Communications between the body and the brain can be more or less fully accomplished by means of a very much smaller number of conductors than would be necessary according to any view like the well known clavier theory. As we know by clinical facts that any part of the medulla oblongata can be destroyed without paralysis, and that in some cases a very small portion of it has proved sufficient for the persistence of voluntary movements, it would seem that an order of the will may be transmitted as well by one nerve fiber as another, and that it is necessary to recognize the existence of faculties of a much higher order in the spinal cord than those which are admitted to exist there. Many facts and similar reasoning tend also to show that the nerve cells of the spinal cord possess, as regards sensibility, faculties of a much higher order than those which are now admitted.

In another connection, the lecturer asserts his belief that the experiments of Fritsch and Hitzig, Dr. Ferrier and Dr. Bochefontaine, in proving the sensitiveness of the convolutions of the brain to galvanic irritation—his own experiments showing the excitability of all parts of the brain by the application of heat to the convolutions, to the white substance of the cerebral lobes, and to the great masses of gray matter at the base of the brain—and the evidence supplied by thousands of cases of disease, prove that the brain is not to be considered as different from the peripheric parts of the ner-

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 crystalline formation takes place more rapidly; those surfaces become rigid sooner than the inner metal, and therefore resist the strains produced in the cooling and crystalline 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 brilliancy. 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 Cofferdam.

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 under water, 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 debris 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