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## THE NATURE OF PAIN.

As one of the chief determining factors in the struggle for sentient existence, pain impresses itself upon our attention almost momently. The ideal perfect life that men imagine is always one in which pain forms no part: yet curiously, in all the life we know, pain is ever the penalty paid for superiority. The higher the organism in the scale of being, the greater its capacity for pain: this is the universal rule. Mutilation, such as an insect bears without apparent inconvenience, will kill a reptile. A fish or a reptile disregards injuries that would be quickly fatal to a mammal through nervous shock. A savage laughs at wounds that would rack the nervous system of a civilized man with acutest agony. Thus in every instance capacity for pain is the measure of development.

The question: What is pain? consequently assumes the highest speculative interest and importance: while the determination of its physical conditions and causes ranks second to no other scientific problem in practical significance. Nothing else promises so much for the alleviation of human suffering, to say the least: and the discovery of no other secret of Nature appeals more strongly to the feeling of average humanity.

Common experience tells us that pain has its source in the physical system. The gulf between nervous movement and sensation is as unthinkable as the gulf between brain movement and thought: yet no one presumes to say that pain is other than the product of material conditions, however obscure those conditions may be; or that pain can be imagined as existing apart from organization.

In his prize essay on therapeutic means for the relief of pain, Dr. Spender makes the strange assertion that "we look for the cause of pain in dead nerves and dead nerve centers; and if we miss the expected result to-day, we do not doubt that it will be found hereafter with more perfect instruments of scrutiny."

Seeing that pain is ever an adjunct of life, and that death and insensibility always go together, the cause of pain must rather lie in some disturbance in living nerve or nerve center; and such is the view of most of the more recent investigators in this field. Even the learned writer just quoted subsequently abandons, albeit unwittingly, the position he had taken, when he assumes "as a positive truth, that pain connects a molecular disturbance in the nerve which carries the idea of pain to the sensorial center;" for surely a nerve which performs in that way its normal function cannot be justly described as dead.

Long ago, Romberg described pain as the prayer of a nerve for healthy blood. The definition is true as far as it goes, but it stops short of the whole truth. Pain is also the protest of a severed, bruised, or poisoned nerve; and not unfrequently an excess of healthy blood in the part traversed by a nerve will result in pain. Indeed, Dr. Chapman has gone so far as to erect a theory of pain on this basis alone, and a method of treatment also.

On the other hand, Drs. Anstie, Ratcliffe, and others hold that pain is usually, if not always, associated with an opposite condition, with deficiency of blood, and impaired nutrition. Dr. Anstie, in his classic work on neuralgia, shows that those neuralgias are most acutely agonizing which occur under circumstances of impaired nutrition incident to the period of bodily decay; and that there are strong reasons for the belief that there is especial impairment of the nutrition of the central end of the painful nerves. From this point of view, pain involves a depreciation of true function. It is due to a perturbation of nerve force; and the susceptibility to this perturbation is in proportion to the imperfection of the nerve tissue, until the destruction of nerve tissue cuts off communication and ends in insensibility.

The perturbation of nerve force, however, does not always result in pain; it may show itself in the motor or the intellectual department as well. When nerve degenerates, the first result is shown in the sensory department, as pain; in the motor, as spasms; in the intellectual, as delirium; and the final results of nerve destruction are shown respectively in numbness, paralysis, and coma. Thus the pain of nerve, the spasm of muscle, and the delirium of brain are described as correlative phenomena; and a similar parallel is held to exist between the numbness of nerve, the paralysis of muscle, and the coma of brain. And these phenomena are often interchangeable, the members of the two series being subjectively identical, though outwardly very different.

Evolution being attended by an ever-increasing complexity and delicacy of nervous organization, it is inevitable that increasing liability to nervous derangement must mark every upward movement in the scale of being. Will the price of elevation ever rise so high as to put an end to progress in this direction? There would certainly seem to be a possibility of such a result, when we consider the fate of those most admirable persons who are, as we say, too finely strung for this rude world. The acuteness and delicacy of their sensibilities make them at once the highest moral and intellectual types of humanity, and physically the most unfortunate. And they rarely or never leave behind them a vigorous family.

Regarded as an independent evil, pain is one of the deepest of life's mysteries; as a necessary condition of sensibility—the mainspring of intelligence—it is no mystery, but an inevitable reality, and therefore, where not to be prevented, bearable. It is only preventable evils that are intolerable.

Religion has pronounced all pain to be the penitential heritage of a sinful world—a dictum as false as it is foolish: false because pain existed long before sin was possible, and remains with innumerable forms of life which can have no share in sin; and foolish because it discourages the avoidance or mitigation of pain.

Philosophy has done better in finding pain to be a severe but beneficial schoolmaster. But there are pains which do not teach, as for example the pains of parturition, which are purely physiological; while other unavoidable pains speedily bring the sufferer to a state in which learning is impossible, yet convey no instruction to the looker-on.

Another view of pain finds it the grand preserver of existence, the sleepless sentinel that watches over our safety and makes us guard against both present injury and present pleasure that may bring injury in its train. Pain does have this function sometimes, but too often it does nothing of the sort, and can do nothing, since it comes from conditions over which we have not and cannot have any control.

In short, though it may be all three, pain is not in itself a punishment; it is not a schoolmaster; it is not a sentinel; it is not an unfathomable mystery. It is simply an inseparable condition of sentient existence. It does not always destroy, because in the main, with such types of life as have escaped extinction, capacity for enduring pain has not fallen short of capacity for pain; while the average environment of life has never been absolutely incompatible with some type or types of existence. Some time or other it probably will become so on earth, as it already has on the moon: then life and pain will go out together.

## SCIENTIFIC SIGHT-SEEING.

Anybody of good character and over 16 years of age, with $5,000 and two years' time at his disposal, can now go around the world. Mr. James O. Woodruff, Director, and Mr. Daniel Macauley, Secretary, have organized a "scientific" expedition, which is to depart from New York on October 1st next, and to proceed to South America, Pacific Islands, Australia, Japan, China, India, and Europe, traveling a distance of some 50,000 miles—funds payable in advance before the ship sails. As a special inducement, the prospectus of the project says that the vessel will be navigated by officers of the United States Navy, six in all, whose names are given below. A faculty of scientific instructors has been engaged, also "a competent corps of attentive waiters, who will not be permitted to solicit or accept any fee or gratuity whatever." Naval cadets will be taken at half price, and are to be drilled by the officers aforesaid, and to be treated as if on a naval academy practice cruise; but as there is a probability that a class of scientific maidens will likewise be aboard, a disturbing element will, we fear, be introduced, such as does not obtrude itself among the midshipmen when at sea.

The naval officers referred to are Commander J. W. Philip, Lieutenant Commander A. S. Crowninshield, Lieutenants C. T. Hutchins, W. W. Rhoades, and F. A. Miller, and Surgeon J. H. Kidder. On looking over the numerous testimonials appended to the prospectus, we find the scheme to be commended by the following eminent gentlemen: Governor J. D. Williams, and Secretary of State J. E. Neff, of Ohio; Professors Joseph Henry, J. S. Newberry, Asa Gray, James D. Dana, D. C. Eaton, A. E. Verrill, and George J. Brush: Presidents Porter of Yale, Anderson of Rochester University, Angell of Michigan University, Indiana State Geologist Cox, and Acting President Russell of Cornell University. In view of the fact that the names of the naval officers above noted are prominently referred to, both in order to create confidence in the safe navigation of the vessel, and as constituting a part of the scientific faculty, we recently addressed a letter to the Secretary of the Navy, with a view of verifying the statement of the prospectus that "some of these officers have not yet been detached for the purposes of the expedition, but all have been conditionally engaged and will undoubtedly accompany it." In reply, the Secretary informs us that his department has no knowledge of this expedition, except that gained "through your (our) letter, and at the same time the receipt of a pamphlet giving its details." The assertion, then, that the aforesaid naval officers are going, and the promises and assurances based thereon, appear to be untrue and unfounded. The doubt thus cast over the whole scheme leads us to think that the college professors and other eminent gentlemen above named, who have lent it their indorsement, have been imposed upon.

## CROUP DUE TO MIASMA.

Dr. Lewis S. Pilcher has recently made a valuable report to the Kings County (N. Y.) Medical Society on the subject of croup. Dr. Pilcher has studied that disease with much care with reference to local conditions. A map of Brooklyn accompanies the report, on which the dwellings wherein cases of the disease have been met with are suitably indicated. It needs but a glance at the map to perceive just where the malady has been most prevalent, and to enable deduction as to the probable influence of the soil, drainage, etc., on its persistence to be readily made.

Under the term "croup," the author includes "all forms of acute inflammatory affections of the larynx or trachea which may produce narrowing of their caliber to such an extent as to occasion serious prolonged dyspnœa." This embraces three conditions, namely, catarrhal croup, membranous croup, and diphtheritic croup. The first two differ in the secretion, in the former case being liquid, and in the latter its giving rise to a false membrane of varying thickness. Diphtheritic croup differs only from membranous croup in being recognized as a part of a general diphtheritic infection.

Exposure to cold produces catarrhal croup; but membranous croup demands for its production not only cold and moisture but also a miasmatic poison, the character of which is allied to that which is active in diphtheria.

The conditions under which the author has found that the worst forms of croup may be generated are abundantly prevalent in some parts of Brooklyn. The disease runs riot among the large numbers of badly nourished and weakly children in the thickly populated tenement house districts; and wherever examination has been made into the physical nature of the soil, in localities where croup has been most frequent, there unfavorable conditions have been encountered. Along the water front, occupying ground rescued from the river or bay; upon the site of marshes, now more or less obscured by the filling-in process; in valleys that have been the site of watercourses, whose drainage is imperfect; these are the districts over which, as the map plainly shows, the malady has destroyed the most people.

Croup is not commonly encountered among the list of diseases which Science has thus far traced to miasmatic causes. Dr. Pilcher's conclusions are therefore of especial value in calling attention to the fact that so prevalent a malady is preventable by the ordinary sanitary precaution of proper drainage.

### THE TORPEDO DEFENCE PROBLEM.

Some of our contemporaries, in discussing the question of torpedo defence, which certainly is the ruling one of the hour in relation to naval warfare, apparently consider that the offensive powers of torpedo boats have been overrated, and that, to whatever type these craft may belong, so long as they are not submarine, the modern ironclad has ample resources to protect herself against them. These resources include, first, speed; secondly, the electric light; thirdly, heavy long range artillery; and fourthly, torpedo nettings. It is urged that an ironclad capable of steaming 16½ knots, the Alexandra, for instance, can easily run away from such a craft as Admiral Porter's Alarm, whose speed is much less; that by two electric lights, kept in revolution and so constantly illuminating the horizon, the approach of a torpedo vessel at night would instantly be noticed; that one well aimed shot from an 81 or 100 ton gun would infallibly send the aggressive boat to the bottom; and that, even did the latter manage to reach the ship, the torpedo netting (see our engraving of the Thunderer on another page) would prove a troublesome obstacle. It is scarcely the province of this journal to discuss naval tactics or the art of war; but the investigation of this problem of an efficient system of torpedo defence involves the consideration likewise of all circumstances of torpedo offence. As in any other scientific investigation, it is absolutely necessary that all conditions having any bearing on the subject be carefully gathered and weighed, otherwise accurate results are impossible. Theoretically, the objections above summarized appear forcible: practically, that is, viewing all circumstances under which torpedo attack might be made, they do not. It must be admitted that defences inadequate under any conditions do not answer the requirements of the problem; and that there are conditions under which each one of the above-named means of protection fails, a little consideration will render evident. First, as to speed. While it is reasonably certain that, running a straight course, the torpedo vessel making twelve could not catch the ironclad making sixteen knots, account must be taken first of the delay in developing that speed in the larger vessel, and the difficulty in manœuvring her, as compared to the facility with which the torpedo boat can be handled. It is safe to estimate that at least fifteen minutes will be occupied in getting an 8,000 ton ironclad under swift headway, supposing her to be under low steam, keeping her position off a blockaded harbor. This would afford a torpedo boat abundant time to overtake her. The electric light is of little avail in fogs. In the dense mists prevalent on the Northern Atlantic, there is no mode of illumination which would reveal an enemy until too late for effective resistance. Thick weather, moreover, would necessitate the vessel keeping under slow headway, another advantage for the attacking craft. As regards the use of heavy guns against an approaching vessel, it is easier to talk of hitting such a target than to do it, even in the full glare of the electric light. A small Thorneycroft launch, for example, would be in some measure screened by the waves in an ordinary sea way; it is reasonable to believe that at night such a vessel might easily approach within a quarter of a mile of her enemy before being revealed by the passing beam of the electric lamp. As she would be under full headway of at least twelve knots per hour, this interval could be traversed in a minute and a quarter. In that period, we do not believe it possible to train and sight a heavy gun and fire so as to hit a craft coming bows on, and thus presenting a minimum and rapidly moving surface at which to aim. Torpedo nettings may be reached over by a boom of proper length on the attacking boat; or if the latter is of the Alarm type, there probably would be little difficulty in breaking through them. It is of course most likely that torpedo vessels will attack only under circumstances which give them an advantage: that it is to say, they will await foggy and stormy weather: or when, as in the case of a bombardment, immediate action is necessary, several launches at once might attack a single ironclad with every prospect of at least one torpedo accomplishing its object. The recent sinking of a Turkish monitor by a torpedo, attached to her and exploded by the electric current, the work being done by sheer audacity on the part of the aggressive party, indicates how great the advantages normally are on the side of the torpedo.

In previous articles, we have noted the nature of the attack of the submerged torpedo, against which the general means of defence must also be a safeguard. Above we have endeavored to point out sundry especial sources of weakness in the present mode of protection. Other conditions affecting the problem will probably develop themselves on closer study. Meanwhile we especially commend the investigation to American inventors, as we think they can produce something better than the crinoline for ironclads which just now is the extreme outcome of English ingenuity in this line.

### St. John, N. B., Burned.

St. John, the commercial metropolis of New Brunswick, was recently visited by a conflagration which destroyed the entire business section of the city, extending over an area of some 200 acres. But one building was left standing in the portion covering some forty blocks south of King street. How the fire originated is not known; but it appears to have broken out among some wooden buildings, and, fanned by a gale, to have spread with a rapidity which defied all efforts to prevent it. Shipping and wharves served as additional fuel; and then, making their way into denser parts of the city, the flames destroyed churches, hotels, public buildings, and all the prominent stores. The value of the property burned is estimated at $10,000,000. Several persons were killed, and thousands of people have lost everything.

St. John possessed a presumably adequate water supply, the works having a daily capacity of 5,500,000 gallons. The fire department was well disciplined, and it was supposed that the safeguards against a large fire were sufficient. The calamity, however, only goes to prove that wherever highly inflammable wooden structures are allowed to exist in a city danger is always imminent. The best drilled fire organization is not a match for the intensely hot blaze of well dried wood. When laws become general forbidding the existence of any but fireproof buildings in cities, then immunity from great fires will be reasonably secure; but until then, even the best organized fire service can only be regarded as partial protection.

### The India Rubber Supply.

The native way of supplying the trade with rubber is highly wasteful, and if no preventative means were taken it would not be many years before the supply would fall far short of the demand, which is increasing at an enormous rate; in fact, the world cannot get along without rubber, which has now become one of the most necessary materials in a variety of trades. It has been the improvident practice to cut down trees 150 or 200 feet high, to secure one hundredweight of rubber, and thus the forests of rubber trees, especially in Brazil, are being destroyed, and will ultimately belong to the past. Without waiting for such an event, the British Government has shipped 2,000 Brazilian rubber plates to the Island of Ceylon, and, strange to say, in the incredibly short space of two months after the seeds had been sown, the little trees produced the finest kind of rubber —equal to the best of Brazil. In June, 1876, 90,000 seeds were received, of which, however, only 2,500 were alive; as their vitality is very short, they were sown at once, covering a space of 300 square feet. A number began to grow, and in a few days many of them were eighteen inches high. Cases were then made containing fifty plants each, large enough to allow for growth during transit on shipboard. They were sent to Ceylon, Singapore, Burmah, and other places, and the 2,500 plants thus distributed will do a great deal of good in preventing the otherwise impending calamity of a scarcity of rubber.

### Earthquake Waves.

At a recent meeting of the California Academy of Sciences, the President, Professor George Davidson, of United States Coast Survey, exhibited an enlarged drawing of the regular tidal waves, and of the recent earthquake waves that reached San Francisco Bay on the 10th of May, 1877, and supposed to have been occasioned by the terrible earthquake that destroyed the town of Iquique, Peru, on that day.

At Fort Point the United States Coast Survey maintains a self-registering tide gauge whereby a sheet of paper is drawn horizontally over rollers that are moved by clockwork. The forward movement is nearly two feet in 24 hours. Over this sheet of paper a pencil moves athwartships by the lowering or rising of the float in the float box, and the wheel work is so proportioned that one foot movement of the tide exhibits itself as a movement of one inch of the pencil. The drawing at the Academy was four times the length and breadth of the tidal sheet. On the sheet there is an apparent irregular ebbing of the tidal waters for a few minutes, and then a sudden rise, followed by a depression, until six large waves, of about nine inches each, had exhibited themselves in the space of one hour and 20 minutes. The earthquake waves continued to nearly noon of May 15th, when the last one registered itself; but long before this it was evident, from the irregularity of time, elevation, and form, that these were reflex waves reaching from far-off limits in the ocean. In fact, it seems likely that the reflex waves commenced certainly not later than the 30th, and possibly before that.

"So far as we have been able to ascertain," says Professor Davidson, "the earthquake at Iquique occurred on the 10th of May, at 1 o'clock, A.M., but we must await more definite information before endeavoring to decipher the readings of the tidal register. Assuming, however, that the earthquake occurred at 1 A.M., we know that the difference of longitude from San Francisco is 3 hours and 28 minutes, and that the first indication of the incoming wave occurred at 6 hours and 18 minutes at San Francisco. This would give 8 hours and 46 minutes for the time occupied in the wave traversing 5,200 statute miles, mainly along the shores of South and North America, at a rate of 600 miles per hour, or 10 miles per minute.

"This is much greater than the progress of the earthquake wave that left Simoda, Japan, on the 23d of December, 1854, and reached San Francisco in about 12 hours, traveling at the rate of 375 miles per hour, or 6·2 miles per minute. But the great waves of that earthquake were only eight inches in height and 35 minutes apart when they reached Fort Point. In the present case the main principal waves were much higher, and their crests much further apart.

"Further information may place the *locus* of the earthquake away from Iquique. Upon this coast we ascertain that the earthquake wave was not noticed at open ports or landings, such as Santa Barbara, Gaviota, etc.; but its effects were exhibited in such harbors as Wilmington, Cayugas, and doubtless would have been especially noticed at the mouth of the Estero Limantour, in Drake's Bay. In these harbors the rapidly advancing and rising wave would be concentrated as into a funnel and rise and fall rapidly and largely. It is reported that the rise and fall was 7 feet at Wilmington, not noticed at Santa Barbara and Gaviota, and 12 feet at Cayugas. The reported shock to two vessels near the entrance to San Francisco harbor seems somewhat problematical. The waves entered the Golden Gate about 1 foot high and about 10 minutes long. We were at Fort Point at the time, and, with a smooth sea, could detect no change of rise and fall on the beach, where a very slight surf was running."

News of the earthquake waves coming in was telegraphed to Washington a few hours after they commenced, and from their length and height it was predicted that a great earthquake had occurred at a distant place.

### Porotype.

Porotype is, we learn from the *Photographisches Archiv*, a newly devised process for copying copper-plate engravings, woodcuts, and other designs of a like nature. It is based on the principle that porous paper which has been printed upon by fatty ink loses, wherever ink attaches, its porous character. An engraving upon paper is only porous when there is no ink, and will neither allow gas nor liquid to penetrate wherever the black ink appears. A gas which acts upon a certain chemical agent, and either bleaches or discolors it, is permitted to penetrate a copper-plate engraving or woodcut where possible, and, coming into contact as it permeates with paper which has been suitably prepared, brings about a reaction—that is to say, wherever the gas has found means to penetrate, the color of the prepared paper alters, and a copy of the engraving is in this way produced.

In the process, therefore, four papers are necessary; one, which is capable of generating gas, and which is soaked with hyposulphite of soda; a second, or sensitive paper, which is, in fact, paper treated, first of all, with extract of nut-galls, and afterwards with sulphate of iron solution (ink paper); thirdly, filter paper; and fourthly, oiled paper. The copying of the engraving may be effected in the leaves of a book under pressure. The engraving is put upon the sensitive paper, and upon the engraving is laid the generating paper. Over these is laid a sheet of filter paper which has been previously impregnated in dilute sulphuric acid; then a sheet of plain filter paper; and lastly, the oiled paper. The whole is pressed together for ten minutes, when the copy ought to be finished. A report upon the process by Professor Böttger is not very favorable to it.

### A Vindication of Justice.

Eleven men recently suffered the death penalty in Pennsylvania, in expiation of murders committed by direction of a lawless gang which for several years has, in certain parts of the State, rendered life and property insecure. The conspiracy bore the outward semblance of a trade society among the miners, and its victims were those who in some manner had interfered with their attempts to override the rights of other people. Murders by order of similar leagues have not been unknown in England; but in this country the worst outrages committed during trade uprisings have rarely extended beyond ordinary assaults. The "Molly Maguires" have now, it is to be hoped, discovered that the law alone arrogates to itself the right to destroy human life.

### Huber's Test for Free Mineral Acids.

This new agent consists of a mixture of solutions of molybdate of ammonia and ferrocyanide of potassium. When this clear yellowish solution is added to a colorless aqueous solution, which contains, besides salts of alkalies and alkaline earths, a trace of free mineral acid, such as sulphuric, hydrochloric, nitric, phosphoric, arsenic, sulphurous, or phosphorous acid, there appears at once a reddish yellow color or turbidity, and with more acid a dark brown color, which disappears again upon adding the slightest excess of alkali. Boracic and arsenious acids, however, do not give any reaction with this test. It has been suggested that this Huber reagent may be employed, instead of litmus or cochineal, as indicated in acidimetry and alkalimetry, to determine sharply the neutral point.