Pain as a Storm Indicator.

The friends of Captain Robert Catlin, United States Army, are aware that he has for some years been serving as an animated barometer, to determine problems with reference to the relations of pain to weather, suggested by that eminent specialist in nervous disorders, S. Weir Mitchell, M.D., of Philadelphia. Captain Catlin has just published a report on his case, which was read before the College of Physicians of Philadelphia, June 6, 1883. In an introduction to this Dr. Mitchell specifies some of the circumstances which peculiarly fitted Captain Catlin for the service he has undertaken in the cause of medical science. In the first place, he is the victim of traumatic neuralgia, resulting from the loss of his foot, crushed in battle by a round shot, in August, 1864. Aside from the pain resulting from this mutilation, and which has been felt at intervals ever since in the lost foot, the observer is in admirable health; "his attacks are so definite as to coming and going as to create little difficulty in this direction, and from a former position as instructor in certain scientific branches at West Point he is well qualified by training to pursue this difficult study." "I may add," says Dr. Mitchell, "that I never knew any man more free from unwholesome attention to his own ailments;" and we may add that we never knew of a man who bore his burden of pain with more cheerful resignation and philosophy.

That this burden is by no means a light one is shown by the fact that the total amount of pain for the eight years ending on January 1, 1883, was 12,944 hours, or nearly one fifth of the time. This is Captain Catlin's calculation, but as he is free from pain during sleep, the proportion of pain during his waking hours is more nearly one-quarter. The winter months, it appears, hold the advantage as pain producers, and the proportion while the sun was north of the equator was 6,783 hours against 6,161 hours while it was south of the equator. March has the lead among the months, January being a close second, and November, December, May, February, April, August, October, September, July, and June following in this order. The average duration of pain was found to be greatest in February, 20·8 hours, the average for the whole time being 18·97 hours. February is one of the coldest, if not the coldest, of months, and contains probably the greatest barometric fluctuations of any month in the year; low temperature and high barometer producing pain, and extreme barometric undulations extending its duration.

As the result of the observation of sixty well defined storms, through ten consecutive months, it appears that storms announce their coming by the twitching of Capt. Catlin's nerves when the storm center is at an average distance of 680 miles, ranging from 200 to 1,200 miles. "Storms from the Pacific are felt the farthest off, very soon after crossing the Rocky Mountains. Those which move along the coast from the Gulf of Mexico are associated with neuralgia not quite so intense, and are not felt as a rule until within the average neuralgia distance." Should the pain be on a day of intermitting rain, it takes on an additional activity just before the increasing shower, and continues twenty to forty minutes; this will sometimes happen four or five times in twelve hours. Each little increment of pain seems to bear about the same relation to the showers as the main attack bears to the storm. Eating a meal hastens an attack and intensifies it when on. Eating, for example, at 8 A.M. brings on at 9 A.M. an attack not due until 10 o'clock. There is an ebb tide of pain just preceding meals, and storms coming within range during the early and the middle sleeping hours do not ordinarily arouse their victim, but delay their attack until sleep becomes less profound, thus following the ordinary rule that a victim of pain does not experience an attack until after a brief release from the influence of the anæsthetic sleep. Intense auroral periods are also believed to produce the pain.

As to treatment, Capt. Catlin says: "There has been no treatment in a medical way of late. I have had good health, take a great deal of exercise, but in a rather irregular way; my appetite is always good and I sleep well, except when the disturbance of neuralgia interferes. Physical exercise, nutritious food (have found milk most fattening of all), and light, agreeable occupations are, I found, the best regimen for a neuralgic subject."

Diagrams illustrating the relation between neuralgic pains and the barometer accompany this brochure, which, in the opinion of that competent authority, Dr. Mitchell, constitutes a most valuable contribution to the strict science of medicine. It is unfortunate that any officer should be subject to such an experience as Capt. Catlin has had for nearly twenty years; it is fortunate that, finding no escape from it, he should have the patience and zeal for science which have prompted him to make his own experience available for the benefit of other sufferers.—*Army and Navy Journal.*

PYRETHRUM, OR CHRYSANTHEMUM CORYMBOSUM.

This is a robust herbaceous plant with elegantly cut foliage and white and yellow flower heads, known also in gardens as *Pyrethrum corymbosum.* Under cultivation it grows about 4 feet high, and probably higher in rich soil. It is as hardy and persistent as the allied species, *C. Parthenium,* syn. *Pyrethrum parthenium,* of which the Golden Feather is a variety. In a wild state it grows from 1 to 3 feet high, and it is a common plant in Central and Southern Europe, ranging from Portugal to Switzerland, Austria, and Turkey. Our illustration, which is from the *Gardener's Chronicle,* was taken from a plant in the herbaceous ground at Kew, where we recently noticed it as the best and most effective of its near allies.

The insecticide and insectifuge qualities of the dried and finely powdered flowerheads of different species of *Pyrethrum* and the harmlessness of the powder to man, to other animals, and to plants, have long since been known. Used against various household pests, under the names "Persian insect powder" or "Dalmatian insect powder," it has hitherto been put up in small bottles or packages and sold at high prices. The so-called Persian powder is made from the flowers of *Pyrethrum carneum* and *P. roseum,* while that from *P. cinerariæfolium,* a native of Dalmatia, Herzegovina, and Montenegro, is more generally known as Dalmatian powder. Some interesting experiments made during the past year on different insects by Mr. William Saunders, of London, Ontario, show that the use of this powder may be satisfactorily extended beyond the household, while a series made by Professor Riley in the summer of 1878, with the same powder on the cotton worm, showed it to have striking destructive powers, the slightest puff of the powder causing certain death and the almost instant dropping of the worm from the plant. Repeated on a still more extensive scale the present year at Columbus, Texas, the powder proved equally satisfactory in the field.

Here, then, we have a remedy far exceeding any other so far known in efficacy, and harmlessness to man and plant, and the only question has been to reduce its cost. Mr. Milco, a native of Dalmatia, has been cultivating the *P. cinerariæfolium* in California in constantly increasing area for the past three years, and deserves great credit for his efforts in introducing it. The insect powders made from the California grown flowers have proved to be very effective. In SCIENTIFIC AMERICAN SUPPLEMENT No. 218 will be found an interesting and instructive article on the subject of insect powders.

THE INSECT POWDER FAMILY.—CHRYSANTHEMUM CORYMBOSUM: FLOWERS WHITE.

Construction of Induction Machines.

Dr. St. Doubrava contributes the following note upon the principle and construction of induction machines to the *Journal* of the Vienna Electrical Exhibition: In 1831 Faraday enunciated the following general law: "When a conductor moves in a magnetic field in such a manner as to cut the lines of magnetic force, a current exists in the conductor; when it moves parallel to the lines of force, there will be no current." In induction machines the space between the magnetic poles is generally understood by "magnetic field." When one pole is positive and the other negative, the lines of magnetic force run parallel to the line joining these poles, thus + P = — P; but between like poles the lines of force are perpendicular to the line joining the poles, thus + P || + P.

Upon this general law Faraday constructed his first magneto-electrical machine, as a laboratory experiment. It consisted of a copper disk revolving between the poles of a powerful steel magnet, or electro magnet. The axis was connected by a conductor with the periphery. The direction of the current was either from axis to periphery, or the reverse, according to the direction of rotation and the polarity of the magnet. In all induction machines subsequently constructed, up to the Pacinotti-Gramme and Hefner-Alteneck machines, spools of wire (helices) were made to approach and recede from the magnetic poles, so that they were alternately in and out of the magnetic field, causing a considerable loss of power.

The Faraday disk embraces the fundamental principle of all induction machines for constant currents. To prevent the opposite currents in different parts of the disk from neutralizing each other, it is constructed in radial segments, which are isolated from each other. The periphery of two opposite segments of the same disk may be joined by a wire, while the circuit may be completed by sliding contact with the axis.

Two such disks can be arranged upon the same axis in such a manner that currents may be set up in opposite directions in the radial segments corresponding in position, when both disks rotate in the same direction. By connecting the peripheral and axial end of every radial portion, we obtain the principle of the ring inductor of Pacinotti and Gramme, in which the two external side surfaces of the wire windings correspond to the two disks. The iron core of the inductor increases the intensity of the magnetic field.

Native Woods for Decorative Purposes.

A writer in the *Railroad Gazette* gives some ideas about our native woods and their uses that may be of value to our mechanics. He says that white wood is valuable because it remains where put, notwithstanding the fact that its surface is perhaps as easily affected by water as almost any wood. In Virginia there are tracts formerly known as the "Wild Lands," in which much fine forest remains, tracts where the tulip poplar, or the white wood, shows trees that will square two feet for sixty feet of length, and where the beech, oak, the hickory, and the sugar maple have never been touched. One of the finest tracts of the much used cherry tree is found along the eastern edge of the outcroppings of the coal measures of the northern part of this region. Those who have been accustomed to see miserable, caterpillar-eaten specimens of this tree, would be surprised by the splendid trees found growing in these forests—trees three and four feet over the stump and sixty feet upward before reaching a limb.

Carrier Ravens.

Successful experiments have lately been made at Coblentz in the training of ravens as carrier birds in place of pigeons. The latter are more subject to the attack of birds of prey than ravens. The trained ravens were made to fly a distance of forty miles, and their performances gave much satisfaction.

A New Test for Portland Cement.

Notwithstanding the enormous consumption of Portland cement at the present day, and the perfection to which competition and the demands of exacting engineers have brought the manufacturing processes in the hands of the leading makers, it is yet by no means certain that the essential qualities of good cement are generally understood. Portland cement has always shared, in some degree, the feeling with which experienced constructors have been accustomed to regard steel—admiration alloyed with no little unexpressed distrust. The reason for this feeling is not far to seek. It may be found in instances of the more or less mysterious failures in the employment of cement concrete, which have occurred at some time in the experience of all users of the article. It speaks well for the innumerable advantages of cement that these mishaps—vexatious and costly as many of them have proved—have not checked its advancement in popularity, but have, at most, inspired sufferers with the determination to find out their mistake and escape similar troubles in future. Cement has in this respect the advantage over steel that it offers every imaginable facility for the severest tests before being used. The familiar gray powder—which, by the addition of water, first becomes mud, and then assumes the consistency and hardness of stone—may be analyzed, gauged, sifted, examined microscopically, weighed, etc., with the object of ascertaining precisely what kind of stone it will make. Yet to this day it is not settled how to so treat the powder that indications may be expeditiously obtained of the qualities that will attach to it long after it has been mixed and used. And, in view of the absolute necessity that the user should be satisfied on this point respecting every consignment of cement that passes through his hands (perhaps to the extent of thousands of tons for one job), the importance of testing becomes sufficiently obvious.

The test of strength that is generally adopted in England for Portland cement is exclusively one relating to the cohesion of a section of the material—neat, or mixed with a definite proportion of sand—under a tensile strain gradually but quickly applied. The earlier testing machines were very rough, and exposed the briquette to much preliminary jarring before it was finally broken. It is not improbable that the higher resistance recorded of cement in modern use, in comparison with much that was formerly sold, is due in a great measure to the steadier action of the most improved testing machines. There is, moreover, great art in preparing the briquettes in strict accordance with any ordinary method; and even then the behavior of the test pieces is frequently eccentric. It has been suggested that a more rational way of testing a building material chiefly intended for use in large masses—as in walls, buttresses, etc.—would be to ascertain its resistance to crushing, rather than its tensile strength. For this purpose cement is mixed with a regular proportion of sharp sand and crushed after standing in water for a definite period. This principle of testing finds much favor on the Continent, where the German manufacturers have largely introduced it. Unfortunately, however, if the merely tensile test imposed in England does not satisfy all the conditions of actual use, neither does the compression test; for cement, unlike simple mortar, is very often required to sustain continual or intermittent tensile strength. For an example of this, the use of cement in the construction of gasholder tanks may be cited. Here the walls are required first to sustain the exterior, or crushing, strain of the earth backing, and afterward the tensile strain, acting from within, of the contained water. Cement courses in the walls of ordinary buildings, in substitution for hoop iron bond, is another example of material exposed at once to a compressive and tensile stress.

It has lately been proposed by Mr. Isaac John Mann, in a paper presented to the Institution of Civil Engineers, to ascertain the adhesive strength of cement—*i. e.*, its power of clinging to foreign matter—as well as its capacity for holding together, or sustaining a crushing load. There is much reason in this proposal; for it is evident that, however cement is used—whether neat (in which case it would probably be in the shape of rendering) or mixed with sand or stones, as concrete—a good deal of its utility must depend upon its power of making a good joint with its surroundings. The importance of this quality is generally recognized in the care that is taken for insuring a perfect union between successive layers of concrete in forming a wall. Mr. Mann proposes to carry this system of testing to its highest development, by cementing together two slips of sawn limestone or ground plate glass. The difference between cohesion and adhesion is anything but insignificant; although, in regarding the work done by a plastic cement, this distinction may be lost sight of. To use a familiar illustration, a gasholder sheet and the black varnish upon it will exemplify the two qualities in their highest form. The iron is very strongly coherent—for a tensile strain of about 20 tons per square inch would be needed to part its molecules, which could again be made coherent at a sufficiently high temperature—but it has no adhesive power whatever. The varnish, on the contrary, has no coherence, but unlimited capacity for adhering to anything with which it may happen to be in contact. With Portland cement of good ordinary quality, gauged neat as it comes from the makers, and tested after seven days, the cohesive and adhesive strength may be in the proportion of 532 to 59, or by another test 336 to 51.

There is a consideration now to be mentioned, however, which is of the highest importance. Cement as it is delivered by the manufacturer consists of a mixture of very fine dust and coarser particles. Sometimes the latter may be truthfully regarded as an adulteration; but it is sufficient, for the present, to consider them as of the same nature and origin as the dust, but imperfectly ground. It is evidently a matter for the user to decide whether he will require the manufacturer to deliver his cement ground as fine as flour or otherwise. It can, of course, be done at a price. The matter stands thus: The large particles, when not quite inert, enter into combination so slowly as to be incapable of developing any great cementitious effect within the short period available for any commercial or industrial test. Consequently there must not be too many of them, or the tests, whether of adhesion or cohesion, will be poor. The influence of the coarse particles upon the cohesive and adhesive action of cement differs; for while, within a certain range, the presence of these coarse particles increases the former, it diminishes the latter. It might also be said that the effect of the same thing upon the test of resistance to compression would be different again. Whatever may be said as to the wisdom of adopting a standard test of adhesion, there can be no doubt that anything tending to increase this power, within reason, must improve the value of a sample of cement. Hence the additional importance now shown to belong to the perfect grinding of this material. As ordinarily sent out, 45·6 per cent of cement is stopped by a No. 176 sieve—which is the finest procurable, having 31,000 meshes per square inch, or 176 silk threads to the lineal inch. Mr. Mann's experiments tend to show that, so far as concerns a seven days' test, the particles stopped by a sieve of this mesh, or 54·4 per cent of the whole bulk of the material, develop little or no strength within this period. By another series of tests it was also shown that the cement sifted through a No. 103 sieve (with 10,600 meshes to the square inch) has only one-fifth of the binding power of that which can pass through the No. 176 sieve. Nothing more is needed to show that the binding power of cement greatly depends upon the fineness of the particles composing it, apart from other considerations.

It is somewhat surprising that the roughness or smoothness of surfaces with which it is in contiguity does not affect to any very notable extent the adhesion of Portland cement; although, for many reasons, the cement adheres with varying tenacity to different substances. The following table shows how this power is manifested in cement obtained from five leading makers:

STRENGTH OF ADHESION OF PORTLAND CEMENT TO VARIOUS MATERIALS.

Material.	Average Adhesive Strength. 7 days.	28 days.	13 wks.	6 mths.	Remarks.
Bridgewater brick..	18	..	..	..	Ordinary cement.
" "	24	65	..	..	Sifted through No. 176 sieve.
Slate (sawn) ..	49	..	..	..	Ordinary cement.
" "	53	82	..	62	Sifted through No. 176 sieve.
Portland stone....	36	50	..	..	Ordinary; fragments torn out of surface.
" "	29	62	..	55	Sifted through No. 176 sieve; fragments torn out of surface.
Ground plate glass.	..	102	113	..	Ordinary cement.
" "	..	..	145	..	Sifted through No. 176 sieve.
Plate iron.......	23	68	..	..	Ordinary.
" "	44	66	..	..	Sifted through No. 176 sieve.
Sandstone.......	..	49	..	..	Ordinary; fragments torn out of surface.
Polished marble....	38	..	..	..	Ordinary cement.
" "	52	71	..	75	Sifted through No. 176 sieve.
" plate glass	47	40	..	70	Ordinary cement.
" "	55	49	51	..	Sifted through No. 176 sieve.
Granite (chiseled)..	41	..	..	..	Ordinary.
" "	78	97	153	..	Sifted through No. 176 sieve.
Limestone (sawn)..	57	78	98	..	Ordinary.
" "	78	93	116	..	Sifted through No. 176 sieve.

Total number of tests (omitting those of sawn limestone), 182.

We have only one remark to make on the results here recorded. It does not appear whether the average in all cases really represents the approximate effect, or is the mean of a number of widely different examples. It is evident that there may be all the difference in the world between various samples, according to their preparation, or they may be strikingly uniform. As our contemporary *Engineering*, in commenting on the same results, well remarks: "The connecting bond or film"—in a cement joint between regular surfaces—"is extremely thin, and it is well known that the value of such a joint largely depends upon the skill of the person making the joint. When two pieces of wood are carefully united by glue, the union is often so firm that it is easier to fracture the solid wood than to tear apart the glued junction; but still it is no uncommon sight to see glued articles fall to pieces." This is a sensible check upon assigning too much value to Mr. Mann's figures; but it is open to the objection that, after all, there must always be an allowance for bad workmanship, and the fact of glued work falling to pieces is no argument against the goodness of the glue, which is what may be said to be under consideration.

Mr. Mann's own conclusions upon his experiments, which were carefully conducted and well watched, are (1) that the true binding value of Portland cement can be best determined by testing its adhesive strength; (2) that the degree of pulverization is probably the only other condition, the practical importance of which will warrant an introduction into the standard system of testing, which should therefore include a standard sieve; and (3) that a sieve having 176 meshes to the lineal inch will be found sufficient for all practical purposes. It will be worth while to subject Mr. Mann's tests to extensive examination, in order to see whether they do furnish an additional guide to the qualities most desired in cement, when used in the construction of heavy engineering works. Further evidence is certainly needed upon this point.—*Journal of Gas Lighting.*

Coal and Candles.

In the course of his recent Society of Arts Cantor Lectures on "Solid and Liquid Illuminating Agents," Mr. Leopold Field, F.C.S., expressed the opinion that the formation of coal from vegetal matter is not always a process of such infinite time as is generally supposed. Wood, bearing marks of human labor, has been found partially carbonized; and even some piles driven by the Britons to retard the advance af Cæsar's armies have been found with decided traces of carbonization on their outer surfaces. Mr. Field exhibited specimens of all the links which connect coal and green wood, including samples of peat taken at different depths, which became denser and denser until, at a depth of 14 feet, they resembled lignite—though less dense—and only required pressure to reduce the material to a true coal. Mr. Field supposes that cellulose, $C_6H_{10}O_5$ (the fibrous matter of wood), is split up according to the equation $2C_6H_{10}O_5 = 5CH_4 + 5CO_2 + C_2$; and he supports his hypothesis by reference to the abundance of marsh gas and kindred hydrocarbons found in the vicinity of coal mines. The variation in constitution undergone by wood fiber while changing to coal is as follows:

	Carbon.	Hydrogen.	Oxygen.
Wood	100	12·18	83·07
Peat	100	9·85	55·67
Lignite	100	8·37	42·42
Bituminous coal	100	6·12	21·23
Anthracite	100	2·84	1·74

Speaking in another part of his lecture of the comparative efficiency of candles of various compositions, Mr. Field stated that stearine candles are the best for work, as they never bend or gutter. The dead white color is, however, an objection; and the light of stearine is not so brilliant as that of paraffine. Sperm candles the lecturer characterized as very beautiful; and he expressed surprise that they are not more used, although acknowledging that the price has much to do with it. The great objection to paraffine candles is their liability to gutter, if of low melting point; and, further, to bend. The plasticity of paraffine is a curious quality, as it does not seem to be directly affected by the melting point. Ozokerit candles generally consume before the bending point is reached. In regard to illuminating power, an ozokerit candle being taken as 10, sperm is 7·5, wax is 7, stearic acid is 7·25, and tallow is 3·5. There can be no question, Mr. Field says, that paraffine candles do not as yet give as much light as they should do upon theoretical considerations, and which they would do were the same substance vaporized in a lamp. Mr. Field also admits that the cost of a candle will always transcend that of other forms of illuminants.

Veneer Making.

In an article on the subject of veneers the *Northwestern Lumberman* gives some interesting facts. Straight grained and moderately soft woods are sliced off a log by a weighted knife with a drawing cut, the log, or burl, being ten feet long and the veneers varying from one-eighth of an inch to one-fortieth of an inch in thickness, the width corresponding, of course, to the diameter of the log. A knife machine which gives a half rotary movement to a semi-cylindrical turned log, allowing a veneer to be cut following the log's diameter, produces wide veneers from logs of small diameters. But while the knife has opened up new possibilities in veneer manufacture, the saw has by no means been abandoned; such woods as ebony and lignum vitæ cannot be cut with a knife, while finely figured and consequently close grained mahogany, and some rosewood, are difficult to cut. The saw, therefore, has its place. Such saws must be very thin, and so finely adjusted that hardly the slightest variation will occur in the thickness of the veneers turned out. While a nicely arranged circular saw will turn out boards varying the twentieth part of an inch, which would be imperceptible, such a lack of uniformity in thin sheets would prove a damaging imperfection. Before being cut the veneer material must be carefully steamed, the same as in bending. A tight box twelve feet long and four feet deep and wide is used, and exhaust steam is utilized. An ordinary wood like black walnut, which has an open grain, will steam sufficiently in six hours, but the close grained South American woods require thirty-six hours. Mahogany will steam sufficiently in twenty-four hours. Mahogany, tulip, and rosewood, being hard to cut, require more and careful steaming, and a knife in the best condition. The veneers wrinkle when laid together, but straighten out readily when glued properly to a body. Veneers will dry in the air in about twelve hours, but are not kiln dried, although the latter method is used for lumber out of which veneers are to be made.

Steel Rails.

A manufacturing engineer writes to *La Metallurgie*, Paris, claiming that the success of rolling steel rails depends on the temperature at which the steel is rolled. He states from his own experience that bars which were finished at a bright red heat (and which were recognizable after cooling by their blue tint) were more fragile under tests by striking or flexion than those finished at a lower temperature.