floor, and from the one knob to the other sparks are leaping with increasing rapidity and noise, every one of which would kill twenty men at one blow, if they were linked together hand in hand and the spark sent through the circle. From this conductor wires pass off without the window, and the electric fluid is conducted harmlessly away. Mr. Crosse approached the instrument as boldly as if the flowing stream of fire were a harmless spark. Armed with his insulated rod, he sent it into his batteries; having charged them, he showed how wire was melted, dissipated in a moment, by its passage; how metals—silver, gold, and tin—were inflamed and burnt like paper, only with most brilliant hues. He showed you a mimic aurora and a falling star, and so proved to you the cause of those beautiful phenomena."

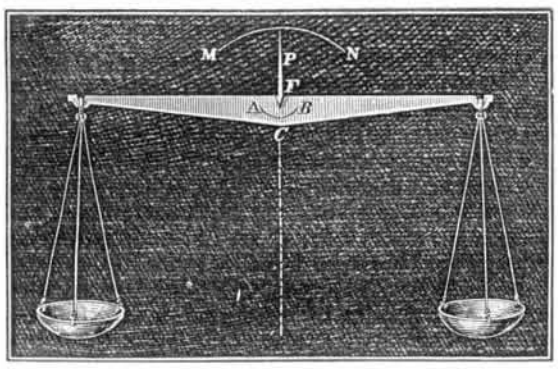
Mr. Crosse appeares to have produced in all "about 200 varieties of minerals, exactly resembling in all respects similar ones found in nature." He tried also a new plan of extracting gold from its ores by an electrical process, which succeeded, but was too expensive for common use. He was in the habit of saying that he could, like Archimedes, move the world "if he were able to construct a battery at once cheap, powerful, and durable." His process of extracting metals from their ores has been patented. Among his other useful applications of electricity are the purifying by its means of brackish or sea water, and the improving bad wine and brandy. He agreed with Mr. Quekett in thinking that it is by electrical action that silica and other mineral substances are carried into and assimilated by plants except fungi; and positive electricity he ascertained to be injurious to fungi, but favorable to everything else.

Mr. Crosse died in 1855. His widow has published a very interesting volume of *Memorials* of the ingenious experimenter.—*Timbs' Curiosities of Science.*

THE BALANCE.

The balance is an instrument so universally used that it seems strange that the principles of its construction should not be generally understood, yet such is the case. To satisfy ourselves that we are correct in this statement, we have conversed with a large number of grocers, druggists, and others, and have only in a very few instances found them posted. Chemists, assayers, and others who have occasion to use very fine balances, are always acquainted with the subject; but we do not write with the view of giving such any information. Our intention is simply to be the means of popular instruction.

The center of gravity in a body is a point so situated that, if the body be suspended from it, the mass may be revolved about this point and will remain at rest wherever it is placed. The balance is a lever having its fulcrum *above* the center of gravity of the beam. When it is balanced the center of gravity lies on a line joining the point of support and the earth's center of attraction. If either end is depressed, the center of gravity describes an arc the radius of which is the distance between the point of support or fulcrum and the center of gravity in the beam. This center of gravity is thus raised or carried away from the earth's center of attraction, and consequently tends to return to it as soon as the weight or other depressing force is removed.



In the engraving, F represents the point of support or fulcrum, C, the center of gravity of the scale beam, and A B, the arc of oscillation. The dotted line represents a line drawn from the fulcrum to the earth's center of attraction, and M N, the arc described by the pointer, P. C, being the lowest point to which the center of gravity can attain, it will remain there unless some force acts upon it. The shorter the distance between F and C, the less will the center of gravity be raised in describing any number of degrees of arc, and the less force will be required to move it. Hence the nearer the center of gravity in the beam lies to the fulcrum, the more delicate will be the action of the balance, all other things being equal. If the beam were suspended from a point coincident with its center of gravity, the latter would not be raised, however much the beam might oscillate; the beam would not then return to its original level, but would remain wherever it was placed. Such a balance would show differences in the weights of bodies, but any difference in weights attached to the ends of the beam, sufficiently great to overcome friction, would continue to move it until it assumed a perpendicular position. The only basis for the estimation of the difference would be the rapidity of this motion, and not the angle which the pointer, P, makes with the perpendicular, as is the case with the properly constructed balance.

If the point of support should be placed below the center, the beam would be reversed by any difference in weight sufficient to overcome friction. Friction is as much as possible avoided by the use of knife edges for supports, and in very delicate balances these edges rest upon pieces of polished agate. A delicate balance with from one to 2,000 grains on each dish should be sensitive to a difference of from .001 to .0005 of a grain.

CAPEWELL'S REVOLVING CARRIAGE WHEEL FENDER AND STEP.

In turning an ordinary carriage short, the wheel is liable to cramp against the body of the wagon, endangering its overturn and wearing and defacing the vehicle. To prevent this is the design of the device exhibited in the engravings. It is a roller, A, turning in projections under one edge of an open work triangular frame, B, of metal which is secured to the under side of the carriage rail. The sides of the frame are of such an angle that the wheel, when backed toward the wagon for turning around, shall engage the face of its tire squarely with the roller, thus effectually preventing cramping or friction. The construction of the roller is seen in Fig. 2, which is a longitudinal vertical section. It consists of alter-

Fig. 1

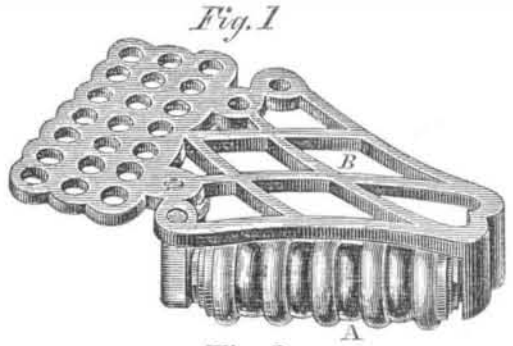
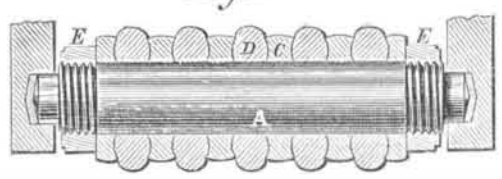


Fig. 2



nate disks of iron, C, and rubber, D, the latter cushioned or compressed by nuts, E, at either end. As the rubber stands above the iron washer rims, it receives the pressure of the wheel and renders the action noiseless. The roller may be placed on either side of the frame, B, to suit either the right or left side of the carriage. Besides its use as a fender, it makes an elegant and handy step to the carriage.

Patented through the Scientific American Patent Agency, September 17, 1867, by Geo J. Capewell, whom address, at West Cheshire, Conn.

Correspondence.

The Editors are not responsible for the opinions expressed by their correspondents

Provincial Protection to Inventors.

MESSRS. EDITORS:—A question which interests many persons in this Province, is the manner in which the Dominion will treat the Patent question. A Government measure was introduced at the recent session, passed the Commons, was amended in the Senate in an important feature, and was consequently withdrawn by the Government. The matter, therefore, stands open to the next session, some eight months hence; and meanwhile it is important that correct notions on the subject should be sent abroad.

Each Province has, at present, a different system. That of the late Province of Canada is, as you know, exclusive—giving no right to a Canadian, the assignee of a foreign inventor, to obtain a patent in Canada. In New Brunswick, on the contrary, our system is most liberal. Here, any assignee of a foreign inventor can obtain a patent for the invention, subject to precisely the same regulations and under the same conditions which are applied in the case of New Brunswickers patenting their own inventions. The fees, too, are moderate, and the mode of application simple. Now, what we desire in respect to a patent law for the whole Dominion is, that it should copy the liberality and simplicity of our local Act. The present law of the Dominion should give its protection to the *creations* of genius, skill, and application, whether the possessor of these qualities lived on one side of the line or the other. We have always found fault with the United States Congress for not passing a copyright law, by which the intellect and the labors of British writers would be protected in the Republic. Not that it would have been of much service to us, for New Brunswick literature is not very extensive; but because we consider it right, just, and politic. What applies to literary creations, applies equally to inventions and discoveries in the arts and sciences.

But beyond this, we think that the Dominion Patent Act should make patents already existing in each Province, patents for and throughout the whole Dominion. Objections to this there may be, but we conceive that the reasons in its favor are overwhelming. It would make what is property in one Province, property throughout the Confederacy; it would simplify the settlement of the patent law question; and it would prevent conflicts of jurisdiction, of local patent laws with the Dominion patent law, of local patents with Dominion patents—which must otherwise arise. We cannot see that it would work injustice to any person, because, of course, all existing rights would be protected in any legislation for the purpose.

Your experience in the matter of patents and patent laws, will enable you to give us advice and assistance in this matter. Although of very great importance, the subject of patent laws is little understood in New Brunswick. J. E.

Woodstock, N. B.

Water Test for Boilers.

MESSRS. EDITORS.—I have a second-hand steam boiler and am desirous of knowing whether it will stand inspection or not, and I have no way of ascertaining except by sending to Chicago, a distance of one hundred miles, which would be an unnecessary expense in case of its not being strong enough to stand the test.

I propose to fill the boiler full of cold water, and then heat, it until it expands sufficient to produce the desired pressure which I think will take place before the water becomes very warm and before any steam has generated. I conversed with several machinists and engineers in regard to this way of testing, all of whom seemed to think it would not answer, but they could not give any reasons for thinking so. I cannot consistently place much reliance on such groundless opinions, and therefore would like to get your opinion and advice on the matter before trying the experiment.

De Pue, Ill. J. H. HASSLER

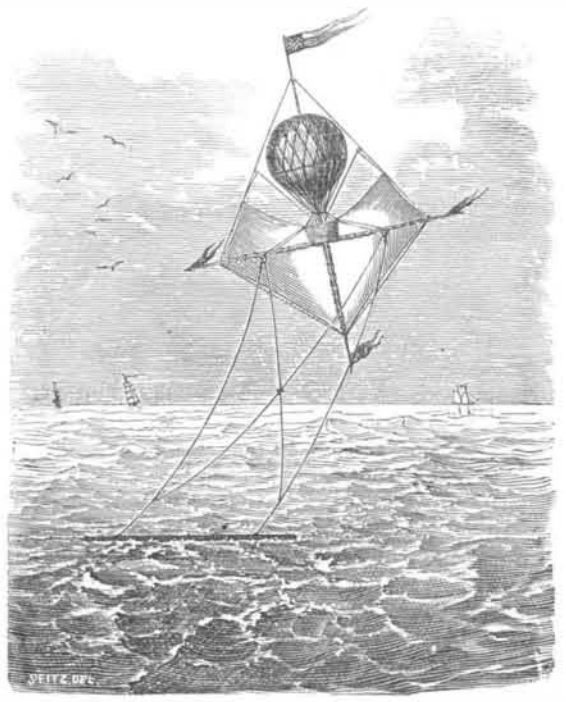
[We cannot advise the plan proposed; we do not think it would work. Dalton says that 1,000,000 parts of water at 32° Fah., becomes 1,046,600 at 212° Fah.; 1 in 23.3. Will not the shell of the boiler expand as much as the water and render nugatory the attempt to determine pressure? The boiler must be fitted with a force pump for feed, and it would be very easy to rig a contrivance to work it by hand so that you could apply the usual hydraulic test. If there is no steam gage to indicate pressure, the weight of the safety valve can be set to the point to which the boiler is to be tested and then the pump used until it rises.—EDS.

Marine Aeronautics.

MESSRS. EDITORS:—In your last number I notice an article entitled "The Great Aeronautical Exhibition." One paragraph particularly attracted my attention, and I quote it:

"In this class we notice only the following, chiefly on account of its absurdity. The expectation that a body floating in a current of air, and propelled by no other force, could be guided by sails, is a folly which our readers will appreciate without further remark."

Probably the most of your readers concur in your opinion, that it is folly to suppose that a body floating along in a current of air or water, propelled only by the force of the current itself, would exert any resisting force upon the fluid by which its direction could be changed. It is a fundamental principle of mechanics, that a body, moved by a single force in a given direction, requires a second force, acting in another direction, to produce any change in its course. A ship propelled through the water by means of sails, can be guided by her sails alone, to some extent. The second force in this case is the resistance upon her keel. If the keel were movable upon a central pivot—proper strength and other difficulties not being considered—the ship might be guided by its keel so as to sail as close to the wind as it now does by the use of the rudder. Many of your readers are acquainted with the old method of utilizing the force of river currents to propel ferry-boats across streams; the ends of the boat being connected by ropes to grooved pulleys running upon a rope stretched from one bank to the other. The end



of the boat lying in the direction the boat is required to move, is hauled up stream by shortening the rope at that end, so that the boat makes an oblique angle with the direction of the current. The force of the current upon the side of the boat propels it across.

So far no means have been discovered of guiding vessels—not locomotive—except by the resistance of one medium to the force of propulsion afforded by another. The difficulties of effecting locomotion in air-navigation are very great, for reasons which I need not here mention.

It occurred to me, some years since, that an application of the principles to which I have alluded, might be made to the guidance of balloons over large bodies of water. Since I first conceived the idea, I have made some experiments which have confirmed my first opinion, and as the subject of aeronautics is now attracting much attention, I have ventured to send you a drawing and a description of the apparatus which I have been experimenting with, representing it, however, as I should suppose it would appear when made upon a suitable scale for actual use. The sails are, however, probably too

large for the balloon as represented in the drawing, but that will not affect the elucidation of the proposed plan.

The vertical axis of the balloon is occupied by a mast extending to some distance below it, to which is attached a yard crossing the mast at right angles, directly beneath the car. Rope stays or braces are attached to, and connect the upper and lower extremities of the mast with the ends of the spar. To these stays and also to the mast are attached suitable blocks and other appliances for furling and extending the sails. On the spar, at about one fourth its length from either end, are blocks through each of which pass two guy ropes. One of these guy ropes passes directly to the corresponding end of a floating keel, and the other passes through a ring placed at the point where it intersects the opposite guy rope to the opposite end of the keel. By shorteuing or letting out these guy ropes a proper inclination is given to both the sails and the keel. The guy ropes are so attached to the keel as to have no tendency to keep it otherwise than perpendicular. The keel is composed of a hollow metallic tube which floats upon the surface of the water, with a thin plate of metal attached to its under side of sufficient depth to prevent drifting by the force of winds. Its cross section would be so small as to oppose little resistance to motion, while by the use of the guy ropes it could be made to assume such a position as to guide the balloon in any required direction. It could not probably be held so close to the wind as a well rigged sailing vessel, still my experiments have demonstrated to me that it can be brought much closer to it than I at first anticipated. The keel not only acts as a means for steering the balloon, but it also takes the place of ballast. It might easily be made to carry the materials for the generation of gas to supply leakages which are liable to occur. These materials could be separated and confined in appropriate receptacles which, by means of a stop cock with a cord attached, could be made to communicate with each other, and the gas thus generated could be conveyed by a flexible tube to the balloon. Enough of these compartments could be provided to furnish the gas in quantities as it would be required.

So confident am I that this apparatus will answer the purpose, that I am willing to undertake the voyage from New York to Liverpool provided a proper person will volunteer to accompany me, and some one can be found to furnish the means for the construction of the "air-ship" under my direction, my own resources being inadequate to meet the necessary expenses. AERONAUT.

Plan for Index Plates.

MESSRS. EDITORS:—I send herewith a plan for an index or dial-plate for a gear-cutting machine. If you or your correspondents know of a better combination, please inform me through the SCIENTIFIC. I propose to make the index-plate twenty-eight inches in diameter, the first circle of holes (commencing at center of plate) four inches diameter, and the last circle twenty-seven inches diameter. There will be sixty-nine circles in all, containing the following number of holes, and in the following order:

77	87	99	109	118	127	135	143	280	420
78	89	101	111	119	128	136	144	300	440
79	91	102	112	121	129	137	145	320	460
81	93	103	113	122	131	138	146	340	480
82	94	106	114	123	132	139	147	360	500
83	97	107	116	124	133	141	148	380	520
86	98	108	117	126	134	142	149	400	

In the above I have left out the number 75, 150, and some between them, because they are factors of other numbers used, viz:

75 is a factor of 300, 85 of 340, 95 of 380, 105 of 420, 125 of 500,
76 " " " 380, 88 " 440, 96 " 480, 110 " 440, 130 " 520,
80 " " " 480, 90 " 360, 100 " 500, 115 " 460, 140 " 280,
84 " " " 420, 92 " 460, 104 " 520, 120 " 480, 150 " 300.

All numbers below 75 are factors of the even numbers between 75 and 150. Consequently, I can cut a gear of any number of teeth below 150; above 150 I can cut as follows:

160 is a factor of 320, 190 of 380, 220 of 440, 250 of 500,
170 " " " 340, 200 " 400, 230 " 460, 260 " 520,
180 " " " 360, 210 " 420, 240 " 480.

Total number of holes in index-plate would be 12,690; number of different gear that could be cut from six teeth upwards, 169; distance from center to center of holes in four-inch circle, 0·1632 inch; distance from center to center of holes in largest circle, 0·1666+ inch; distance from any circle to next adjoining, 0·172+ inch.

Kalamazoo, Mich. E. H. H.

Breech-loading Cannon in Russia.

ST. PETERSBURG, RA., July 9, 1868.

MESSRS. EDITORS:—In your number of June 27th ult., you say that Russia had adopted the Prussian system of breech-loading cannon. This is a mistake. The Prussian system, together with the Armstrong and Broadwell systems of breech-loading cannon, was elaborately tried by a Russian Commission in the presence of the undersigned. The Armstrong gun, first, and the Prussian Krupp gun, second, broke down, and could not longer be loaded or fired without cleaning; while the *American* system of J. W. Broadwell proved a perfect success—his gun being as fresh and quick in loading, and accurate in fire, as at the commencement. As a consequence, Russia gave up the Krupp and Armstrong guns, and bought the Broadwell patent, giving him a decoration and a large sum of money, and now uses it both in the army and navy, in large and small bores. AMERICANUS.

RICH or poor, it is every man's and every woman's duty to earn his or her own living. Everybody is a consumer; therefore, everybody should be a producer. The world's wealth is so much less by everything that is consumed or worn out. The idleness of individuals in all stations and places, makes salaries lower and bread higher; so it is the idle in any community who should be despised, and not they who labor.

THOMAS & RAYMOND'S PATENT ADJUSTABLE LADDER.

Serious injury to body or limb, if not permanent crippling or loss of life, sometimes results from the slipping of the foot of a ladder, when, on account of the unevenness of the ground, it is necessary to "block up." This is usually done by means of brick, stone, pieces of wood, etc., liable to slip at any moment. The invention here illustrated is intended to obviate any such disaster. The engraving shows plainly a simple attachment effectual, cheap, and handy, which can be

applied to both feet of the ladder, which would seem to be preferable, as it would obviate the necessity of turning the ladder to suit its changed position to the surface of the ground.

In the engraving the attachment is very plainly seen. It is a strap of malleable, cast, or wrought iron, with two slots cut longitudinally, and is secured to the ladder by means of two bolts through the ladder leg, the attachment being held in position by nuts. For better security the foot of the attachment is corrugated, and the inside surface where it meets the ladder may be similarly corrugated if deemed necessary. When lifted up, the appendage is entirely out of the way, but it may be dropped to any extent desired to suit circumstances.

The patent for this device was issued June 30, 1868. The entire right or territorial rights are for sale by Thomas & Raymond, Beverly, Mass.

Dyspepsia---Its Symptoms and Causes.

We extract from a communication by Dr. E. P. Miller to the *Herald of Health*, the substance of an interesting article on Dyspepsia, a disease which prevails to an incredible extent in this country, and which is the fruitful source of many complaints often attributed to other causes.

"In persons whose digestion is perfectly healthy, there is, during the digestive process, more or less gas accumulated. This gas is generally all absorbed and used in the system, so so that in the highest state of health no gas will accumulate in the body, it should all be taken up by absorbents and used.

"Flatulence, then, is due to an excess of gas. The cause of this excess may be either a failure of the absorbents to take up what naturally accumulates in the digestive process, or to its being produced in excess. The introduction of a certain amount of air into the stomach in the frothy saliva, by mastication, and in the act of swallowing food, may be considered a physiological process. This air undergoes a change by being interchanged or mixed with the digestive fluids and gases, and in this change it gives up a portion of its oxygen, which is finally absorbed. In the dyspeptic's stomach the absorbents are not active, and this gas accumulates, giving rise to flatulence.

"The chief origin of the gases which produce flatulence, however, is due to the decomposition or putrefaction of food in the alimentary canal, and those persons who are habitually troubled with flatulence, either eat at their meals a quantity of food which is absolutely much too large for their powers of digestion, or they are taking a quality of food that is not well adapted to the diseased condition of their digestive organs.

"Some authors think that the fluids which are thrown back into the intestinal canal from the blood to be excreted, generate gases which give rise to flatulence. This opinion has not, as yet, been so clearly established. The gas in the stomach differs from that in the intestines, and that in the small intestines differs from that in the large. There is a much larger proportion of oxygen in that found in the stomach, being much more like atmospheric air than those intestinal gases.

"Hydrogen is formed in much larger proportion, however, in the gases of the intestines than in those of the stomach. This hydrogen is not found in the blood to any great extent, and is not extracted from the blood into the intestines, so that it must arise from the chemical changes going on in the food after it leaves the stomach. This chemical change is doubtless due to obstructions in the function of the liver. MM. Bidder and Schmidt have tried repeated experiments upon dogs, by tying the duct which conveys the bile from the liver to the intestines, and they have invariably found that rapid chemical changes took place in all sorts of food when this was done. When animal food was fed to these dogs the feces smelled like carrion; there was a continual rumbling in the abdomen, and an evacuation of fetid air.

"From the experiments made, it is supposed that one of the functions of the bile is to act as an antiseptic, and prevent the putrid decomposition of albuminous food, and also to check the acid fermentation of vegetable foods. Dr. Chambers states 'the condition produced in dogs by mechanically stopping the functioning of the liver, answers exactly to the intestinal flatulence of dyspeptics in our species.'

"Flatulence of the small intestines generally occasions the greatest annoyance. There is usually considerable difficulty in this gas passing the ilio-colic valve into the large intestines, and for this reason it often rolls about in the abdomen, causing a very distressing rumbling noise, sometimes remaining several days without being able to escape or to be absorbed. In addition to this rumbling and motion, it often greatly distends the abdomen, causing severe pain in the in the side and other distressing symptoms. At times, when there is but slight pain or discomfort, it occasions much inconvenience by preventing sleep.

"When gas is expelled by the mouth, that has a strong odor of sulphureted hydrogen, it is intestinal gas that has passed up through the pyloric orifice into the stomach. When gas is belched up that has neither taste nor smell, it usually comes from indigestion of starchy food; when it is fetid with the odor and flavor of sulphureted hydrogen, or rotten eggs, it is from the indigestion of albuminous food. Flatulence arising from the indigestion of albuminous food is often attended with diarrhea, while that caused from starchy food is attended with constipation. Flatulence of the colon or large intestines is not near so troublesome as that of the small intestines. It is readily distinguished from that of the small intestines by percussion, by the absence of rumbling, and by its passing off more readily from the bowels.

"Constipation is one of the obstinate and very troublesome symptoms accompanying dyspepsia. It is often so formidable as to be almost the only symptom complained of. Patients often say: 'Doctor, if I could only get my bowels to move freely, I should be all right; but I can't get them to move at all without I first take something to start them.' This taking 'something to start them' is very often the sole cause of their extreme constipation. There are tens of thousands of dyspeptics in the country who have almost ruined the mucous coats of the alimentary canal by the constant habit of resorting to physics to cure them of every slight indisposition they may have.

"If people would only realize that in every dose of physic they swallow they are taking into their systems an irritant and dangerous poison, which the vital instincts hasten to expel from the body by this rapid purging, and that this poison must leave its damaging effects in the blood, on the nerves, bones, muscles, and particularly on the mucous membrane of the alimentary canal, it seems to me they would see a reason for not being in quite so much haste to defile the beautiful bodies God has given them.

"Constipation and costiveness are usually regarded as synonymous terms, yet some authors make the distinction, that in costiveness there is less fecal matter formed than in constipation. In both there is a default in the repulsive power of the bowels, allowing the fecal matter to accumulate, but in costiveness there is less accumulation than in constipation. In this difficulty there is evidently a great deficiency of expulsive power in the lower bowels. The causes of course are various. Purgative medicines, I think, should head the list. Imperfect digestion of the food before it reaches the colon; sedentary habits; acute diseases, which confine the patient to the bed for a long time; general debility; neglect to attend to the natural call to evacuate the bowels, thus keeping them too long dilated or distended; imperfect mastication; eating indigestible and insoluble articles of food, such as skin, gristle, stones and seeds of fruits, and half-cooked vegetables, highly seasoned food, new bread, starchy food that is imperfectly digested, alcoholic stimulants, tobacco, vinegar, and whatever interferes with the healthy action of the liver, will produce constipation.

"Too highly concentrated food is often a cause. A certain amount of innutritious material seems necessary to complete digestion, and thus, while we should not exclude the innutricious entirely, we should avoid the extreme of swallowing too much of the coarse and indigestible. The exclusive use of fine flour bread is a prolific cause of constipation. It prevails more among Americans than any other class of people; the reason for this being, they use more concentrated food, take more physic, and less exercise. Old people are most most liable to constipation."

OUR Secretary of the Navy within a few days past, has sent in a communication to the Senate in reference to the acquisition of the Midway Islands, belonging to the West Indies group, and the opinion is expressed that the acquisition will prove a highly important one. The principal harbor is said to be equal to that of Honolulu, the soil is good and fish are abundant in the bays.