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A GLANCE BACKWARD AND FORWARD.

As we approach the end of another twelvemonth the usual questions arise: What has been the character of the year's events? What its progress? What its promises?

Naturally those things which bear most directly and forcefully upon a man's life and study and daily labor will seem to him to be the most important. The business man, the engineer, the artisan, the student, the inventor, will each review the past or contemplate the future in his own way, by the light of his individual or professional experience and hopes.

But there are events, achievements of labor, discoveries, inventions, and the like, which all men make note of sooner or later, and which give to the year its historic character. Who can name those of the year just closing?

The task would not be so hard if each year stood alone in its work or measurably distinct, like the links of a simple chain; or if it were possible for men to pick out infallibly from the complicated tissue of current events those most worthy of commemoration. But the great work which was brought to fruition this year was begun perhaps a decade, perhaps a century ago. The invention, observation or discovery by which the year 1881 will be best known a century hence is most probably yet unreported or hid away in the mass of the year's records, with its importance unsuspected or at best but vaguely recognized, even by the man whose name it will make known to many generations. Our point of view is so close that we cannot well see the things our descendants will see most plainly when the things we now magnify most will, perhaps, have gone to the limbo of forgetfulness.

Of some things, however, we may be sure; and, though we may forget them next year, they have played a prominent part in the current history of the past four seasons.

Of one thing we can speak with confidence. Though not the best of years, 1881 will go down to history as certainly not an empty or a bad one. Crops have been fairly good the world over. There have been no great famines, no widespread plagues, no devastating wars. The industriously inclined have had enough to do everywhere, and in our own country, at least, have been able to command an average amount of the mental and material good things going.

Our industries, on the whole, were probably never more flourishing, more varied, or more reasonably hopeful as to the future. There have been no general disturbances of labor nor anything tending to throw large numbers of men and women out of employment. Commercial failures have been comparatively few, and every productive industry has thriven. In many departments the work already called for and undertaken is sufficient to insure steady employment for men and machinery for several if not all of the months of the coming year.

The rapid extension of our railway system, in the older States as well as in the newer Territories, has given and doubtless will continue to give employment to vast armies of out-door laborers and scarcely smaller armies of machinists, mechanics, iron and steel makers, and workmen in all the arts tributary to the railway system.

The industrial development of the South, Southwest, and Northwest during the year has been unprecedented, vast acres of virgin and long neglected soil having been brought under cultivation, vast stores of natural wealth in forest and mine having been newly opened up and made accessible by new roads.

As the commercial and financial center of the country, and now, as the late census has shown, the manufacturing center also, New York naturally feels intensely the quickening pulse of general activity. An index of the impetus of national prosperity, we have seen in this city and across the river in Brooklyn over four thousand houses begun and many completed during the eleven months of the year already passed, not a few of these structures covering large areas eight or ten stories high. The estimated cost of the buildings for which permits were granted during the first eleven months of the year exceeds fifty-five million dollars.

The lighting of our streets and squares by electric lamps was officially begun less than a year ago. The work of putting down mains for the conveyance of electric conductors for a general system of incandescent electric lighting for stores, offices, and dwellings is going on rapidly. And the same may be said of mains for steam heating from central stations.

The great bridge across the East River is nearing completion. The year has seen the approaches substantially finished and the work on the superstructure begun. Now nearly all the floor beams are laid. The original plans have been materially changed during the year, making the bridge five feet wider and four feet higher above the river, with greatly increased strength, to enable it to carry railway trains of Pullman cars.

The tunnel under the Hudson is progressing rapidly and securely by improved methods, work going on from both shores. Steady progress is also making in the excavations under Hell Gate for the removal of Flood Rock. Safety in the navigation of our harbor and adjacent waters has been largely enhanced during the year by the introduction of iron hulled passenger and excursion steamers.

In marine engineering the most notable progress has been seen in the building of steamships exceeding 5,000 tons and up to 8,000 tons, and in the substitution of steel for iron, as in the construction of the Servia. On the destructive side we have seen the successful testing of the Ericsson torpedo boat Destroyer, the less successful testing of the Alarm, and the launching of some notable torpedo-boats in England.

Besides the work of civil engineering already noticed are several more or less important ones, begun or completed, which should not be forgotten. Another line of railway communication across the great West has been completed in the Southern Pacific road, and rapid progress has been made toward the completion of the Northern Pacific. Canada has undertaken a rival transcontinental railway still further north, and has done considerable serious work upon it during the year. Our northern neighbor has also completed the improvement of the Welland Canal, a work lately pronounced by high authority to be the best of its kind in the world. Our southern neighbor, Mexico, has manifested unwonted activity in railway extension, and unwonted wisdom in greeting cordially American enterprise therein, and in the Tehuantepec ship railway scheme of Capt. Eads. At Panama the De Lesseps canal project has been seriously begun, surveys and some excavations have been made, and a heavy tribute paid to the evil genius of the climate in death and disease among the engineering staff and the small army of laborers employed. The St Gothard Tunnel through the Alps has been opened to traffic, and the projectors of the English Channel Tunnel have given earnest of their sincerity in steady and promising work in actual drifting under the sea. The new Eddystone Lighthouse has been completed. The centennial of the birth of George Stephenson has been duly celebrated in England, and duly commemorated in this country by a commendable advance in the speed of fast trains between our principal cities. Though built last year, the Fontaine locomotive makes its mark by actual service this year.

Not the least notable characteristic feature of the year has been the increasing attention given to useful applications of electricity, due partly to rapid advances in electric lighting, but more perhaps to the prominence given to electrical affairs by the successful exhibition at Paris. The storage of electricity, so called, though not new, has been greatly developed and improved during the year. From being a laboratory experiment known to few it has risen to be a promising factor in the practical application of electricity to every-day affairs. The employment of frictional electricity in the separation of bran from flour has been brought prominently before the scientific and milling world during the year, and a successful mill using electric purifiers throughout has been established. The electric railway has been more extensively tested in the carrying of many thousands of passengers at the Paris Exhibition; and ground has been broken for a commercial electric railway in Ireland. The system of telephonic stations for civic purposes begun in Chicago has been much extended, adding materially to the efficiency of the police system. Among the undeveloped but very promising discoveries made public during the year in connection with electricity we must not forget the experimental researches which have produced the photophone, thermophone, and other applications of radiant energy in the transmission of speech. Much that is useful may come from them.

The researches of Pasteur among the lower forms of life, especially those associated with certain malignant diseases, have given results which are perhaps more pregnant of benefits to come to humanity than any other work of the century. If by cultivating the specific virus of our more malignant diseases the morbific elements may be deprived of their malignant character and yet remain capable, when inoculated, of making the organism as proof against the true disease as a real attack of it would, preventive medicine has entered upon a stage of infinite importance to mankind. So far the tests seem to justify the most hopeful anticipations.

Enough has been said to remind us of some of the more notable results and promises of the year. A multitude of perhaps equally important topics crowd upon us for recognition—progress in the industrial arts; Arctic research; comets; archæological discoveries in Egypt, Mexico, and elsewhere; the Atlanta cotton fair and its proofs of an undeveloped world of wealth in the South; the great works begun in Florida for the transformation of a vast swamp into an industrial State; and scores of other enterprises begun or completed at home and abroad. This is a period of great things, and no man can afford either to remain in ignorance of them, or to supinely let the opportunities they offer for self service and public service go by unimproved.

PATENTS AS INVESTMENTS.

It has been said that the introduction of useful inventions seems to hold by far the most excellent place among human actions. Unfortunately this, like many other truths, is not sufficient of itself to incite the inventive faculty. In these money-getting times mere sentiment succumbs to pecuniary gain, and, when the value of an invention is called into question, it is not its moral or beneficial effect upon the community that is considered, but rather the more practical one of its influence upon the pocket. Do patents pay? is a question often put and frequently answered in the negative, but erroneously so. For the amount of money invested, there are few properties that have paid more handsomely. Take the leading investments of the day; how many of them are gigantic failures? Of course all patents do not pay, neither do all investments in any description of property; but in these days of wild speculation, railroad bubbles, and bank failures, it may be very opportunely asked whether thirty-five dollars, or a little over two dollars a year, paid to the government for a seventeen years' exclusive right in and to some useful invention, is not a promising investment? It at least is not a very extravagant one.

We all know of patents that have paid their millions, but we do not all know of the many thousands upon thousands of patents which have realized for their owners amounts varying from five thousand to fifty thousand dollars and upward. Contrast these realizations and the paltry outlay required with other investments, and where is the property which yields as large a return? That many patents do not pay is not always the fault of the invention, but not unfrequently is due to the want of proper commercial management, or to the clumsy form in which the invention, perhaps a very meritorious one, has been ushered to the public. But even these patents ultimately sometimes prove valuable, on account of the principle involved or some one particular construction or combination they cover, so that holders of subsequent patents are compelled to pay tribute, and it is never safe to consider a patent worthless because it is dormant. Its day, after the lapse of years even, may come unexpectedly.

Again, inventors frequently are at fault in not following up their inventions by fortifying the original patent with subsequent ones covering improvements in matters of detail. Nor should repeated failure discourage an inventor; for, if only one patent out of every ten pays, it will many times more than compensate for the cost of the ten. Not merely scientific men and mechanics, but men of leisure, will do well, then, to consider whether a patent, if only as a speculation, is not a cheap investment, even if the weightier consideration of advancing the cause of science or adding to human comfort, by ever so small a step, be altogether discarded.

VIBRATION OF RAILWAY BRIDGES.

It is not at all improbable that the coming railway engineer will design bridges and superstructures and machinery with a view to obviating the injury done to these structures by vibration caused by rolling stock in motion. To build a bridge capable of sustaining heavy loads is the aim of the engineer. He may accomplish this to his entire satisfaction so far as a dead weight is concerned; a tremendous load causes but little deflection, and the bridge is pronounced perfect. In one sense this would be a correct verdict, and yet it would not contain all the elements of a perfect bridge. The bridge is calculated to support a load much greater than it will ever be called upon to sustain, and the ordinary load will not strain any of its members by reason of the factor of safety. But when there is an undue or excessive vibration, the fibers are disturbed and a gradual weakening of the material is the result. To prevent vibration and unequal deflection it is important that the supports be made as uniform as possible. By making one portion of the rail support, whether on bridges or grade, stronger than another, the deflection being unequal, causes a vertical oscillation of rolling stock which is not only destructive to the stock but also to the substructure. This destruction arises not only from disturbance of foundations, but by reason of the tendency of long-continued vibration to separate the particles which constitute the mass of the material. We take a piece of tin, lead foil, annealed wire, or some similar metal, and bend it, and there is no perceptible injury or tendency to break, but we repeat the bending process between our thumbs and fingers, and pretty soon the fibers part and there is a break. This is precisely the case with an iron girder or other member of a bridge. Thus constant vibration has a tendency to weaken and destroy these structures, and to this may be assigned the cause of many mysterious and disastrous bridge failures. This vibration also tends to weaken joints and rivets, and unless the structure is under constant and thorough inspection disaster may occur. How to prevent excessive vibration is the question; but probably to follow the plan of the deacon in his construction of his "wonderful one-hoss shay," to "make each part as strong as the rest," would be as effective as any.

A cat, in walking along a large beam in a wood frame building has not the slightest effect on the structure; but let the feline take a lively trot on the beam, and the whole building trembles. A horse, in walking across a bridge, causes no perceptible vibration, but a trot gives it a thorough shaking up; and this vibration continues for some time after the animal has left the bridge. This vibration is more destructive than an excessive load moving slowly. A locomotive, in crossing a bridge at a high rate of speed, shakes the structure by the counterbalances on the driving wheels, precisely as the cat or the horse shakes the barn or the bridge.

The remedy for this, then, would seem to be to run slow over bridges, but this is obviously impossible with our high velocities on lines where bridges are frequently met with. It only remains, then, to prepare the bridges in all the details of construction to resist vibration as far as possible.

The above has reference to vertical disturbances; but the lateral strain, caused by the natural sway from side to side, which is the result of uneven surfaces, and the space left for lateral play between the flanges and the rails, is equally damaging to bridges. There is more or less lateral oscillation of rolling stock that cannot be avoided. This causes a series of vibrations in that direction which has the same tendency to weaken the members as the vertical disturbance.

It is claimed by good authority that long continued vibration crystallizes metal, which of course renders it unfit for service, and bridges that have seen long service should be examined to ascertain the exact state of the metal. The frequent breaking of rails is, no doubt, owing in a great measure to vibration as the primary cause. Many rails break near the ends, especially when the splices are loose and the ties near the joint and under it are "low." The ends of the rails being depressed by the wheels, spring back to their normal position, and vibrate with a singing noise like a huge tuning fork. If this looseness of joints continues long, a break is sure to follow. Oscillation produces vibration, which, in turn, produces crystallization, cracks, and breakages.

In a bridge, if one member is more exposed to vibration than another, it will in time become weakened, and the whole structure may fail mysteriously. A proper arrangement of stays and braces will prevent vibration, and this is a subject worthy the attention of engineers.

NAVAL AND COAST DEFENSE.

The annual reports of our military and naval authorities have lately given special emphasis to the well known facts that, though our relations with the rest of the world are friendly, war is ever liable to arise, and a sudden war would find our coasts utterly defenseless and our navy inadequate for any service likely to be put upon it.

A complete revolution has been wrought in the material and methods of naval and coast defense during the past fifteen years; and as a nation we have done little or nothing to keep ourselves abreast of the military and naval progress of the world. Meantime, our prolific inventors have been steadily at work devising new means and appliances of which the nations of Europe have not been slow to avail themselves; so that we as individuals have put into the hands of possible enemies the means of doing us fatal harm. Unless we bestir ourselves as a nation and begin to guard our rich and vulnerable seaports by defenses at once adequate for present needs and susceptible of easy strengthening as new needs may arise, the neglect may cost us in a day, in property destroyed and ransom demanded by a dashing enemy, more than it would have cost to make every seaport on the coast practically impregnable. The Chief of Engineers, General Wright, states the case very compactly when he says in his report:

"For many years no appropriations whatever have been made for the construction of new works or for the modifications of the old works which were built before the introduction of modern ordnance and armored ships, and which latter, although there were none better in their day, are now most of them utterly unfit to cope with modern ships of war. The earthen batteries more recently built in the positions which are available for such batteries in our harbors are generally in effective condition, though by reason of the late increase in the power of ordnance some of them should be strengthened by thickening the parapets and coverings of magazines. The casemated works of which our seaport defenses are necessarily largely composed were built when wooden walls were the only protection of guns afloat. Now ships of war are clad in armor up to two feet in thickness, and the old smooth-bores have been replaced by rifled guns, the largest of which throw shot of nearly a ton weight, and which burn at each discharge nearly a quarter of a ton of powder. While other maritime nations are adding to their already powerful navies heavily armored ships of war, which are armed with 81 and 100 ton guns, and which cost, exclusive of armament, more than $2,500,000, they are building armored defenses for the protection of their own coasts. Great Britain has already 500 guns in position behind armored defenses. We have not one such gun, nor have we any armored defenses whatever."

Approving of the position taken by the Chief of Engineers the Secretary of War lays proper stress upon the fact that "modern wars come on suddenly, that serious international disputes occur between nations the relations of which are apparently the most unlikely to be other than friendly, and that a condition of readiness for defense and an attitude of belligerency are sometimes the best preventives of actual war. We know that the necessary new works and the proper modifications of our old works will require many years for their completion, and it seems simply a matter of common prudence that we commence without delay and under liberal appropriations to put our coasts in an efficient condition of defense."

As to the means of coast defense the opinion of General Wright that the most efficient, most enduring, and least expensive are fortifications and torpedoes, is unquestionably the true one. One gun properly mounted and handled on land is as efficient as several guns of equal power afloat, owing to the greater certainty of aim.

An armored fort on land can have its power of resistance increased unlimitedly and much more rapidly than increased power of penetration can be given to guns. Not so with floating forts: their buoyancy is limited and their security is gone the moment a gun is made of greater penetration than they were built to withstand. Several fixed forts (whether simply revolving, or both revolving and movable about a defensive mole) can be built for the price of one sea-going ironclad mounting as many guns of like caliber; and the fixed fort is not liable to be enticed away, as ironclads are, leaving a harbor defenseless.

Our geographical position and general policy forbid offensive war on our part, thus relieving us absolutely of the need of building the huge sea going fortifications of the sort favored by European powers. This fact is clearly though grudgingly recognized in the recent report of the Naval Advisory Board, convened last summer to consider plans for the reconstruction or rather recreation of our Navy. They say:

"Since it was decided that iron clads must be left out of consideration, it became necessary to determine upon auxiliary means of defense, which, although not so far-reaching in their protection, should still hold foreign armored fleets in check until armored defense could be provided."

Naturally professional spirit led the Board to contemplate only floating "armored defenses," the best service of which, as we have seen, may more cheaply and efficiently be rendered by armored defense on land.

The auxiliary means of defense recommended by the Board for immediate construction are:

Two first-rate steel, double-decked, unarmored cruisers, having a displacement of about 5,873 tons, an average sea speed of fifteen knots, and a battery of four eight inch and twenty-one six-inch guns. Cost, $3,560,000.

Six first-rate steel, double decked, unarmored cruisers, having a displacement of about 4,560 tons, an average sea speed of fourteen knots, and a battery of four eight-inch and fifteen six-inch guns. Cost, $8,532,000.

Ten second-rate steel, single-decked, unarmored cruisers, having a displacement of about 3,043 tons, an average sea speed of thirteen knots, and a battery of twelve six-inch guns. Cost, $9,300,000.

Twenty fourth-rate wooden cruisers, having a displacement of about 793 tons, an average sea speed of ten knots, and a battery of one six-inch and two sixty-pounders. Cost, $4,360,000.

Five steel rams of about 2,000 tons displacement, and an average sea speed of thirteen knots. Cost, $2,500,000.

Five torpedo gunboats of about 450 tons displacement, a maximum sea speed of not less than thirteen knots, and one heavy powered rifled gun. Cost, $725,000.

Ten cruising torpedo boats, about one hundred feet long, and having a maximum speed of not less than twenty-one knots per hour. Cost, $38,000.

Ten harbor torpedo boats, about seventy feet long, and having a maximum speed of not less than seventeen knots per hour. Cost, $250,000.

With the exception of the cruising torpedo boats recommended, all of the proposed vessels would seem to be gravely inefficient with respect to sailing capacity. An unarmored cruiser carrying only light guns, if unable to overtake a first class merchant ship or run away from an armored vessel carrying heavier guns, would be of very little use in actual warfare. They might be comfortable for naval officers to cruise in in times of peace, for lying off popular summer resorts, or for picnicking along friendly foreign shores; but they would not do to rest national security and honor on in times of serious conflict. Instead of speeds of from ten to fifteen knots an hour, our unarmored cruisers should aim to be able to make, when occasion demanded, not less than eighteen knots, and from that to twenty-five knots. Both armored and unarmored war ships of thirteen knots and less have gone out of fashion the world over, and except in a war of grain ships and mackerel smacks, the proposed thirteen knot rams would be as useless as so many billy-goats.

Our cruisers should be built with special reference to staunchness and speed. With proper coast defenses we would not be likely to be involved in war with any nation likely to hurt us except in harrying our coast-wise commerce or the foreign merchant marine, which is to be developed, we trust, in the near future. Against such an attack the means of striking back in kind would be our best weapon. And the same fast cruisers, wind-wafted for the most part in time of peace, would be best adapted for the scientific, humane, and other peaceful occupations likely to engage them during most of their lives. Instead of idling at home or in foreign ports, we should like to see our navy always engaged in works of exploration scientific investigations at sea, or cruising up and down the great commercial routes for the protection and relief of mariners and travelers. They should hover upon the track of storms like Mother Carey chickens, in search of distressed or disabled merchant men; and the practical schooling in seamanship. pluck, and energy, which our naval officers and men would thus gain in times of peace, would stand us in good stead during the trying times of war, should war ever prove honorably unavoidable.

Salt in Diphtheria.

In a paper read at the Medical Society of Victoria, Australia, Dr. Day stated that, having for many years regarded diphtheria, in its early stage, as a purely local affection, characterized by a marked tendency to take on putrefactive decomposition, he has trusted most to the free and constant application of antiseptics, and, when their employment has been adopted from the first, and been combined with judicious alimentation, he has seldom seen blood poisoning ensue. In consequence of the great power which salt possesses in preventing the putrefactive decomposition of meat and other organic matter, Dr. Day has often prescribed for diphtheritic patients living far away from medical aid the frequent use of a gargle composed of a tablespoonful or more of salt dissolved in a tumbler of water, giving children who cannot gargle a teaspoonful or two to drink occasionally. Adults to use the gargle as a prophylactic or preventive, three or four times a day.