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## NOTE AND COMMENT.

A GREAT deal of interest has of course been excited in Montreal circles since our last issue over the visit of the American Association for the Advancement of Science, which opened its session here on the 23rd of August. A considerable number of foreigners of eminence in the scientific world were expected, and, as the result proved, disappointments were few, though HERBERT SPENCER'S non-appearance was of course one of the greatest. We give on another page a full account of the proceedings of the Association, and portraits of the principal members who honored us with their company. On the whole, though no very remarkable results were announced, the meeting passed off most successfully. Nearly a thousand strangers were in town during the session of the Association, and all were delighted with the entertainments and excursions provided for their benefit. The meeting was made the occasion, of course, of much social display, and various receptions and garden parties were tendered to the strangers, while that held by Dr. DAWSON, the new president, in the Redpath Museum was utilized for the formal presentation of the building to the College authorities by Mr. PETER REDPATH the founder.

ONE result of the meeting of last month has been the bringing into definite shape of the scheme for the union of the British and American Societies which seems now not unlikely to be formulated at the forthcoming meeting of the British Association in 1884. The meeting for this year has, after much discussion, and in spite of considerable opposition, been fixed to take place in our city, and it is generally understood, that occasion will be taken to enunciate the scheme which has met with so much favor on this side of the water, and not a little in England itself. It is a little unfortunate that, in the face of this amicable feeling on both sides, the English press, or rather two of the leading English papers should have done their best to destroy the *entente cordiale* for no apparent reason other than the poor opinion which the learned gentlemen who preside over their respective destinies have conceived of the capabilities of Canada and the Canadians. Perhaps after the recent strictures passed upon the Canadian Address, to which the Hon. L. S. HUNTINGDON so fully replied, we might have expected the opposition which the *Times* has shewn to the selection of the Dominion, but the *Saturday Review* has gone beyond its mentor, and lavishes upon us that acridity and bilious hypercriticism which in old days earned for it the *sobriquet* of the "Saturday Reviler." There are many reasons which might be alleged in answer to the objections of these gentlemen, why Canada is in some respects unusually suited for the experiment about to be tried. The country in which the *savants* of Europe will find themselves is new and both geologically and ethnologically remarkably interesting, while if we do not possess, as our English friends will have it, many names of world wide scientific repute, we have at least amongst us many worthy workers in the cause of Science, whose recorded observations upon their own country at least possess a merit which, but for ignorance pure and simple, even the *Times* would probably not be prepared to deny them. But apart from this the very existence of a desire to receive our distinguished visitors, and to treat them as no one who knows Montreal can doubt they will be treated, at least deserves more courteous treatment than it has received, while the additional reasons afforded by the amalgamation scheme probably never occurred to either of the papers in question, whose distinguished writers have probably never even heard of the American Association, or, if they have, class its work on a par with our own benighted Colonial ignorance. Such is at least one explanation of the articles in question, and probably the most charitable.

## HERBERT SPENCER.

Mr. Herbert Spencer, the eminent English philosophical writer, arrived in this country August 21. He has long desired to visit America, but has been deterred from the undertaking by his very imperfect health, and his apprehensions of the effect of the Atlantic voyage. He landed in a very exhausted condition, and declining all social engagements and excitement, went quietly away to the mountains to rest and recruit.

Mr. Spencer was born in Derby, England, in 1820. His father was a teacher, a man of culture, of independent views, which he carried out in the education of his son. His fundamental principle in teaching was that only what the pupil does for himself is really valuable to him, and hence he labored to establish inquiring and self-reliant habits in the mind of his pupils rather than to help them to passive acquisitions. Young Spencer was educated on this principle in his boyhood by his father, and afterward by his uncle, an English clergyman. He early took to mathematics and science rather than to classical studies, and instead of going to Cambridge, as his uncle, a university man, desired, he went into railroading, as a civil engineer, at the age of seventeen. The great railroad reaction of 1845 threw him out of business, and he then took to a literary career.

Mr. Spencer is perhaps most widely known by the little work on education, which was contributed first to the Reviews and issued as a book in 1860. It is written largely from the point of view of his own experience in methods of study, and is so strenuously favorable to the study of science, and so practically valuable as a guide to self-education, that it fell in with the tendencies of the age, and has exerted a very wide influence upon individual minds and upon practical school instruction, as shown by the fact that it has passed through many editions, and has been translated into a great number of languages in all quarters of the world.

Mr. Spencer's life has been outwardly uneventful, and the world is interested in him solely as a thinker and a representative of great modern ideas. In this respect there has been a remarkable unity in his intellectual career. No more striking example can be found of a man working on from his youth through life in a broad but continuous line of research, although from the number and diversity of the fields he has had to traverse, there has arisen the notion that he has a great propensity to write upon everything. The simple fact is that he early got possession of a new all-comprehensive principle, and has spent his life in working it out in all directions.

In 1842, at the age of twenty-two, young Spencer published a pamphlet on *The Proper Sphere of Government*, an ethical discussion of individual rights and public duties. This germinal exposition was developed into a volume, and published in 1850 under the title of *Social Statics*. This book was an attempt to establish a scientific basis for private and public morals. Finding that the subject demanded far more extensive treatment, he projected a series of works, scientific in method, to bring out this view, and the last of them is a treatise on the *Principles of Morality*, of which the *Data of Ethics* has been recently published. He is thus upon the same track of thought that he entered forty years ago, and all his intermediate labor has been pursued with distinct reference to the final result.

But this alone will not account for Spencer's hold upon the thought of the age. He is widely known as the philosopher of evolution, but he was led into the investigation of this great doctrine by the necessities of his studies in ethical science. His first pamphlet is full of the idea of progress and adaptability in man and his social relations. In *Social Statics* the idea of evolution, though vaguely presented, has become the key to the discussion, and from 1850 on, Mr. Spencer made the working out of this doctrine his great object. This he did at first in a fragmentary way. Having to get his living by writing, he made numerous contributions of articles to leading reviews from 1850 to 1860, all implying, illustrating, or expounding the evolutionary principle in a large number of its aspects and applications. He then projected the *Synthetic Philosophy*, in ten volumes, as a twenty years' work to develop the doctrine of evolution, and has been at it ever since. To show how far in advance he was of all other thinkers in this field, it may be stated that he had written more than thirty elaborate articles in the chief English reviews, all bearing upon evolution (although by the rule of those reviews unfortunately anonymous), and had drawn up a detailed scheme of the evolution philosophy in the exact logical order which he has since followed, and all this before Mr. Darwin had published a word upon the subject.

Mr. Spencer's health gave way in the year 1855, after the appearance of his *Principles of Psychology*, perhaps his profoundest work, and which was written in eleven months. After this he could do nothing for a year and a half, and he has been troubled with sleeplessness and much nervous irritation ever since. His main business for twenty-five years has been to economize his vital forces for the continuance of his work. All his books and letters are dictated, and at the best he has been able to give but about three hours a day to his amanuensis. He seeks relief from the strain of thought by recreations such as billiards, concerts, and country excursions, and has found social excitements so disturbing that he has been compelled very much to restrict them.

In social intercourse Mr. Spencer is easy and agreeable. He is a ready and interesting talker, though his capacity for society small-talk is slender. If conversation engages him, and he is in a vigorous condition, his talk is impressive and often brilliant; but as such excitement generally costs him sleep, he is apt to decline and avoid serious subjects on social occasions. Indeed, he is more and more compelled in these latter days to avoid all argument and exciting discussion, and if he is very much compelled to do so while in this country, his friends must credit it to his low physical condition, and remember that he regrets it more than anybody else.

E. L. YOUMANS.

## MEN'S NAMES.

The study of men's names is as curious as it is interesting. Arbitrary as they seem to-day, they all had their source evidently in some fitting fact. Many English surnames express the county, estate, or residence of their original bearers; as Burgoyne, from Burgundy; Cornell, or Cornwallis, from Cornwall; Fleming, from Flanders; Gaskin, and Gascoyne, from Gascony; Hanway, from Hainault; Polack, from Poland; Welsh, Walsh, and Wallis, from Wales; Coombs, Compton, Clayton, Sutton, Preston, Washington, from towns in the county of Sussex, England.

Camden, the antiquary, says every village in Normany has surnamed some English family. Dale, Forest, Hill, Wood, and the like, are derived from the character or situation of those who first bore the names.

The prefix "atte," or "at," softened to "a," or "an," helped to form a number of names. Thus, if a man lived on a moor, he would call himself Attemoor or Attmoor; if near a gate, Attegate or Agate. John atte the Oahs was in due time shortened into John Noaks; Peter at the Seven Oaks into Peter Snooks.

Byfield, Byford, Underhill, and Underwood, indicated residences originally. In old English applegarth meant orchard, whence Applegate and Appleton; chase, a forest; clive, a cliff; clough, a ravine; cobb, a harbour; whence these names.

The root of the ubiquitous Smith is the Anglo-Saxon smiton, to smite. It was applied primarily to blacksmiths, wheelwrights, carpenters, masons, and smiters or strikers in general. Baker, Taylor, Butler, Coleman (coalman), Draper, Cowper (cooper), Cutler, Miller, and the rest, plainly denote occupations. Latimer is from latiner, a writer of Latin. Lorimer is a maker of spurs and bridle-bits; Arkwright, a maker of chests; Lander, contracted from lavandier, a washerwoman; Banister, the keeper of a bath; Kidder, a huckster; Wait, a minstrel; Crocker, a potter.

Such names as Baxter and Bagster are the feminine of baker; Webster, or Webber, of weaver, which shows that these trades were first followed by women, and that when men began to take them up they for some time kept the feminine names.

Steward, Stewart, or Stuart, Abbot, Knight, Lord, Bishop, Prior, Chamberlain, Falconer, Leggett (legate), either signified what the persons so-styled were, or were given them in jest or derision, like the names King, Prince, and Pope. The termination "ward" indicates a keeper, as Durward, door-keeper; Hayward, keeper of the town cattle; Woodward, forest-keeper.

Many Welsh names, naturalized in English, are from personal traits, as More, great; Duff, black; Vaughan, little; Lane, slender; Mole, bald; Gough, red.

Surnames, now apparently meaningless, had meaning in old English and provincial dialects. Brock, for instance, signifies badger; Talbot, Mastiff; Todd, fox; Culver, pigeon; Henshaw, young heron; Coke, cook.

# Notes and Clippings.

## SCIENCE AT SOUTH KENSINGTON.

The *English Mechanic* is very bitter against the clique which runs the South Kensington Scientific Departments. It says:—The general public, whose ideas of science teaching at Kensington are mainly derived from the newspaper reports of the field-days at that remarkable institution, would probably experience a feeling compounded of surprise and indignation were they permitted even the briefest peep behind the scenes, at the wonderful Brompton focus of jobbery and place-making. To read the fulsome way in which "the butter-boat" is passed between Mr. Mundella and certain of the most prominent and leading spirits among the vast staff of hangers-on of the "Department," could scarcely fail to impress the conviction upon the uninstructed outsider that great and valuable educational work in science was being performed at Brompton, at a relatively insignificant national cost; and that the oft-reiterated complaint that the British artificer was wofully behind his Continental confrère, was in a very fair way, indeed, of being speedily remedied. Now, *in limine*, the total amount distributed in the shape of grants to successful candidates, may be taken roughly to amount to £40,000; a sum which the nation need scarcely grudge, were it devoted to a legitimate end. The total annual cost of the Science and Art Department, however, is £337,181, and if we halve the sum devoted to these subjects jointly, it needs but very rudimentary arithmetical achievements, indeed, to deduce the fact that three-quarters of the sum annually voted by the state for teaching sciences is swallowed up by the staff of leeches who fatten on this most singularly constituted establishment. But, even then, do we get our "hapor'th of bread" in connection with this "intolerable quantity of sack?" We wot not. Artificers proper are extremely scarce among the competitors; and such subject as machine construction and applied mechanics are taken up by a totally insignificant proportion of the competitors. Pupil-teachers are the people who figure most conspicuously among the candidates, for a reason which must be at once apparent to all school managers and others having anything to do with the administration of the Education Code. To meet this state of things, there has arisen a wretched system of cramming from a series of textbooks (many of them compiled by members of the overgrown and overpaid staff at Brompton themselves), by the aid of which a considerable percentage of candidates contrive to pass in various fancy subjects in the elementary stage. Should one of them manage, by dint of more than usually energetic cram, to pass in the advanced stage, he forthwith receives a certificate entitling him to teach the subject in which he has gone out; and so hordes of scientifically blind teachers of the blind are scattered broadcast over the country. We cannot better illustrate the kind of information communicated by this most faulty system than by quoting a series of actual answers given by various students in the new-fangled subject of "Physiography"—a subject expressly invented to create a berth at Brompton for one of the creatures of the department. We have received them direct from a quandom examiner, and pledge ourselves as to their absolutely genuine character and literal transcription. (1.) "The negro race have a very thick skull, at which the back of the head goes quite straight up to the forehead. Their hair is of a black, woolly color, and their perplexion (*sic*) is rather black. The part of the world in which they live is India. The negroes are very strong, and if you wanted to kill one of them, the best place to hit them would be in the body. The tenderest place of the negro is the back of the leg, just below the knee." (2.) "Climates are those vast plains which are very cold and frosty." (3.) "On the west cost of Europe the climate is very cold compared with the east of America. This is owing in some measure, to the Ural Mountains." (4.) "The chief rainless districts are Europe, Asia and Africa. They are caused by the sun shining so much on the countries, and, therefore draws up more water." (5.) "During an eruption the crater gradually gets lifted up until it reaches the top and flows over the side of the volcano." (6.) "A great circle must be something that we cannot see the end of, like a raindow, which when it is seen in the heavens appears to reach from one end of the sky to the other." (7.) "A great circle is called an oblate spheroid." (8.) "The equator is the line showing the centre of the Earth," and (9.) Finis coronat opus). "The increase of civilization of the British Island is rectified by the many indentations in the coast, which proves the commercial pursuits carried out; for the ships coming in gradually wear the coast away. Africa has the least indentation in its coast, and is the most degraded." Such are, *verbatim et literatim*, a few of the replies given at some tolerably recent Science (?) Examinations at South Kensington. We do not, of course, pretend that those who penned them passed, even in the elementary stage. Our purpose in quoting them here is to invite a careful perusal of them in connection with that of certain notorious textbooks, in order that the reader may see for himself just how and where such astonishing blundering has had its origin; and exactly how the miserable examiners have muddled up the ill-digested mass of facts which have been crammed into them from these compilations. Such a comparison will show that, in a large proportion of cases, the very words of the textbooks have only been sufficiently distorted or misapplied to just make nonsense of the answer. This, then, is the outcome of the system of cram and sham, for which the British nation is annually called up to pay such an exorbitant sum. Even did the cost of the staff bear some reasonable proportion to that of the actual grant, a system which encouraged such a form of scientific education (Heaven save the mark!) as all this indicates, must stand self-condemned. Mr. Mundella may flatter Professor Huxley, Professor Huxley may flatter Colonel Donelly, and the gallant Colonel may "pass it on" to Mr. Mundella again; but the day must come when all this sham will be found out. Then will an indignant public learn that all these examinations, certificates, scholarships, et id genus omne, are but an excuse, cloak, and blind for the maintenance of an enormous horde of overpaid hangers-on and parasites at Brompton; and that if a clean sweep were made to-night of the entire party, British science could not fail to be in an infinitely sounder, healthier, and more prosperous condition for it.

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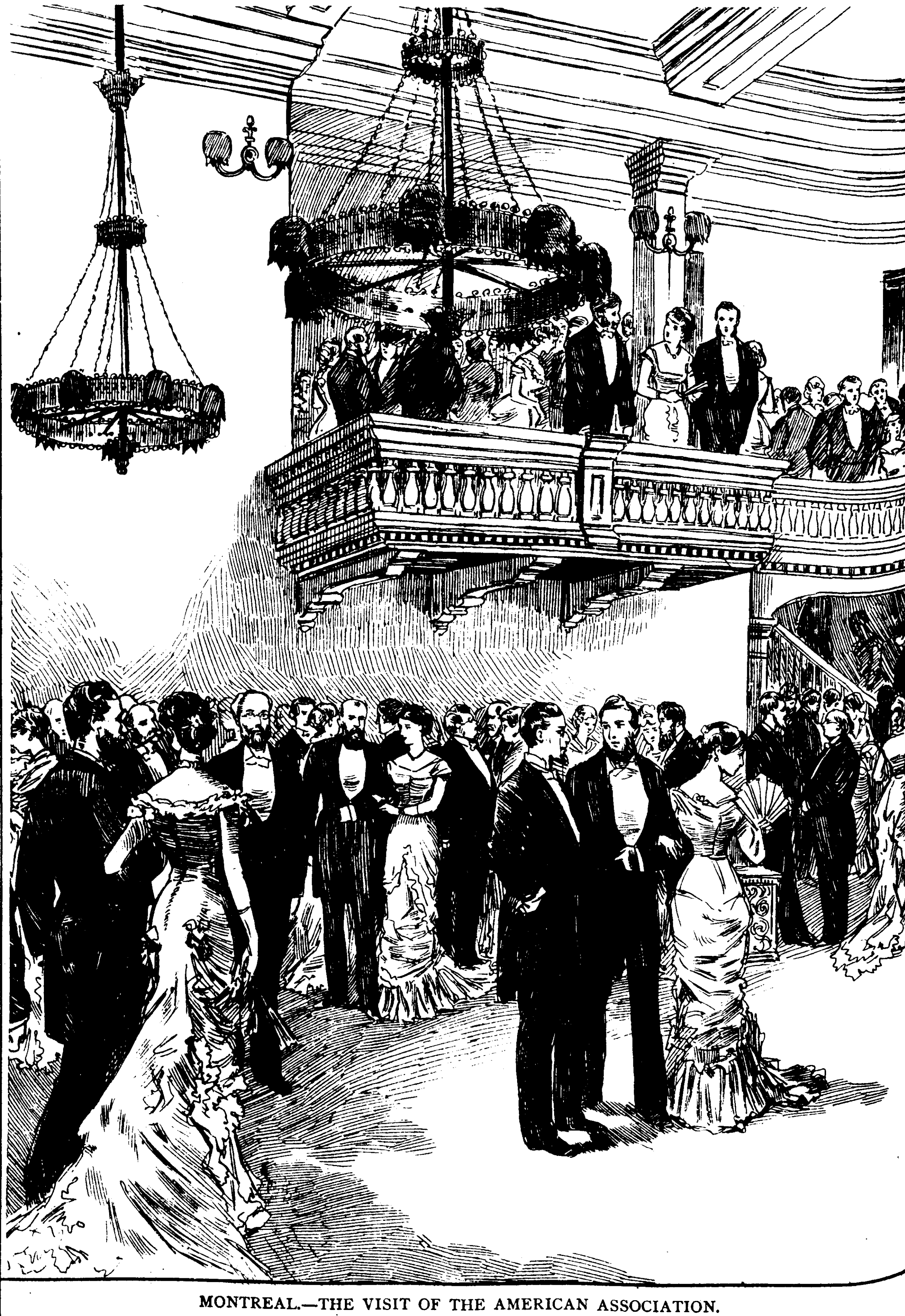
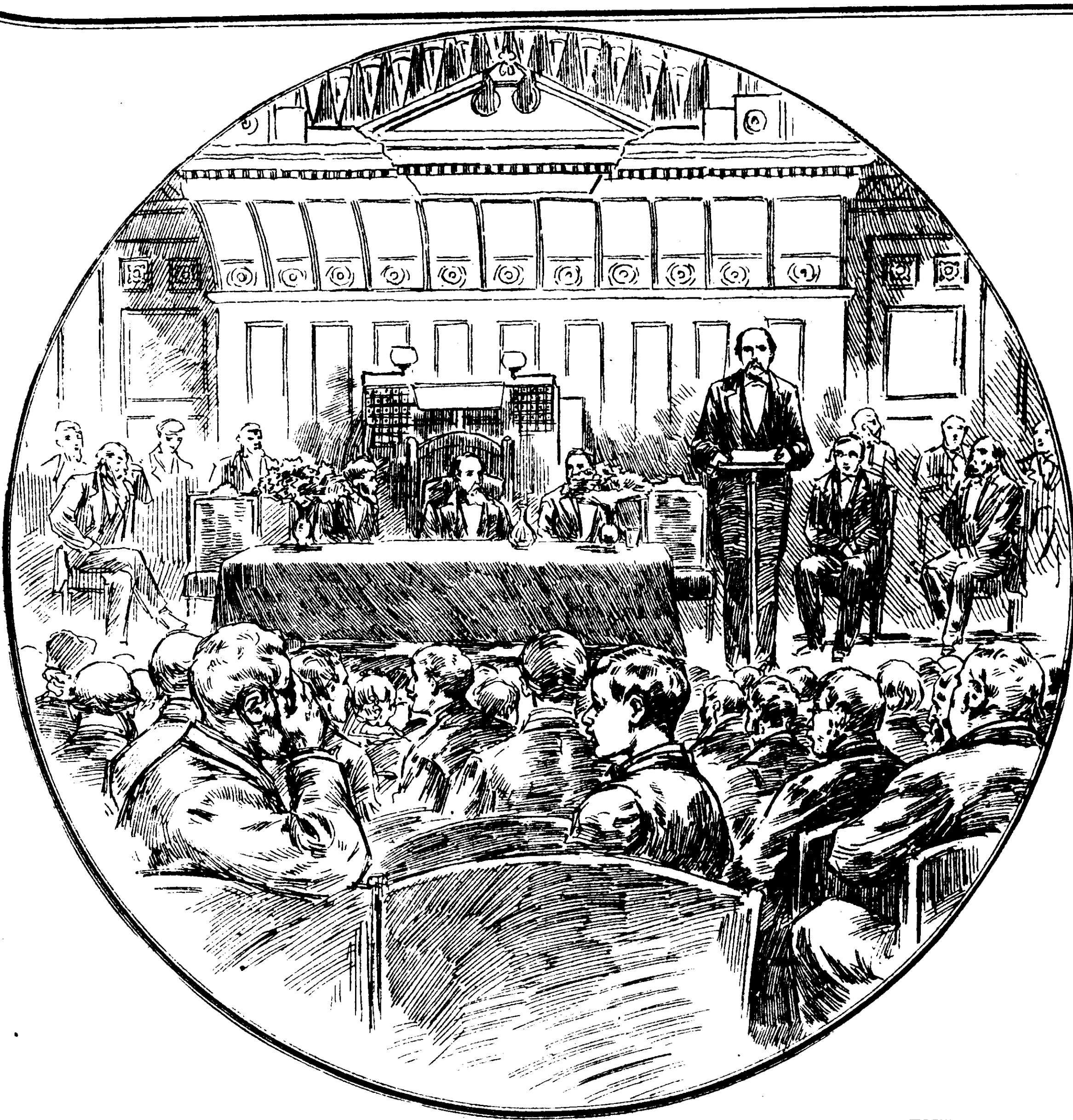
Brennan's Torpedo.—This torpedo has been in process of manufacture and improvement for some considerable time at Melbourne, partly under the auspices and with the assistance of the Victorian Government. The invention has been patented in England and the Colonies, but it was not considered politic to exhibit it at the late Melbourne Exhibition, pending the negotiations with the British Government. It is difficult to convey a clear idea of such a machine as a locomotive torpedo to the general reader without the aid of sketches; but compared with the Whitehead, Fiume, or the Woolwich Royal Laboratory patterns, the Brennan is simplicity itself. Its motive power is not compressed air, neither is it contained in the body of the torpedo. To propel the weapon through the water at a speed of from 15 knots to 20 knots an hour for 1,000 yards, a separate engine, or at least a special connection with an existing one, is necessary. This engine drives two drums, about 3 feet in diameter, with a velocity at their peripheries of 100 feet per second. Their duty is to wind in two fine steel wires No. 18 guage, the same as used in the deep-sea sounding apparatus of Sir William Thomson. The rapid uncoiling of these wires from two small corresponding reels in the belly of the fish imparts to them, as may readily be conceived, an extremely high velocity. The reels are connected with the shafts of the two propellors which drive the torpedo through the water. The propellors work, as has long been known to be necessary to insure straight running, in opposite directions and both in one line, the shaft of one being hollow and containing the shaft of the other. At first sight it would seem as if hauling a torpedo backward by two wires was a sufficiently-curious way of speeding it "full speed ahead" but it is found in practice that the amount of "drag" is so small, as compared with the power utilized in spinning the reels that give motion to the propellors. that it may be left out of calculation altogether. The steering-gear of the Brennan is a most ingenious contrivance, whereby the relative velocities of the two driving drums, and consequently of the two propellors, can be varied at any moment. The perpendicular rudder, which is marvellously sensitive, is reacted on by the screws, and in this way the torpedo may be made to follow as tortuous a path as a figure-skater. The course the torpedo is taking is indicated to the operator by a slight steel telescopic mast carrying a pennon, which, when not in use, is folded along the back of the torpedo.

Sulphur and grease have a cooling tendency upon hot bearings. This is probably because the fine metallic dust formed by the hot journal combines with the sulphur to form a greasy sulphide.



MONTREAL.—THE VISIT OF THE AMERICAN ASSOCIATION.



OPENING OF THE SESSION AND ADDRESS BY THE RETIRING PRESIDENT.

## THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BY H. C. HOVEY.

Twenty-five years ago this scientific body met in Montreal, where it now has met again. Of the members who were present at the former meetings only three remain. The city that then had but 50,000 inhabitants now has 150,000. The American Association for the Advancement of Science was originated in Philadelphia in 1848, but held no meetings from 1860 to 1866 on account of the war, which explains the fact that this is but the thirty-first annual meeting.

The opening ceremonies this year, August 21, were quite impressive. After the new President, Dr. J. W. Dawson, had taken the chair, prayer was offered by his Lordship the Bishop of Montreal. Addresses were made by the Mayor of the city, wearing the "collar of office;" by Dr. T. Sterry Hunt, Dr. Thorburn, of Ottawa, and others. It had been hoped that the Marquis of Lorne might have been present, but he was prevented.

The attendance was unusually large. The list of scientific papers entered was 256, most of which received attention. The custom is allowed, however, of letting favorite speakers run over the time alloted to them, thus crowding out others having an equal claim to be heard. For instance, one paper, to which fifteen minutes were assigned in the programme occupied, with very rapid delivery, fifty-five minutes, not including subsequent discussion. This member must have known that his paper could not be read in fifteen minutes. I should add that in this instance the contribution was valuable and worth hearing throughout. But in most cases the quality would be improved by condensation, and papers should not greatly exceed the time indicated on the programme.

The American Association for the Advancement of Science is divided into nine sections for the special consideration of as many branches of science as possible, and these sections meet separately after the general sessions. A great amount of work is thus accomplished; and while, perhaps, some of the papers read are crude or visionary, the majority are the fruit of long toil and wide research.

The first place, among addresses before the whole body, belongs to the address of the retiring President, Prof. G. J. Brush, of Yale College. It was delivered in Queen's Hall, which was crowded with hearers. The subject, "The Progress of American Mineralogy," led the speaker over an extended range of observation. The main points were as follows: The distinct beginning of the science was in an association, formed in 1798 in New York City, as the "American Mineralogical Society." Only two minerals new to science had before this been found here, namely labradorite and strontia. The study of mineralogy was carried on by aid of European collections. Four men were especial leaders in active search for minerals peculiar to American rocks. Dr. Archibald Bruce founded, in 1810, the *American Mineralogical Journal*, and described in it the first discoveries made in this country, and described by an American, namely, the *native magnesia* of Hoboken, and the *red zinc* oxide of Sussex Co., N.J. In 1805, Col. George Gibbs, of Rhode Island, brought back with him from Europe the most valuable collection of minerals ever brought to this country. He then devoted his great wealth to extensive journeys and unselfish research to unfold the resources of his native land, generously aiding others in the same direction. Another was Prof. Parker Cleaveland whose treatise on Mineralogy and Geology (1816) met a pressing need, felt by all classes of students, for a distinctly American text book. The fourth name was that of Prof. Benj. Silliman who raised the funds to purchase the splendid cabinet of Col. Gibbs, which has probably done more to stimulate research and create an interest in mineralogy than any other one agency. This was added to minor collections previously made in his travels in this country and in Europe. Silliman also established in 1818, the *American Journal of Science*, to which he furnished many original contributions. For more than fifty years he was a professor in Yale College; and when he resigned he was happy in having Prof. J. D. Dana as his successor, who had already made himself eminent as a mineralogist.

Prof. Brush traced the results of the work done by these pioneers whose individual enthusiasm really upheld the science, to which they were devoted, during the first twenty-five years of this century. Besides the four men to whom pre-eminence was given, others were named, whose long journeys on horseback, by canal boats, and in other primitive ways in the intereste of science, were such as to command our admiration. The public mind at length caught their enthusiasm, and government came to the aid of science. The first State Geological Survey was made by North Carolina, in 1824; the example was followed in 1830, by Massachusetts, and then by other States, until now the whole territory of the United States and Canada either has been or is being surveyed. It cannot be attempted, however, to follow the admirable sketch of work now being done by living mineralogists, nor to reproduce the highly suggestive remarks on the relation of this science to chemistry and kindred sciences. Evidently a broader foundation is now needed for it than in earlier days, and there must be co-operation between special investigators. There is an inter-dependence between mineralogy, geology, chemistry, and physics, such as warrants the continued existence of an association that shall make sure that every new fact and law observed shall be used for the common advancement of all the sciences.

The Vice-Presidents of the several Sections opened work in their respective rooms by addresses. In Section A, (Astronomy and Mathematics) the subject of the opening address by Mr. Harkness was "The Transit of Venus." In Section B (Physics), Prof. Meddenhall spoke on "Methods of Teaching Physical Laws." In Section C (Chemistry), the address by Dr. H. C. Bolton reviewed the history of chemical literature. In Section D (Mechanical Science), Prof. Trowbridge spoke on the "Importance of Experimental Research" in this era of applied science. Prof. E. T. Cox laid before Section E (Geography and Geology) some results of his observations along the Pacific slope. Prof. W. H. Dall reviewed the progress of American conchology, in Section F (Biology). Section H (Anthropology) was opened by an address by Prof. Daniel Wilson, read by Prof. Otis T. Mason, on the "Physical Characteristics of Native Tribes of Canada." Section I—a new section of economic Science and Statistics—was opened by an address by Mr. Elliott, chiefly devoted to explaining the special scope and province of Economic Science. All these addresses were of a most interesting character.

It would be gratifying to give a full account of all the papers read in the various sections from day to day; but, considering that there were about 250 of them in all, it cannot be expected that they should even be given in a condensed form. The very list of titles is formidable to the eye and one wonders how even the devotees of science can be induced to listen to so much learning in the sultry days of August. The attendance, however, was good in every room, from first to last, and the interest did not seem to flag.

Recognizing the fact that another might mention other articles of equal merit with those that attracted the writer's notice, I may mention a few of the noteworthy contributions, without specifying in each case the section before which it was laid.

An important paper was read in the section of Mechanical Science, by Mr. Joseph L'Etoile, of Ottawa, on "Atmospheric Currents, Electricity, and Gases, as related to Practical Aerial Navigation by Balloons." He held that such navigation of the air is perfectly feasible, but that many improvements in balloons are needed as to their form and general construction; some of these he pointed out. He proposed that the balloon should take the shape of a fish, and be provided with a propeller, a rudder, an air compartment, gas and air pumps, electric battery, electric motor, safety valve, ropes and ballast. Each improvement was particularly described, and it was shown that the balloonist might have a vehicle as safe and controllable as any other machine, with certain advantages of a remarkable nature.

Prof. W. A. Rodgers offered a communication concerning the problem of "Fine Rulings, with reference to the Limit of Naked Eye Visibility and Microscopic Resolution." The finest lines ever reached are those of Nobert's bands, namely, 113,000 to the inch. No one has been able to go with certainty beyond this limit, although Mr. Fasoldt, of Albany, claims to have ruled one million lines to the inch. Conceding this to have been done, it is not conclusive as to their visibility. In the discussion that followed it was shown that when ruled lines are filled with graphite and the surface covered with a film of moisture, they become for a moment easily visible, even though their width is but one hundred-thousandth part of an inch.

Prof. C. A. Young gave a description of the new twenty-three inch equatorial recently erected in the Halsted Observatory, at Princeton, N. J., and which is regarded as the most nearly perfect telescope in this country, if not in the world.

A singular discussion arose in consequence of a paper read by Prof. De Volson Wood, of Hoboken, on "A Correction in Newton's "Principia" in regard to the Time of the Approach of the Two Spheres." Newton says that if two spheres of the same material as the earth, and each one foot in diameter, be placed 12¼ inches from each other between their centers, in void space, they will be a month's time in coming together by their mutual attractions; whereas the experiments of Prof. Wood showed the time required to be less than 5½ minutes. Dr. Haughton at once challenged the quotation, saying that it was incredible that so accurate a writer as Sir Isaac Newton should have fallen into such an error. A spirited discussion followed, that led to the production of the Jesuits' edition of the famous Principia, with numerous foot-notes. Dr. Haughton claimed that the second volume, from which Prof. Wood had quoted, while a great literary curiosity, was not genuine, because it referred to matters that were unknown in Newton's time. Prof. Wood, in defense, asserted that the error he had corrected was found also in the larger edition of Newton's works, page 527, in his "Treatise of the System of the World," and he took it for granted that it was genuine.

Dr. Haughton read a paper on Darwin's Theory of the Evolution of the Earth-Moon System, in its Bearing on the Duration of Geological Time." Concurring in Darwin's published calculations, he differed from his physical conceptions. The eighteenth century astronomers believed in the perpetual motion of the planetary system, but now we know that perpetual motion is as impossible among planetary bodies as it is at the surface of the earth. It used to be held that the planets passed through a liquid to a solid condition, and that the earth now consists of a solid crust resting on a fluid mass. But Sir Wm. Thomson has proved that the present condition of the earth, as a whole, is more rigid than glass or steel. From the most probable hypothesis as to the rings of Saturn being composed of discrete meteoric stones; from the low specific gravity of Jupiter and other outer planets; from recent researches as to meteoric showers and comets; and from investigations into the true nature of asteroids, as well as from other considerations, it is probable that when the earth and moon separated from the solar nebula, they did so as a swarm of solid meteoric stones, each having the temperature of interstellar space, *i. e.*, about 460° F. below the freezing point of water. The earth and moon were pushed apart by tidal friction; and the algebraic calculations by which this may be proved fit equally well the hypothesis of a viscous earth or that of a rigid earth with a liquid ocean. Sir William Hamilton's theory, that one hundred million years ago the earth was as hot as melted steel, differs greatly from Dr. Haughton's theory that its component particles were intensely cold, and that volcanoes were but as pustules on the surface. His paper was discussed by Profs. Chase, Young and others, eliciting much interest.

Dr. George F. Barker's observations on secondary batteries, in which he directed attention to the cheapest possible method of producing electricity for the purpose of illumination, were regarded as having a practical bearing of very great value, and explained the way of facilitating the reversal of electro-motive power in secondary batteries at a minimum of cost.

Prof. W. H. Brewer, drew attention in a paper on the "Apparent Size of Magnified Objects," to a series of experiments he had made with many persons as to the relative size of objects as seen by the microscope and the naked eye. A magnified image having a theoretical value of 4·66 inches, appeared to one observer to be six inches, to another twelve inches, and to another (an experienced draughtsman), five feet in length. The practical conclusion was that, while much depended on a healthy condition of the eye, much was attainable by education, it being evident that an eye educated to use the microscope would be less liable to error than one that had never been trained.

Mr. W. Le Conte Stevens, who had made the subject of stereoscopy a study, read a paper describing the results attained by the use of the electric spark in binocular vision. When the relation between the visual lines was such as to imply no unusual muscular strain, it was found possible to interpret the binocular retinal image by the aid of a single spark.

Prof. A. Graham Bell's paper on a newly devised apparatus for the detection of bullets in wounds was listened to with especial interest, on account of its failure to show the true location of the ball lodged in the body of the late President Garfield. Prof. Bell explained his improvements, by which he was confident of more exact results on any future occasion of a similar nature.

In the Section of Geography and Geology, highly important papers were read of a variety of interesting topics; some of which will be noticed further on.

Prominent among foreign visitors present was the celebrated Dr. W. B. Carpenter, who delivered an interesting address in Queen's Hall, on the "Temperature of the Deep Sea." He stated that previous to his own investigations due allowance had not been made for the enormous pressure on the bulbs of thermometers at great depths, by which the mercury would be forced up into the tubes and record fallacious indications. His experiments led to the construction of the Miller-Casella thermometer, capable of bearing a pressure of five tons to the square inch, without affecting the temperature recorded. With this improved instrument his deep sea observations were made. The generally received impression had been that the sea had a universal temperature below a certain depth, of 39 degrees Fahr. But Dr. Carpenter found the temperature of the deep basin of the North Atlantic to be 35 degrees Fahr. while in the Färöe Channel, within a hundred miles of Scotland, it fell to 29½ degrees. This proved that, in the Fä％onese Channel, there was a tongue of the arctic current. In the Mediterranean Sea, while the surface temperature was 60 degrees, the great mass of water below, down to the depth of 2,500 fathoms, was unvaryingly 55 degrees. The reason of this temperature, 20 degrees higher than the mass of the Atlantic, was found in the fact that the Mediterranean was walled off by a ridge at the Straits of Gibraltar, by which the colder currents were shut off. A similar phenomenon was presented in certain partly inclosed seas in the Pacific Ocean. The Polar currents, however, swept without interruption through the great body of oceanic waters, obeying laws that could be easily demonstrated in the lecture-room, by applying a block of ice at one end of a tank, and a plate of hot iron at the other, the currents being indicated by coloring the water. The Arctic and Antarctic underflows meet and rise almost to the surface near the Equator in a very cold current, so that, while the surface may have a temperature of 78 degrees, it falls to 35 degrees only about 300 feet below. Receding from the Equator this submarine temperature gradually rises as the cold currents fall again toward the bottom of the sea.

In connection with this play of currents, Dr. Carpenter explained the Gulf Stream, which carries into the mid-Atlantic an enormous body of warm, not losing its velocity till it encounters the polar currents. The venerable physicist occasionally relieved the severity of his learning by bits of pleasantry that were very well relished by the hearers; as for instance, when he expressed apprehension that some ingenious Yankee might divert the Gulf Stream by cutting through the Isthmus of Panama, by which process Great Britain might possibly be rendered a howling wilderness. We were implored not thus to bring ruin on the British Isles.

One of the most thorough discussed papers presented before the Geological Section was that by Professor Carril Lewis, on "The Terminal Moraine across Pennsylvania." The southern limit of the great ice sheet that once wrapped a large part of North America is marked by a terminal moraine. It is claimed that this deposit has been traced from Cape Cod, where it begins, across Rhode Island, Long Island and New Jersey, into New York State. It has also been traced across Ohio, Indiana, Illinois, Wisconsin, Minnesota, and Dakota, to the Saskatchewan region of the Dominion. Professor Lewis claims to have filled the gap in this long chain by his discoveries in Pennsylvania. He traced the moraine for 400 miles, across the great divide between the Atlantic and the Gulf of Mexico, where it exists at the height of 2,480 feet above the sea. Where it enters the State of Ohio it has descended to the height of 800 feet above the sea level. The line between the areas of glacial action and those where the ice had not been were so sharply defined that you could stand with one foot on the striated rock and the other on rock that had not been glaciated. All along this line of demarkation were found crystalline bowlders and masses of labradorite that must have come down from the Adirondacks and highlands of Ontario. Dr. Dawson and several other geologists of note took part in the discussion of this important paper.

Prof. F. W. Putnam read papers in the Anthropological Section on "The Exploration of Mounds in Ohio and Tennessee," in which flints were found, as well as fragments of pottery and numerous animal remains. The remains of a log cabin had also been discovered belonging to the "Stone Grave Period" in Tennessee. The first indication of the building was a piece of charcoal found in digging. This led to the unearthing of a mass of charcoal so fresh as to be plainly the remains of some burnt building. The clay between the logs was well preserved, and even the marks of fingers could still be seen. The antiquity of the structure was shown by the fragments of pottery amid the ashes.

Prof. Putnam also read a paper to show that copper implements and ornaments had been in use from the beginning of the so-called Neolithic Period. None of these were cast, but all were hammered out from pieces of native copper. Mr. R. P. Hoy held that the mound-builders were the immediate ancestors of our modern Indians. Some of the mounds are of very recent date, as is evinced by the brass kettles, iron tomahawks, beads, and other modern articles found in them.

A valuable paper, read by Mr. Horatio Hale, traced Indian migration by linguistic peculiarities. Curious resemblances between the Indian and the Basque languages lead to the conclusion that the ancestors of our Indian tribes were emigrants from Europe. It is also probable, as Mr. Hale thinks, that the inhabitants of modern Europe are people of a mixed race, forming a transition in mental and physical traits between the easter Aryans and the Aboriginal Americans.

Among the most entertaining papers read before Section H were those presented by Mrs. Erminie Smith and Miss Alice Fletcher, who have for a long time actually lived among the Indians and been adopted into their tribes, in order to gain information as to their home-life manners and customs, beliefs and superstitions, and any other peculiarities of interest to science.

Among the concluding papers in Section E was one by the writer on "Subterranean Map Making," particularly with reference to American caverns. A map of Mammoth Cave, Kentucky, was exhibited, being the completion of the diagram only partially shown at the Cincinnati meeting last year, and also a new map of Luray Cave, Virginia, made from a careful survey by the proprietors last winter. This was followed by a paper on the "Caves of Staffa and their Relation to the Ancient Civilization of Iona," by Mr. F. C. Whitehouse, of New York, who advanced the original idea that Fingal's Cave, and other grottoes in its vicinity, were artificial productions, instead of being caused by erosion. While there was a difference of opinion as to the validity of Mr. Whitehouse's conclusions, all who heard him were interested in the explanations he offered, and regret was expressed that more time might not have been allowed for the discussions of his novel views of this famous locality.

Minneapolis was chosen as the place for the next meeting. Prof. C. A. Young, of Princeton, was elected President. and the following were elected as Vice-Presidents: W. A. Rogers, H. A. Rowland, E. W. Morley, DeVolson Wood, C. H. Hitchcock, W. J. Beale, J. D. Cox, O. T. Mason, and F. B. Hough. The general Secretary is J. R. Eastman, with Alfred Springer as assistant. Treasurer, William Lilly.

In general, the Montreal meeting, which came to an end August 30th, may be regarded as one of the most interesting and successful ever held by the American Association for the

PROF. BRUSH, OF YALE,
*Retiring President.*


PROF. FRED. PUTNAM, OF CAMBRIDGE,
*Permanent Secretary of the Association.*

MONTREAL.—THE VISIT OF THE AMERICAN ASSOCIATION.—PORTRAITS OF THE PRINCIPAL VISITORS.—FROM PHOTOGRAPHS BY NOTMAN.

PROF. YOUGHMANS,
*Editor of the Popular Science Monthly.*

DR. CARPENTER.

MONTREAL.—THE VISIT OF THE AMERICAN ASSOCIATION.—PORTRAITS OF THE PRINCIPAL VISITORS.—FROM PHOTOGRAPHS BY NOTMAN.

Advancement of Science. The number registered as in attendance was 937, of whom 324 were new members.

The local Committee, of which Dr. T. Sterry Hunt was chairman, managed their multiform duties with skill and efficiency. Mention should especially be made of the various delightful excursions that were planned to Quebec, Ottawa, Lake Memphremagog, and also of the visit to the Montreal Harbor, the celebrated Victoria Bridge, and the shops of the Grand Trunk Railroad.

We conclude this notice by a short account of our body Scientific Visitors.

### PROFESSOR G. J. BRUSH.

Professor George J. Brush was born in Brooklyn, New York, on the 15th of December 1831. His father was a merchant in that city, but in 1835, retiring from business, took up his residence in Danbury, Connecticut. Young Brush intended to pursue a business career, and accordingly entered, in the latter part of 1846, the counting-house of a merchant in Maiden Lane, New York City. There he remained for nearly two years, but the taste for scientific study which he had already acquired did not desert him, and, in particular, he took advantage of every opportunity that came in his way to go off upon mineralogical excursions.

Just about this time Professor John P. Norton and Professor Silliman, Jr., opened at Yale College a laboratory for the purpose of practical instruction in the applications of science to the arts and agriculture. To attend these lectures, Professor Brush, not as yet seventeen years old, repaired to New Haven in October, 1848, intending at this time to change his mercantile life for that of a farmer. This event changed his career. He came to attend a single course of lessons on agriculture. He remained two years as a student of chemistry and minerology. In October, 1850, he went to Louisville, Kentucky, as assistant to Benjamin Silliman, Jr., who had been elected Professor of Chemistry in the university of that city. There he remained the following winter, and in March, 1851, made one of the party who accompanied the elder Silliman on a somewhat extended tour in Europe. Returning to Louisville in the autumn of that year, he continued acting in his old capacity until the spring of 1852. Then he returned to New Haven, and after undergoing examination, received, with six others, at the commencement of 1852, the degree of Ph. B., the first time it was given by the college.

The academic year 1852-53 was spent by him at the University of Virginia, where he was employed as assistant in the chemical department. In 1853, he sailed for Europe, and, during one year at the University of Munich, devoted himself to chemistry and minerology under Liebig, Von Kobell, and Pettenkofer. The year following—that of 1854-55—he spent at the Royal Mining Academy in Freiburg, Saxony. Just about this time an effort was being made at New Haven to put the scientific department of Yale College in a more satisfactory position than it had previously held.

He was first offered the chair of mining and metallurgy; but this he declined as embracing too much, and the title was limited to that of metallurgy alone. This, several years after, was exchanged for that of mineralogy. To qualify himself still further for the position, the newly-elected President went, in the autumn of 1855, to London, where he pursued his studies in the Royal School of Mines. The following year he made an extended tour through the mines and smelting works of England, Scotland, Wales, Belgium, Germany, and Austria. In December, 1856, he returned to this country, and, in January, 1857, he entered upon the duties of his professorship.

From this time, the history of Professor Brush has been the history of the special scientific department of Yale College, which, in 1860, owing to the liberal benefactions of Mr. Joseph E. Sheffield, received the name of the Sheffield Scientific School.

Others have done their part towards developing various departments of the school, but the growth as a whole, the position which it has acquired among scientific institutions, whatever that position may be, has been due to him very much more than to any other one man connected with it.

Nor has Professor Brush been idle in his special work, in spite of the exhausting demands made upon his time and thought by the management of the Sheffield Scientific School.

He co-operated with Professor Dana in the preparation of the fifth edition of the treatise on "Descriptive Mineralogy," published in 1868.

In 1876 he brought out also a "Manual of Determinative Mineralogy and Blowpipe Analysis." In addition to these and other works he has been a constant contributor to the *American Journal of Science.*

In 1862 Professor Brush was made a corresponding member of the Royal Bavarian Academy of Sciences; in 1866 a member of the Imperial Mineralogical Society of St. Petersburg; and in 1877 a foreign correspondent of the Geological Society of London. He is also a member of the American Philosophical Society, of the National Academy of Sciences, and of various other scientific bodies in this country. In 1880, at the meeting of the American Association for the Advancement of Science, held at Boston, he was elected its president for the following year, and in that capacity presided over the meeting held in August, 1881, at Cincinnati.

### PROF. FREDERICK PUTMAN.

Prof. Frederick Putman, of Cambridge, Mass., the permanent Secretary, is one of the oldest members of the Association, which he joined in 1857, at the age of seventeen the "baby member."

For a year previous to this he had been the assistant of Agassiz, whose pupil he was for eight years, and under whom he had charge of the department of ichthyology.

In 1864 Mr. Geo. Peabody gave $180,000 to found the Peabody Academy of Science at Salem, Mass., and of this Professor Putman was appointed the first director, an office which he held for eight years.

A few years after this first gift Mr. Peabody founded, in addition, a museum in connection with the Harvard University, known as the Peabody Museum of American Archæology and Ethnology, and of this Professor Wyman was appointed the first curator, an office which he held until his death. On this occurring, in 1874, Professor Putman was appointed his successor, a post which he still holds.

In addition to this, the professor received, last July, at the hands of the Governor and Council, of Massachusetts the appointment of Commissioner of Inland Fisheries, in succession to Col. Lyman, a post for which his early studies have particularly fitted him.

Besides his connection with the American Association, Professor Putman is a member of the Society of Anthropology of France, and of various other Scientific societies at home and abroad.

### DR. CARPENTER.

Dr. William B. Carpenter, eldest son of the late Dr. Samuel Carpenter, brother of Mary Carpenter, the well-known philanthropist, and of Dr. Philip Carpenter, late of Montreal, was born in Exeter, in 1813; but passed the greater part of his early life in Bristol, whither his father had removed in 1817. After receiving his general education under his father, he entered upon the study of medicine, which he pursued in the Bristol Medical School, and afterwards in London and Edinburgh. He took the degrees of M. D. in Edinburgh in 1839; in which year he published the first edition of his "Principles of General and Comparative Physiology," a work which at once gained a high scientific rank, and was soon followed by a companion treatise on "Human Physiology," which speedily acquired an extended reputation, being used as a text book in many of the principal medical schools, as well in America as in Great Britain.

Desiring to make the science rather than the practice of medicine the business of his life, Dr. Carpenter removed to London in 1846, where he has held several public appointments, notably that of Registrar (or Principal Executive Officer) in the University of London, which institution under his administration has undergone a remarkable development. That office he held from 1856 to 1879, retiring from it in order to be able to devote the remainder of his life to scientific pursuits, and especially to the completion of several Monographs (among them one on *Eozöon Canadense*) for which he has been collecting materials during several years.

As an original investigator, Dr. Carpenter first became known by his microscopic researches on the structure of shells; then by his studies in the group of Foraminifera, on which he now ranks as the leading authority; and subsequently by his researches on the physical geography of the deep sea, the further prosecution of which by the "Challenger" Expedition was undertaken by the British Admiralty on his (Dr. Carpenter's) representation of its scientific interest and importance.

Dr. Carpenter is a Fellow of the Royal Society, and received about 20 years ago one of its Royal Medals in recognition of his researches on the Foraminifera. He is also a Fellow of the Linnæan and Geological Societies of Great Britain. In 1872 he was elected President of the British Association for the Advancement of Science at its meeting at Brighton. He is a Corresponding Member of the Institute of France, of the American Philosophical Society, as well as of many other foreign academies.

To the present generation of scientific workers, Dr. C. is best known by his "Treatise on the Microscope," the sixth edition of which embodies the results of nearly half a century of microscopic experience. And his treatise on "Mental Physiology," first published about nine years ago, has gained for him a large body of readers among those who desire to acquaint themselves with the constitution and operations of the human mind.

PROF. YOUMANS.

E. L. Youmans was born in Albany County, N. Y., in 1820—but grew up in Saratoga. He went to the Common School, but early contracted a disease of the eyes which blinded him for many years and leaves him still with very imperfect vision. This made collegiate education impossible. He early took interest in scientific subjects and had scientific books read to him. Chemistry was at first a favourite subject which he studied with the aid of his sister, Miss Eliza A. Youmans, who made the experiments. By the aid of a machine which he invented, and the partial recovery of sight he wrote the class book of Chemistry for Common Schools which was published in 1852. After this he lectured extensively before Lyceums and was perhaps the first to popularize the new doctrines of the Conservation and Correlation of forces, upon which he subsequently compiled a book. Always interested in scientific education he edited in 1864 a volume entitled "The Culture Demanded by Modern Life."

Mr. Youman's interest in the general subject of scientific culture and in the advanced philosophical ideas of the age which are the results of scientific progress, induced him to exert himself for the reproduction in the United States of the able works of British thinkers, such as Mill, Bain, Spencer, Maudsley, Huxley, Lecky, Tyndall, Darwin, Carpenter and others, and he exerted himself to bring about an arrangement on the part of the American publishers with whom he was associated to pay foreign authors in the same way that American authors are paid. By devoting himself much to the diffusion of their ideas and laboring to create a demand for their books his policy proved so very successful that the practice first systematically carried out by D. Appleton & Co., has been extensively adapted by other publishers with a corresponding advantage to foreign writers.

In 1872 Mr. Youmans became much interested in the question of International copyright and went abroad to organize the International Scientific Series on the basis of a simultaneous publication in different countries of scientific books under which equitable payment should be made to the authors. It was his hope that by establishing such an international arrangement spontaneously and getting the rights of authors conceded on a commercial basis by the voluntary engagements of publishers, that the American government might then be induced to recognize and give legal security to the literary property that has been thus far unprotected by law. There are but few symtoms of any such governmental action, but a valuable series of scientific books has at any rate been secured and all their authors handsomely paid.

In 1872 Mr. Youmans also established the *Popular Science Monthly* to give currency to a class of articles that but rarely make their appearance in the literary periodicals. The Magazine went up to a successful circulation at once and has continued to hold an influential position as an organ of scientific thought upon all the broader and higher questions of the time.

Mr. Youmans has never been able to devote himself to the work of scientific research, being crippled in this respect by his imperfect vision, but feeling that the work of diffusing the great results of modern scientific activity is only next in importance to that of creating science itself, he has worked industriously in this field and has won conspicuous success.

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An examination of the wire suspension bridge across the Ottawa River below the Chaudiere Falls, shows that the metal is as sound and free from rust as when the bridge was built, 30 years ago.

# Engineering, Civil & Mechanical.

## THE HISTORY OF A GREAT INVENTION.—THE GIFFARD INJECTOR.*

Giffard has recently died. He was a great inventor, and every one has interested himself in the details of his life and with the recollection of his labors. We believe that it will prove of interest to all to learn the history of the discovery that has immortalized his name. The invention of the Giffard injector affords still another instance of the fact that it has always through serious studies, patient preparation, unremitting work, and persistent thought that those results of genius are reached which endow the industrial world with a new process or a new apparatus.

For many men, it would seem to be a sorrow and almost an offense to recognize the merit and superiority of an inventor; and to attribute to hazard and chance the occasion of a great discovery is to cause them genuine satisfaction.

If the inventor has benefited by a chance, by an accidental experiment, he is no more than a man, the equal of and like others—a fortunate of the earth; and people may envy him while esteeming themselves unfortunate in not having had the luck to make a similar "find" just as is envied the possessor of the ticket which drew the grand prize in the lottery, or the miner who finds an ingot of gold.

It is our intention to use Giffard as an example furnishing a new proof of the absolute assertion that if the discovery and appropriation of a material already existing, but for the moment hidden from the eyes of man, can be attributed to accident, to chance, the discovery by Giffard of his great invention, the injector—that treasure that he neither found nor invented, but created—can be attributed only to his genius and persevering labor.

Up to the present time it has always taken a combination of endurance, persevering effort in work, and of inventive genius to endow the world with those wonderful creations that mark an epoch, such as the printing press of Gutenberg, the enamels of Bernard de Palissy, the steam engine of Watt, the mule-lenny of Arkwright, the loom of Jaquard, and the works of Robert Fulton, Phillippe ne Girard, etc.

I have cited the names of inventions known to all, but, in aid of the assertion that I maintain, the examples are numerous, and all characteristic, from the manufacture of iron by Lord Dudley, in 1621, down to the manufacture of steel by Bessemer, in 1856, and of the Giffard injector, in 1858.

During the course of the year 1849, Giffard had Mr. Flaud construct the high speed steam engine that he (Giffard) had devised, calculated to draw an engine whose arrangements and proportions disagreed with all those ideas that had, up to that time, been admitted and accepted by constructing mechanicians.

Gifford relied on the admitted theory and mechanical formulas, but it was only to deduce from them ideas of surprising boldness. A single example will suffice to demonstrate this, since at that epoch he caused to be constructed and regularly operated a three horse-power engine, weighing only 45 kilogrammes, flywheel included, and running with a speed of 3,000 revolutions per minute.

Like many others, I visited Mr. Flaud's shop, in which a 45 kilogramme engine was running a dozen tools, the smallest of which was larger than the engine. What appeared singular, at first sight, was the large size of the bearings or plumber-blocks in which the little steel driving shaft revolved. A connecting rod, also of steel, transmitted to the driving shaft the motion from a piston rod that makes 6,000 strokes per minute in traversing from top to bottom and bottom to top the small vertical cylinder that the steam entered,

The bearings employed for the small steel driving shaft were wider than those used on ordinary steam engines running at the rate of 50 revolutions per minute, and with a large iron shaft, 10 to 12 centimeters in diameter.

At my observation Gifford contented himself with showing me, in a copy that he had made from one of our books of the Central School, the formula of the friction whose terms were independent of the surface; and I then understood in what manner he had utilized theory in order to pass to the practice of construction under new and fecund conditions.

The important thing for the builder, as well as for the inventor, was to earn money, since all resources were used up—by Giffard in experiments and the construction of his little

*Emile Barrault, in *La Nature*.

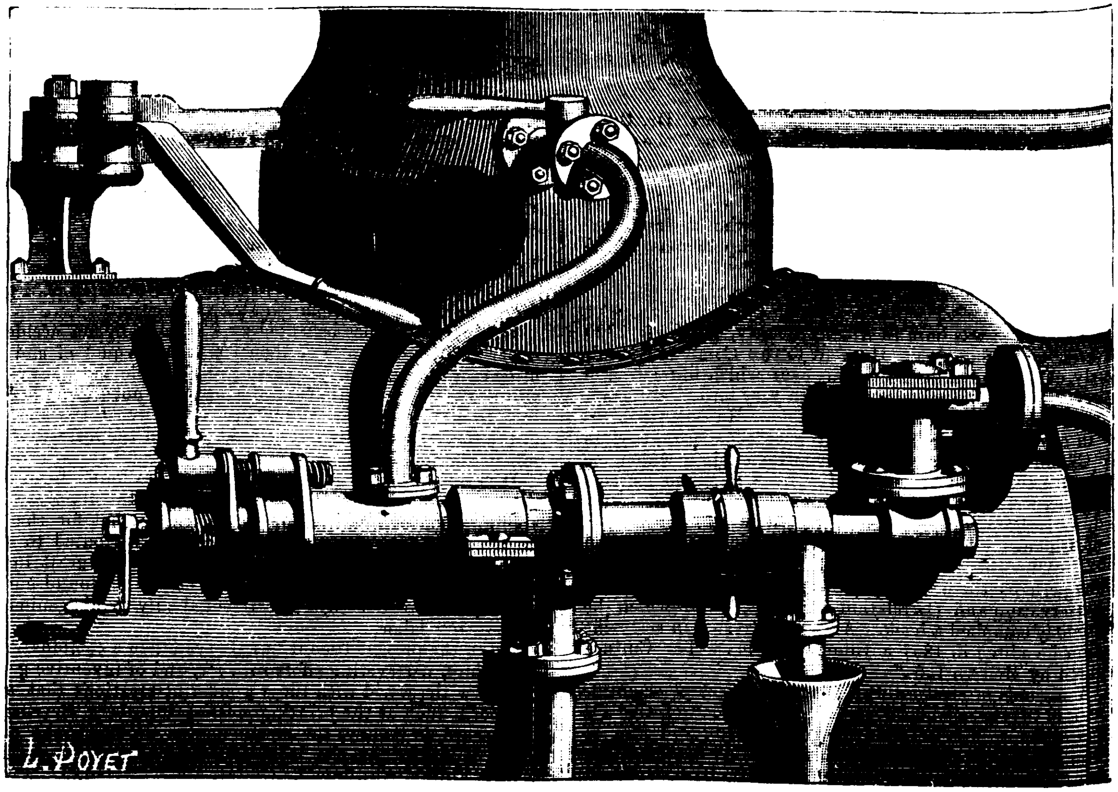



FIG. 1.—THE GIFFARD INJECTOR MOUNTED ON A LOCOMOTIVE.

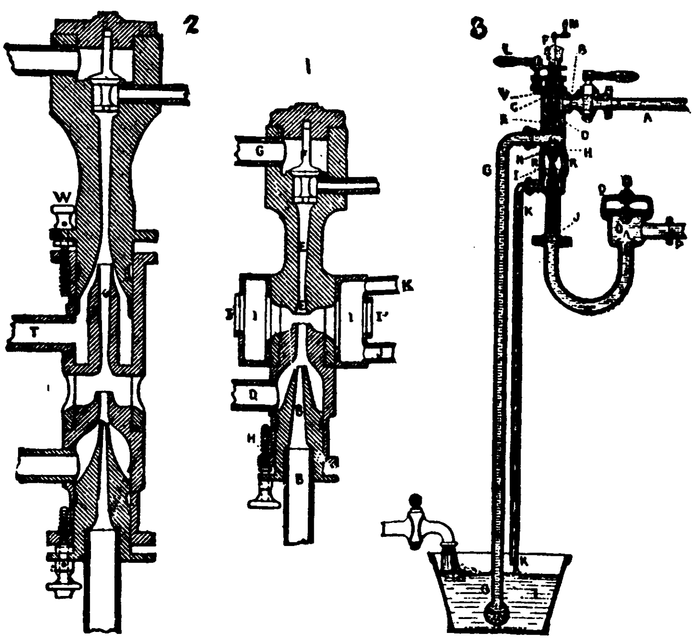


FIG. 2.—FIRST SKETCHES OF THE INJECTOR AND FIRST FORM OF THE APPARATUS.

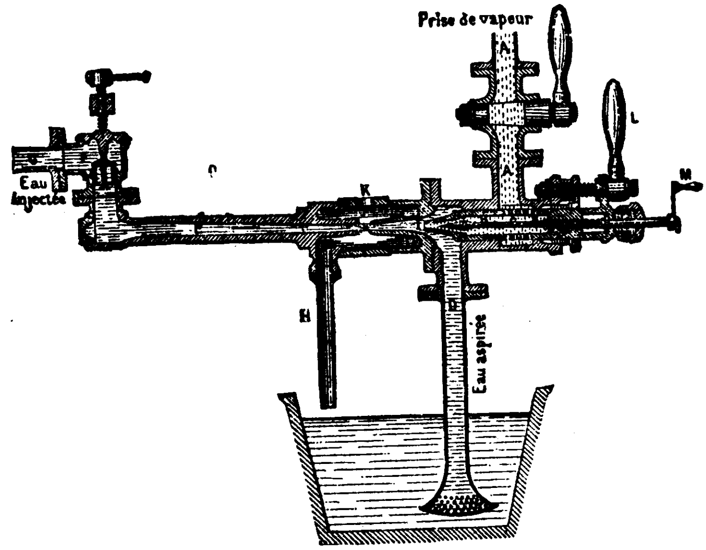
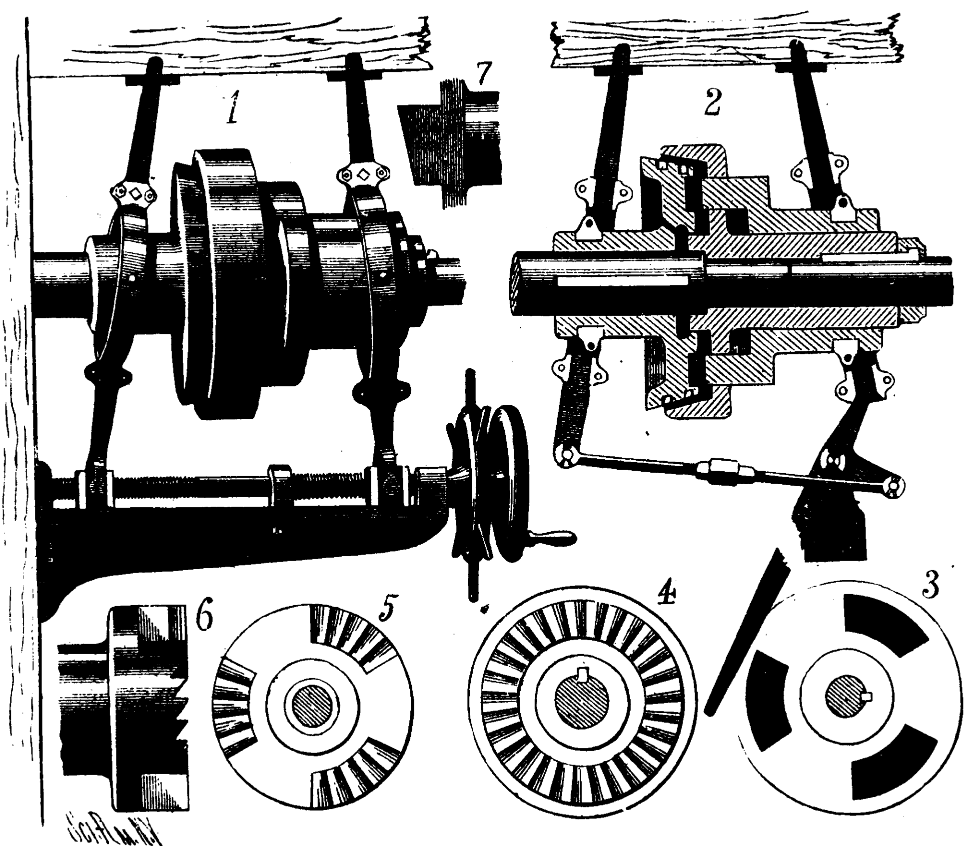



FIG. 3.—SECTION OF A GIFFARD INJECTOR.




WILKINSON'S IMPROVED COMBINATION CLUTCH.

high speed engine, and by Flaud in the starting and keeping up of his small workshop.

The want of funds was so complete that it was impossible to obtain, by uniting their two purses, the sum of 100 francs that was necessary to deposit for the patent, the drawings and description of which were all prepared.

It was precisely at that period of time (towards July, 1850) that, while pursuing the theoretic calculations that he desired to make a practical application of, Giffard wrote the *résumé* and the calculations for his feed injector without movable parts, and with conical tubes and free interval. This apparatus he wished to make an application of to locomotives as a substitute for feed pumps, and to do away with the ridiculous method then in vogue of feeding boilers at the station.

The final calculations for the injectors, with geometrical sketches, indicating the dimensions, are made on four loose sheets, written in Giffard's own hand; but, as I have just explained, at the dates of July and August, 1850, it was impossible to spend money for making experiments or for constructing a new apparatus. Mr. Flaud did not then believe in the possibility of realizing practically an apparauts the data for which were in contradiction to all the theories of heat that were admitted up to that time.

Under these circumstances the injector made no progress at that epoch. Desiring to first obtain resources, Messrs. Flaud and Giffard took out their first patent, under date of the 9th of September, and under No. 10,441, for a *system of high speed steam engine*—that is to say for new arrangements in the engine which was practically experimented with in 1849, under conditions as exaggerated as possible as to speed.

But in 1850 Giffard had met some engineers of the Central School to whom he had communicated his ideas on aerial navigation, and who had become enthusiastic over this new application of the steam engine. His studies were pushed with activity, as were his experiments, and on the 20th of August, 1851, under No. 12,226, he made application for a new patent for France for the *application of steam to aerial navigation.*

I should say that, up to the end of his life, the direction of balloons under certain given conditions was the constant object of Giffard's labors, and he was absolutely convinced of the possibility of realizing such aerial navigation, which he was proud of having been the first to experiment with practically; for, in 1852, he had ascended alone to a great height in the atmosphere by means of a balloon elongated like a ship and moved by a remarkably light high speed steam engine. In view of the scanty means at his disposal, this attempt had all the success that the inventor could dare to hope for, and if, at that time, he had been seriously aided, the question to-day would have been more advanced. But of his three co-laborers two had suddenly died, David and Sciama, and the third, Cohen, had used up his financial resources.

Persevering in his researches, Giffard wished to try again under better circumstances his great experiment in aerial navigation; so, with this end in view, he made numerous balloon ascents, studying with care the means of constructing light steam boilers; of manufacturing pure, and consequently lighter, hydrogen; and all the minutest details in regard to the numerous means that might remedy the defects that he had observed in his first experiment.

In was in a new patent (No. 24,057) of July 6, 1855, that we embodied the improved system of aerial navigations whose elements he had combined; and, on the 25th of November, 1856, we likewise indicated the practical processes which permitted of the manufacture of pure hydrogen. However, Giffard's resources were still very modest, and it was only after having studied out and patented a regulator valve, in 1857, with Flaud, whose shops had grown, that he took up again the problem of feeding boilers, and obtained a patent (February 1858), for a system operating by centrifugal force.

At this time it was a question of finding a boiler feed apparatus without any particular reference to very high speed engines. The plan was executed in Flaud's shop by means of two small turbines united on the same axis: the one, receiving the steam on its circumference, acting as a motor and the other, receiving the water at its center, acting by centrifugal force. To feed a hundred horse-power boiler it took an apparatus of only 10 centimeters diameter, weighing 3 kilogrammes.

The little feed apparatus was very simple and ran with regularity. Orders began to come in in numbers, and Mr. Flaud was full of confidence in the industrial success of it; but there was another inventor who held a valuable patent for a turbine whose arrangements resembled those adopted by Giffard. This patentee, Girard, a distinguished hydraulic engineer, had never thought of the combination invented by Giffard, or even of the feeding of boilers. He was a very positive person, a man who had suffered much, and in the new application devised by another he hoped to find something to make up for his numerous troubles; and he, therefore, was desirous of working up, to his own exclusive profit, what many manufacturers would necessarily have seconded. In the face of a claim that was presented with some irony, and under the threats of a lawsuit that he was not in a position to defend, in view of his financial position at the time, Giffard betook himself to his calculations of 1850.

It was May 8, 1858, about one month after abandoning the centrifugal apparatus, that he took out his patent in France for the feed apparatus that bears his name—the first realization of those new scientific doctrines the knowledge of which to-day is the basis of classic teaching.

The annexed cut (Fig. 2) shows, at Nos. 1 and 2, the figures of the patent which represent the injectior as seen in sectional elevation.

The perfection of this apparatus, in which no part was in motion, made nil the project of working up the first centrifugal motion apparatus that Mr. Girard had seen fit to seize upon.

For four or five months the injector, constructed as shown in the cut, worked in the shop in Rue Jean Goujon, and was visited by the most prominent engineers, who could scarcely believe what they saw until they had an opportunity of experimenting for them selves.

Before the injector, the only feed apparatuses employed for steam engines were four in number, viz.:

1. The *pulsometer*, which consisted of a large and strong vessel that was emptied and filled alternately by manœuvering cocks and valves, and which could be employed for locomotives and steamboats.

2. The *pump*, actuated by the engine, and the vagaries in the operation of which were numerous, since nothing more was necessary to stop the play of the valves than the presence of the smallest foreign body, or even of sour water. Moreover, the working of the pump required a certain amount of force from the motor that diminished its power; and in addition, freezing and frequent repairs were to be apprehended.

3. The *donkey engine*, or pump actuated by a special engine, a costly apparatus that consumed much steam and took up considerable room, on locomotives for example.

4. The *reservoir*, which allowed water to enter the boiler through the action of gravity, thus necessitating its being placed at a great height.

During the year that followed the obtaining of the patent, numerous practical improvements brought the injector to a state of perfection in working, and the certificate of addition in which I embodied all these improvements bears date of May 7, 1859.

Fig. 2, No. 3, shows the drawing that was annexed to the certificate of addition of 1859, and represents in section the improved and final arrangements of the feed apparatus of Giffard's invention.

I have said that mechanical builders and engineers had considered that it was impossible for the injector to work; so, when the first application of it was made on the locomotives of the Railway of the East, care was taken to leave the feed pumps in place so as to be able to use them if there should be needed. But it was not found necessary to have recourse to them; for it was ascertained by experiment that the action of the injector was easy and sure, and, at the end of a fortnight, the feed pumps were removed. Fig. 1 represents portion of a locomotive engine with its injector.

It will be still remembered at the present time what surprise and astonishment followed the first applications made by M. Dupuy de Lôme, the director-general of naval constructions who was one of the first, in 1858, to negotiate for the introduction of the injector into the navy.

Communications were received by scientific societies from distinguished men whom they had charged with the duty of making in their behalf an attentive study of this apparatus, which was attracting the attention of all competent men by its originality and the novelty of the scientific principles that it brought in play.

In a report made to the Société d'Encouragement, and which was published in its number for June, 1859, Mr. Ch. Combes, of the Institute, after saying that the injector contained no solid movable piece, added that it was founded upon the principle of the lateral communication of the motion of fluids, and that it utilized "the jet of steam from a boiler for feeding this boiler itself," realizing an industrial application in which "the heat contained in the jet carried along by the steam played the principal role."

In one part of this important paper, Mr. Combes expressed himself thus: "Considered as a feed apparatus for steam boilers, Mr. Giffard's apparatus is, undeniably, the best of all that have been or can be employed, as it is the simplest and most ingenious of them. If we suppose, in fact, that conformably to ideas hitherto held, the quantity of steam contained in bodies is preserved in its entirety through the changes in volume that these undergo, independently of the quanties of motive or resistant power that are the consequence of such changes, it is clear that the operation of Mr. Giffard's apparatus will give rise to no loss of heat except that due to radiation or to contact of the boiler aud its appendages with the surrounding medium. The supply will take place gratuitously. If, conformably to the more rational principles of the new dynamic theory of heat, we admit that heat is converted into motive power, and reciprocally, so that all motive or resistant power, all the live force developed or destroyed in the changes of volume or state of the bodies, be accompanied by a disappearance or a production of equivalent heat, the quantity of heat expended in the operation of the Giffard apparatus will be (setting aside losses through radiation or contact with the surrounding medium) precisely equivalent to the motive power that corresponds to the elevation of the quantity of feed water from the reservoir that holds it, and to the forcing of it into the boiler under the pressure that exists therein. We are, then, justified in saying that the Giffard injector is a feed apparatus which is theoretically perfect for steam boilers. The inventor has proved that the dimensions can be so arranged that it will work under material conditions that nearly reach such theoretic perfection."

Testimonials in regard to the importance of this invention are numerous from all sources, but it will suffice to mention that the mechanical prize (Montyon prize) was awarded Giffard by the Académie des Sciences at the competition of 1859, without his having taken any steps to obtain it or even make any communication.

I shall not, at present at least, speak of the difficulties that the invention met with later on, for I desire to remain faithful to the title of this article and limit myself to the history of the invention.

Reduced to its simplest terms, the invention of the injector is based upon the idea that the steam boiler should furnish directly the power necessary to supply itself with water.

To realize such an idea, a section in the boiler causes a jet of steam to issue, which passes into a conical tube that leads it in such a way as to suddenly come in contact with the sucked up liquid, in order to bring about by a sudden condensation the transformation of the live force.

As a consequence of the conversion of velocity into pressure, the water is carried to a valve in another section of the boiler, and the dimensions of which are smaller than those of the aperture that allows the steam to escape. A system of two cones, one convergent and the other divergent, permits of regulating through the former the convergence of the fluid jet, the form of which is so modified by the divergent cone as to facilitate its re-entrance into the boiler in spite of the pressure existing therein.

Such is the apparatus as arranged on all locomotives to feed their boilers.

Fig. 3 shows in longitudinal section an injector in position; and this, with the description appended to this article, will be sufficient to allow the working of the apparatus to be understood.

And now we may sum up the new scientific principles, four in number, that are combined and brought into play in this remarkable invention, along with principles and mechanical methods already known:

1. On contact with the water the steam condenses and communicates to it its velocity.

2. Condensation can only take place if the water is notably colder than the steam; and it is therefore necessary that the water, already heated by the condensation of a part of the steam, shall be put in contact with uncooled steam.

3. The pressure of the jet obtained by the condensation of the steam may be notably greater than that of the motive steam.

4. A liquid may be thrown to a distance from a stationary ajutage within another one also stationary, communicating with a reservoir wherein there is pressure, without any loss of liquid occurring as a consequence of such transmission.

I hope that I have given proof of what lies close to my heart, and furnished enough details to cause it to be understood that Giffard alone was in the position proper for realizing the invention of the injector, because he had slowly and laboriously amassed those treasures of science and individual experience that permitted him to succeed.

He was an indefatigable and patient worker, who recorded in his note books all that he saw, observed, and calculated; and it was thus that, at an opportune moment, he was enabled to sum up in one powerful effort the long prepared elements of the problem that he had proposed to himself in youth.

When Giffard escaped from the Bourbon College to go to the Saint Lazare station, it was in order to make a study of the running of locomotives, and to become exasperated at seeing them too often expend their power in ridiculous movements made for the sole purpose of bringing to the boilers the water necessary for the supply of their strong steam engines.

The injector was not a lucky find, the result of an accidental experiment, the flash of an inspiration of genius; for Giffard calculated (as did Newton over the fall of the apple) from the experiments made by him in 1850 and after. It is we who today benefit by the fruit of the persevering and conscientious efforts of this immortal man, whose life was well employed for humanity.

Description of Fig. 3.—A, steam pipe communicating with the boiler; B, another pipe receiving steam from the preceding through small holes, and terminating in a cone; C, screw rod, cone-shaped at its extremity, actuated by the winch, M, and serving to regulate and even intercept the passage of the steam; D, water suction pipe.

The water that is drawn up introduces itself around the steam pipe and tends to make its exit through the annular section at the conical extremity of the latter. This annular section is increased at will by means of the lever, L, which acts upon a screw whose office is to cause the pipe, B, and its system to move backward or forward. E, diverging ajutage, which receives the water injected by the jet of steam that condenses therein at I, and imparts to it a portion of its speed, in proportion to the pressure of the boiler; F, a box carrying a check-valve to keep the water from issuing from the boiler when the apparatus is not at work; G, a pipe that leads the injected water to the boiler; H, purge or overflow pipe; K, sight hole, which permits the operation of the apparatus to be watched, the stream of water being distinctly seen in the free interval.

## NEW COMBINATION CLUTCH.

It is, as its name indicates, a positive coupling for all kinds of shafts requiring connection while in motion, and no matter at what rate of speed the shaft may be running, the connection can be made without the slightest shock or jar, and we believe it is the only coupling combining the friction and positive clutch in one, enabling the operator to make a positive connection or not at pleasure, which is the great desideratum in "friction clutches," as the motion lost in the driven shaft of a manufactory, by depending on friction alone, would in a very short time pay for one of these couplings.

They are free from all rotating pins, bolts, levers, and unsightly projections that endanger the lives of the operators; they can clean and work around them while running with perfect impunity. The head of the key is covered with a leaden collar, and there is not a projection in the whole rotating parts of the device on which a thread would hang.

If it is desirable (as it is occasionally in some manufactories where there is danger of a block in the machinery) to use the friction alone, all that is necessary is to withdraw the clutch and adjust the friction cone to the work required, which can be done so nicely that a slight strain over its normal load will cause it to slip, thus often saving very valuable machinery from destruction.

It is well known among machinists that the old fashioned friction cone is the principal device used for driving by friction, but it is extremely liable to cutting or abrading of the two iron surfaces, which makes it very difficult to withdraw the cone sometimes.

In the clutch shown in the engraving, a foreign substance, such as wood, leather, paper, etc., is interposed between the surfaces, and this difficulty is overcome. The mode of applying it is very simple; any intelligent boy can readily take out the old filling and replace it with new in half an hour.

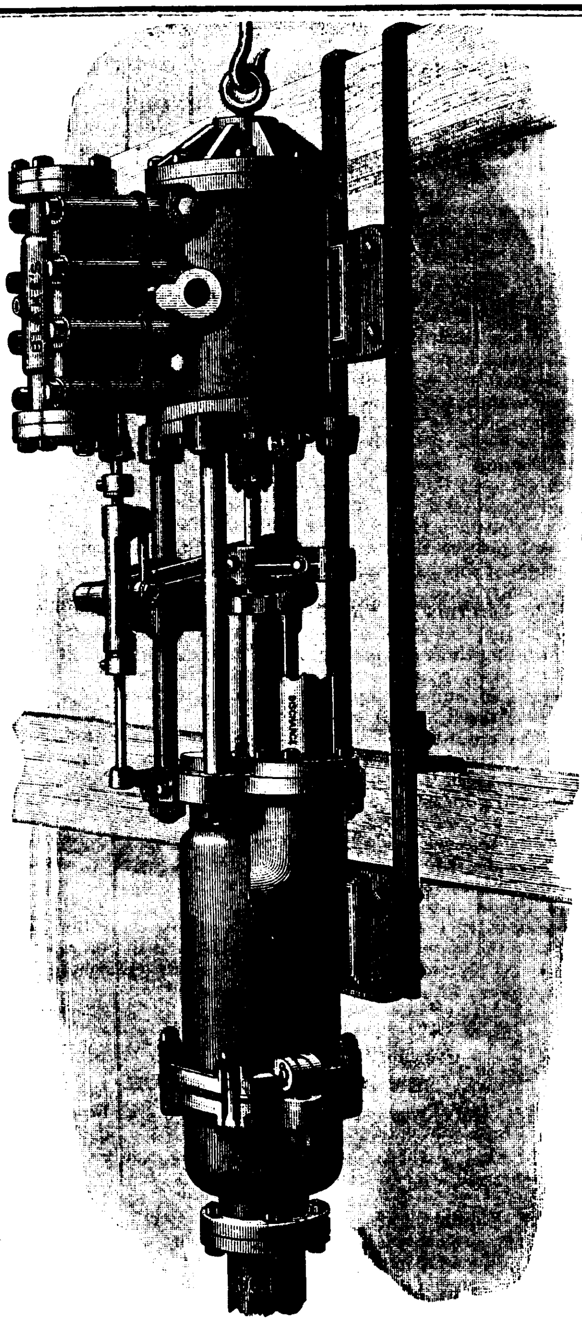


FIG. 1—NEW SINKING PUMP.

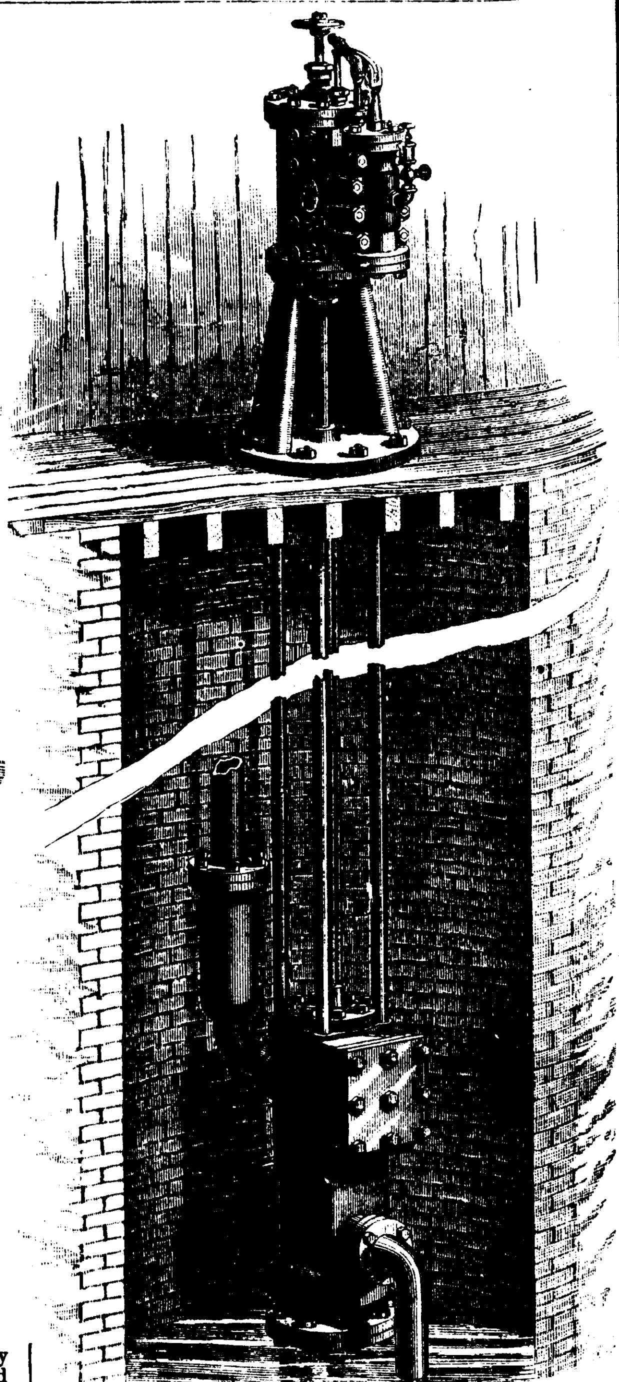


FIG. 2.—IMPROVED DOUBLE-ACTING VERTICAL PUMP.

The method of applying the intermediate substance is by perforating the periphery of the cone, as shown in Fig. 1 and 2, corresponding in depth to the thickness of the filling material, which should stand a little above the surface, so as to keep the cone and drum slightly separated. Wads or pellets of tar millboard, a little thicker than the depth of the perforations, are punched out and driven home with one blow of a small hammer.

Millboard is preferable to any other material, being denser and more adhesive than either wood or leather, punches very smoothly, and lasts a long time.

Two forms of this coupling are made, one for heavy mill work that does not require to be coupled more than once or twice a day, as Figs. 1 and 3, and one for instantaneous coupling, as 2, 4, 5, 6, and 7, for steam winches, elevators, punching presses, shears, etc.

Fig. 1 is a front view of the device, with the parts open showing the filled perforations.

Fig. 2 is a sectional view showing the quick coupling apparatus and serrated clutch.

Fig. 3 is an end view showing the split collar, shifting arms, hand wheels, etc.

Figs. 4, 5, 6, and 7 are detail views of various parts of the clutch mechanism; Fig. 5 showing teeth on the face of the friction cone; and Figs. 6 and 7 being respectively face and side views of the toothed clutch.

The clutch, as will be seen by the engraving, really comprises two systems, one the friction clutch as already described, the other a positive clutch, and these two forms of clutch, both having novel features, are arranged with mechanism for applying them, constructed so that the friction clutch may be applied first, and the positive clutch afterward.

The boss of each part of the clutch is grooved circumferentially to receive a split ring connected with the lever by which the two parts of the clutch are operated.

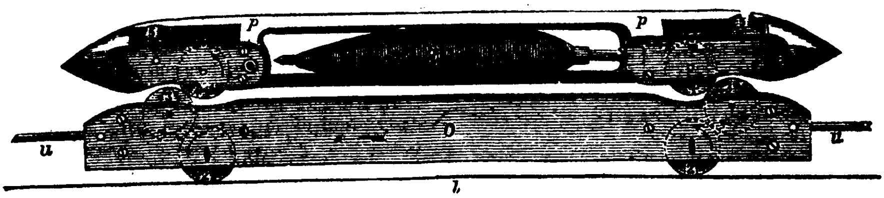
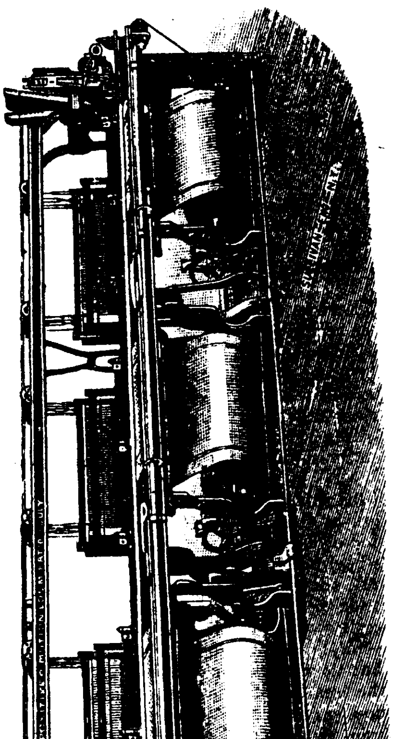


FIG. 1.—SHUTTLE AND CARRIAGE.



THE LYALL POSITIVE MOTION FOUR WEB LOOM.

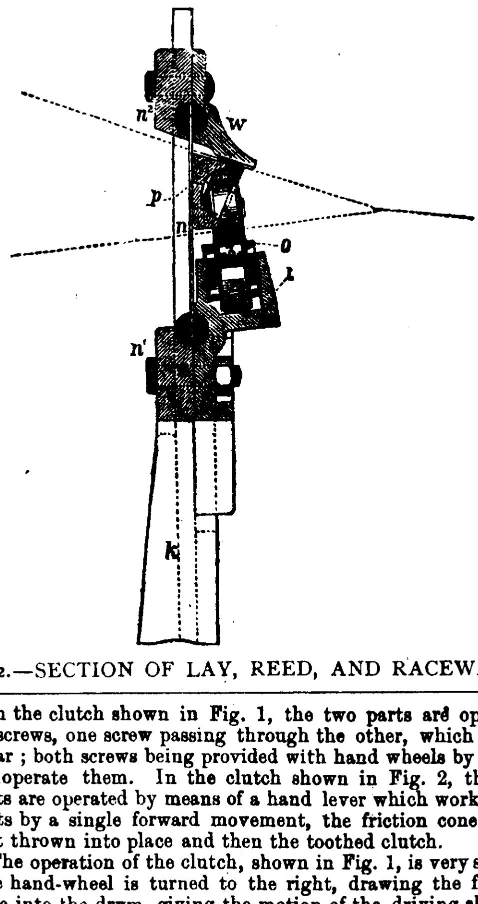


FIG. 2.—SECTION OF LAY, REED, AND RACEWAY.

In the clutch shown in Fig. 1, the two parts are operated by screws, one screw passing through the other, which is tubular; both screws being provided with hand wheels by which to operate them. In the clutch shown in Fig. 2, the two parts are operated by means of a hand lever which works both parts by a single forward movement, the friction cone being first thrown into place and then the toothed clutch.

The operation of the clutch, shown in Fig. 1, is very simple. The hand-wheel is turned to the right, drawing the friction cone into the drum, giving the motion of the driving shaft to the driven shaft. The other hand-wheel is now turned to the left, forcing the lugs of clutch through the apertures of the drum against the face of the friction cone.

The friction is now released a little, allowing the friction cone to gain on the drum, until the long end of the lug enters the recess in the cone, and by the time the cone has gained on the drum the width of the lug, it has entered the recess the depth of the tooth, and abuts against the driving end of the recess in the face of the cone. It now only remains to force the clutch to its destination, and slacken the hand wheels enough to relieve the split collars and their grooves from friction. To uncouple the same, the operation is reversed. The clutch shown in Fig. 2 is operated by the motion of the lever, which has two short ends set at right angles; the short horizontal end is connected to the cone lever, by the connecting rod, which is adjusted by the right and left threaded sleeve, so that when the short end and connecting rod are on the center, the cone is tight enough to drive the drum, and in this position the perpendicular end of the lever has advanced so far that the teeth in the ends of the lugs, Fig. 7, are about to enter the teeth in the face of the cone. When the lever and connecting rod have passed the center, the cone is released enough to ease the split collars, and the same motion has advanced the vertical short end of lever so as to engage the toothed lugs with the serrations in the face of the friction cone. Further information may be obtained by addressing Mr. E. Wilkinson, 276 Ellison Street, Paterson, N. J.—*Sci. American.*

## IMPROVED PUMPS FOR SPECIAL SERVICE.

We illustrate herewith and describe certain improved pumps, each specially adapted, by reason of important modifications of mechanical construction, for the particular duty for which it has been designed. They are from the extensive establishment of the George F. Blake Manufacturing Co. 88 Liberty street, New York, and 44 Washington street, Boston, and represent in their design and construction the most recent improvements introduced by those enterprising manufacturers.

Fig. 1 of our illustrations represents the improved sinking pump of those manufacturers, of vertical double-acting plunger pattern, designed especially for sinking new shafts, recovering old mines that have been "drowned out," and for mining operations generally, requiring the use of a light, portable efficient steam pump; also for sinking wells and general excavation work. The vertical form of this machine permits of its introduction into the shaft without taking up much room, which may often be an important feature of convenience. It is provided with a ring-bolt firmly imbedded in the upper steam cylinder head, which is webbed to give extra strength. To the ring bolt, tackle for raising and lowering the pump can be readily attached. Adjustable wrought iron dogs are firmly bolted to the cylinders, by which the pump may be hung at any desired height to the shaft timbering.

The peculiarity of this pump which distinguishes it from others of the same class, lies in certain important details of the arrangement of its water cylinder. The arrangement referred to, is such that while the water cylinder has but one plunger, the pump is practically doubly-acting in operation. To accomplish this object, the plunger is made of such shape as to give it two effective pumping areas. For this purpose the lower end of the plunger is enlarged, and works in a cylinder lined with a patent removable bushing of hard composition, and is packed with Tuck's fibrous packing. This end of the plunger contains the delivery valve of vulcanized rubber. The upper part of the plunger works through an ordinary stuffing box, packed from the outside. Ports of sufficient area are let into the plunger above and below the delivery valves; the suction valves are in the lower section, near the suction nozzle.

Although, therefore, in the operation of this pump the suction comes into play only at every other stroke, the arrangement of the water cylinder just described, renders the delivery continuous, as in the regular "bucket-plunger" form of pump, the upper part of the plunger serving as an effective air chamber.

The size of the pump just described is as follows: Steam cylinder, 10 inches diameter; upper part of water plunger, 5 inches diameter; lower part of plunger, 7 inches diameter; stroke, 12 inches. The pump weighs about 1,300 pounds, and has a capacity of 100 to 150 gallons per minute.

Fig. 2 is an illustration of the improved piston-pattern, double-acting vertical pump of the same makers, intended specially for service in deep wells, dry docks, etc. In this form of pump the steam cylinder is arranged upon a strong frame for bolting to the wood-work at the mouth of the well, as shown in the cut.

The water cylinder may be located at any desired depth, the elongated piston rod being provided with proper guides. Pumps of this pattern are running in wells, we are informed, as deep as 190 feet.

The lining, piston rod, stuffing box, valve seats, valve bolts, etc., of the water cylinder are made of the bost composition. The water piston is also made of composition, suitably packed.

The design and construction of this pump is simple. It has demonstrated itself to be durable in service, and in fact, possesses substantially all the improvements that have made the regular horizontal pump of these makers so popular. It is double-acting, and will consequently deliver a continuous stream of water steadily, and without shock or noise.

The George F. Blake Manufacturing Co. will furnish additional details on application to the address given above.

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To Make Wood-Work Incombustible.—It is said that Wood-Work of any kind may be made incombustible by painting it with several coats of a solution of silicate of soda, and finishing off with a mixture of this solution and sufficient common whiting to make it about as thick as ordinary paint. Wood treated in this way will not take fire from mere contact with flame.

# Mechanics.

## LYALL'S POSITIVE MOTION LOOM.

In a former issue of this paper we gave the first published description of Mr. James Lyall's invention. We now take occasion to give our readers some idea of the growth of an industry then in its infancy, and to show how all we then predicted of it as one of the most remarkable products of inventive skill of our time has been realized.

We present illustrations of the exterior and interior of the machine shops where the looms are constructed, forming only a part of the premises owned and occupied by the firm, and where in all are employed from twelve to fifteen hundred employees. The number of looms built by them in the course of a year may be conjectured from the size of the works and the number of hands employed. It is a large and steadily growing interest, sprung from the inventive skill of one man. Another picture is given of a two-piece loom with hundred-inch reed spaces for weaving patterns, known as a Jacquard loom, and having Mr. Lyall's positive motion shuttle, thus bringing together two of the three inventions which we shall show to be all that there is of the loom of to-day, in contrast to that of many centuries ago; also a four and a five piece loom. These very perfectly present to the eye the construction of the machine and arrangement of the works.

They are shipped to all parts North and South, South America. and Europe. China and Japan have them, in consequence of the report of an imperial commission sent here to inquire into their excellence. Indeed, wherever looms are used, they have been steadily supplanting those formerly in use for all kinds of weaving, whether of the coarsest fabrics or the most delicate silks, textiles of the fineness of spider webs or screens of iron wire. Diplomas, medals and decorations attest the high appreciation in which the invention has been held.

The reason for this pre-eminence will become clear upon a brief inspection of the loom itself in operation. It will afford those interested a pleasant hour to read the history of weaving from its rude beginning. Concluding with this description of the loom *as it is*, they will be impressed with the fact that Mr. Lyall's invention has made that radical change in the possibilities of weaving which the hot-air blast did in the manufacture of iron—simple enough in contrivance after it has been discovered, but so marked, so radical in character, that it amounts to the creation of a new art—a new art in the sense that it produces, in a new and better way, an article in all respects different from the old article, except in the fact that both are known as fabrics.

The art of weaving has made, considering its antiquity, singularly slow progress in its improvements. Beginning with the dawn of history and apparently simple as an art, there have been but four notable improvements in the looms to this day, of which this is the last, and, we are tempted to believe, the most noteworthy. Until 1735, when John Kay, of Bury, England, devised the "flying shuttle," and was driven out of the realm to die in poverty by the men who were benefited by his invention, the art and the loom remained substantially as they were from the earliest times.

His contrivance reduced the requisite amount of labor, to produce a given amount of work, fifty per cent. of what it had been up to his time. It was the first step taken in the direction of labor-saving in this art. In this line, Dr. Arkwright's "power loom," which was the mechanical application of power other than that of the weaver to driving the loom, naturally followed—a great invention and prominent among the four. Power, as applied to machinery, implies not only labor-saving, but admits of elaborate workmanship, together with other advantages not necessary to enumerate.

In 1801 Joseph Jacquard invented the machine which bears his name, for mechanically weaving irregular patterns and designs. Like that of Arkwright, it has not been materially improved upon, remaining substantially as it left his hand, and marked an era. Thus, after centuries of mere repetition and a most limited application of the weaver's art, we find a movement started, an innovation toward devices for saving labor, or, properly speaking, the production of greater quantities with the same amount of labor. And though opinions differ, it seems to us that the quality and variety as well as the quantity of the product must of necessity be superior when made by machinery instead of by hand.

John Kay and Joseph Jacquard were both mobbed. Arkwright and Lyall were fortuntate in belonging to a more enlightened age, whose inventors are acknowledged as benefactors.

Improvements in any art, machine, or process, almost always shortly require a corresponding advance in respects to something which has been neglected and left behind in the march and which now imperatively requires to be brought up to the same standard of excellence.

So it was in this instance. It soon became apparent that passing the shuttle through the shed of warps by means of the "picking sticks" (the flying shuttle) in a power loom was surrounded with many and great disadvantages, for reasons we will explain hereafter.

Indeed, the shuttle movement has always been considered the least perfect part of the machine, and especially was this true after the application of power. Since Arkwright, inventors have been at work trying to solve the problem, and innumerable attempts have been made to bring the shuttle movement up to a level with the mechanical efficiency of the rest of the parts, and until now without success. The "picking sticks" of Kay continued to hold their ground until this invention supplanted them.

It was a simple contrivance and in its day valuable. Briefly, instead of the shuttle being thrown through by one hand of the operative and caught in the other, it was projected through by a blow of the picking stick, and sent back again by a blow from the other one. Not here to dwell upon the disadvantages of this contrivance, the problem was how to pass the shuttle through the sheds of warp by an action always under control, by an actuation which should be uniform and constant, not intermittent. The difficulty was, that when to accomplish this the shuttle was permanently attached to the actuating parts of the machine, the sheds of warp, in changing position alternately from above and below, would weave this attachment along with the weft into the fabric.

It reminds one of the trials of the Chinese to make a barrel with two heads. They could easily make one with one head, but when it came to setting the other head they had to put a man inside to assist the workman on the outside, and so when the barrel was finished, there was a man inside it. It was many years before they could deliver a complete barrel without a man in.

Innumerable attempts have been made. One was known as the "compressed air" shuttle motion, which was designed to project the shuttle back and forth by the force of atmospheric elasticity; another was by means of quickly revolving rollers which caught the shuttle and expelled it from a sort of shuttle box; "clutch sticks" to pull it through, and magnets, have been tried, all without practical success. It seemed for years as though an insurmountable mechanical obstacle presented itself in the way of obtaining a positive motion, and so it remained until this invention.

It has been accomplished by means at once simple and reliable, admitting of no uncertainty of movement, and fills the conditions required of it.

Fig. 1 is a side elevation of the shuttle and carriage. Fig. 2 is a section of lay, reed, and raceway, with an end view of shuttle and carriage. Referring to fig. 1, the carriage, O, rests on the track, *l*, inside the raceway (not shown), the sides of which are even with the top of the carriage. Immediately over the top of both carriage and raceway, at right angles to them, is stretched the lower shed of warp, passing through the open space between the carriage and the shuttle, *pp*. The carriage propelled by the band, *uu*, in either direction, moves across under the shed of warps, while the shuttle resting on the carriage moves with it over the shed of warps. To prevent the shuttle jumping off its carriage, it is held down by the rollers, 5, 5, which plays against a track above, W, shown in Fig. 2, passing along the upper side of the upper shed of warps. This prevents it rising sufficiently to permit roller 4 to pass over roller 3, and escape from the carriage. The inclosed position of the rollers, 4, 4, between rollers, 3, 3, imparts the motion of the carriage to the shuttle, while the play allowed, amounting to something more that the thickness of a thread of warps, admits of the warp passing through where the rollers are in contact. The revolution of the rollers as indicated by the arrows, which motion is derived from the track, facilitates the passage of warp between them as the carriage moves forward. Friction is thus almost entirely removed.

The mechanism may not be inaptly illustrated by the circus-rider standing on the back of his horse, and leaping over the ribbons as his horse runs. The horse represents the carriage, the ribbons the lower shed of warp, while the weight of the man really represents the upper rail keeping him down. The rider is the shuttle passing over the warp, while the horse, without absolute connection, carries him forward. The purchase which the shuttle gets from the carriage is the same, mathematically, which the man gets from the horse.

To enumerate some of the defects of the picking staff shuttle will be equivalent to describing the merits of the Lyall machine, for it absolutely removes the objectionable features of the former, and has in fact supplanted it. The friction of the fly-shuttle on the warp is sufficient to materially injure the threads and cause them to break. This is also frequently the consequence of the uncertain and unguided direction of the "projectile," as it has properly been called, plunging into the warp and snapping the threads. The irregular indentation of the leather due to the constant hammering often gives a wrong inclination, causing the shuttle to be deflected from its mark, and it goes anywhere at random.

Its eccentric conduct can frequently not be accounted for or remedied for days, and the weavers say it has the devil in it. Sometimes the blow is not strong enough, and it stops short of the requisite distance; and, again, too strong, when it recoils from the opposite pick. This results in an irregular tension on the weft and a consequent defective selvage and irregularity in the texture. It must be borne in mind that every breakage costs time, which is money, and more money for repairs, as well as every defect or irregularity in the goods costs in the reduction of market price.

However useful in its day, it is now necessary that the most essential movement of a machine should be almost entirely independent and out of control in its action, while the other parts go on with the reliability of mechanism. Consequently, if it stops midway in the loom, the other parts move on, and then comes a "smash" and consequent suspension of work and expense.

It is a wayward sort of thing, and we need enumerate its short comings only so far as to say that it is irregular in its motion and violent in its action. Sudden and violent mechanical movements have always been abandoned in all classes of machinery so soon as a more regular and positive means has been discovered which would perform even an equivalent of duty.

Let us now consider the positive merits of the positive motion loom. As a rule, substituting machine work for human skill secures a more perfect product. The machine does not tire nor lapse, and the fabric is more uniform than the best handcraft could make it. These advantages are all here secured. But the enormous strides they have made, and are still making, in improving the loom and its products, can only be properly comprehended by personally inspecting the works of the firm. No written description can more than suggest it. The saving of labor is apparent at a glance. One girl can now run ten looms, that is, two looms of five webs each, that is, the work of ten weavers, and on cloth of a width which formerly could not have been made on any loom in the world.

Indeed, the possible width is practically unlimited with a positive motion shuttle. The uniformity and steadiness of its action naturally produces uniformity and perfectness in the fabric.

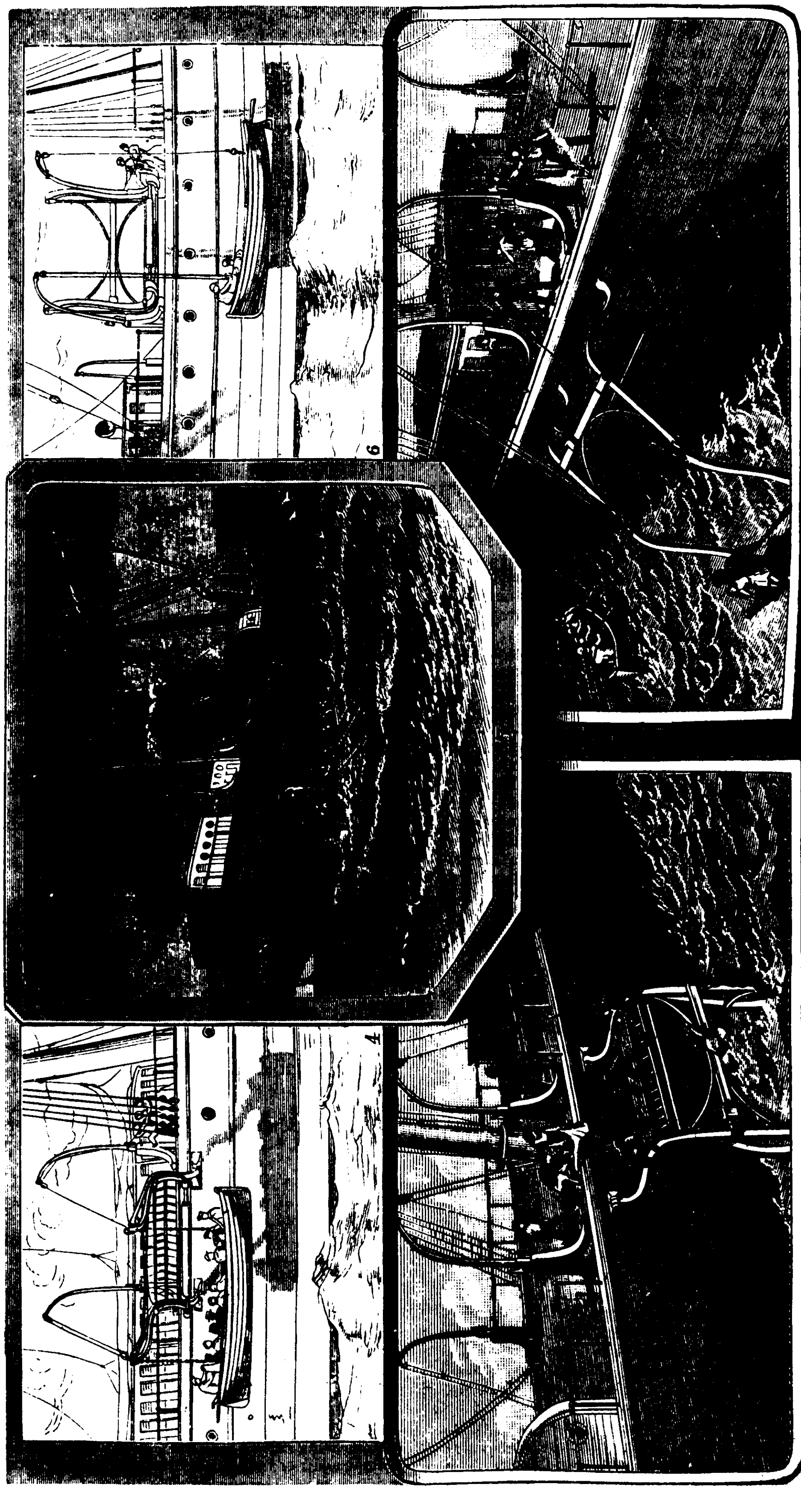
It further admits of the use of a much larger "cop" of thread for the weft. And here, again, is a very great advantage. Every "stop," for the purpose of renewing the cop, involves a defect in the fabric, for it is impossible to start the machine with a new weft without, for one cause and another, the new thread being noticeable in the cloth.

Hence, the fewer the stops the fewer the defects in the cloth. This machine carrying a cop six times as long as formerly was possible, calls for only one stop in six of what was formerly necessary. These two advantages, referring to quantity and quality, are alone sufficient to make the fame of any machine.

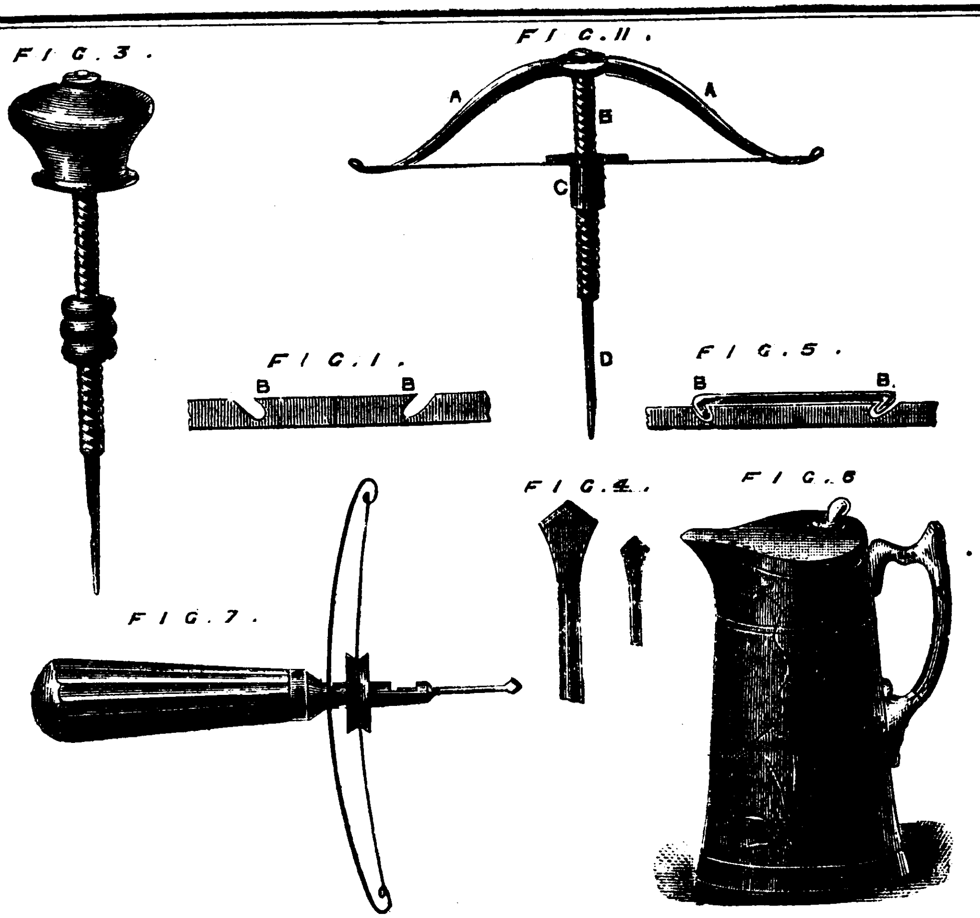
To understate it, the advantage secured is ten to one in quantity, and six to one in quality.

At the risk of repetition, we will conclude by briefly enumerating the advantages secured by it:

The striking features of the loom is that the picking stick, heretofore of universal use, is entirely dispensed with. The shuttle being drawn through the warps, is, with all other parts of the machine, held, controlled and acted upon by a direct and continuous connection with the motive power; hence the liability of a "smash" is removed, and no injury can happen the reed. In case of the loom being stopped during the pas-



EARLE'S BOAT LOWERING AND RAISING AND LIFE SAVING APPARATUS.




RIVETING CHINA AND GLASS.

sage of the shuttle, or at any other time, each part is in place for starting again.

The advantages may be briefly enumerated:

1. The unlimited scope of the shuttle: is being drawn instead of knocked through the warps, enables the carrying of large quantities of weft any distance; which being kept at a uniform tension until it is beat gives a perfect selvage.

2. The friction of the shuttle on the yarn is perfectly overcome, therefore it does not wear the warps, nor break any threads, even in the finest fabrics of silk, wool, cotton or linen.

3. The weft is not subject to sudden pulls in starting, and may be of the most delicate texture, regardless of the width of the fabric.

4. The loom can easily be arranged to run a number of shuttles, weaving as many widths of cloth as there are shuttles, and with perfect selvage.

5. The width of the fabric may be extended indefinitely.

6. The loom runs with less power, much more quietly than others, and at any speed desirable.

7. The great desideratum is, that it dispenses with the necessity for the skilled labor heretofore required, enables the weaving of very wide goods at no greater cost per square yard than that of narrow, and on ordinary cotton and woolen fabrics gives a large gain.

The looms are now running in a number of the largest and most important mills in this country and giving great satisfaction, and for Jacquard irregular and heavy sleyed fabrics it is indispensable.

Their four-piece loom is arranged with head motion, for from 4 to 12 harnesses for seamless bags, jeans, crash, toweling, ticking, duck, canvas, hose, etc. They build the above loom to weave from 2 to 6 webs in each loom up to 36 inches wide. Using the large cops or bobbins (which are 4 to 10 times larger than those used in other looms) a girl can run two looms 5 webs each, equal to 10 ordinary looms. It has positive take-up for a large roll of cloth 20 inches in diameter; wrought iron crank shaft, tension or friction let-off, geared for any number of picks per inch, and beam heads from 18 to 24 inches in diameter, and stop motion for each web; harnesses are also arranged to work from cams, 2, 3, or 4 harnesses. These looms are used for sheetings, quilts and blankets, 2 webs in each looms, 80 to 100 inches wide, and are arranged for "Jacquard" when required. They also manufacture cop-winding, spool-winding and cop-compressing machines, of similar ingenuity and value.—*Scientific American*

## RIVETING CHINA AND GLASS.

It has always appeared to me that an unnecessarily large number of rivets are invariably put in the broken articles by the itinerant menders who perambulate the country. It may be that the workman has an eye to getting as much as possible out of the job, or he is led away by a desire to make the article as strong as possible. It is charitable to allow that the latter is the correct supposition. Anyhow, I think for all ordinary requirements, a few well disposed rivets are quite as efficient as a large number crowded together in an unsightly manner. For a simple crack two or three rivets are ample. A compound fracture necessarily requires an increased number of rivets. There is no great beauty in a rivet at any time, so no more should be used than are absolutely necessary to hold the parts together, and give such strength as the nature of the article and its uses require. Again, the size of the rivet should be proportionate to that of the article under repair. Obviously, such slight and delicately-formed articles as are found in some tea and coffee services, should not be fitted with such large rivets as would be necessary to hold together a punch-bowl or soup-tureen. Yet it is no uncommon thing to see the same sized wire used indiscriminately. The drills and wire should in all cases be consistent with the job. The term riveting is, to my mind rather misleading, as, in fact, the mending is not riveting at all in its generally understood sense, because the holes are seldom or never drilled right through and the wire hammered over. The holes are drilled only partly through, as in Fig. 1, and at an acute angle, as will be seen in the drawing. The purpose of this will be evident, as by reason of the rivet-ends undersetting in the hole, the possibility of the rivet working out is almost nil. The drill should by preference be a diamond, mounted up as in Fig. 2, or in a somewhat similar manner. The diamond being soldered into a metal tube, slightly coned in shape, as at D. The top part A is a flexible spring, fitted with a drilled collar. The screw B is free to move, when acted upon by socket C, by moving which up and down, the part B is revolved, together with the drill. A common form of drill is represented in Fig. 3. This, I think, is known by the name "Archimedean." It is not so useful a form of drill as the other, because both hands are needed to work it, unless the handle is held against the breast. With the other form of drill one hand is at liberty to guide the drill and hold the article. In drilling, a finger should be placed at the spot operated upon, for the purpose of feeling when the drill-point is nearly through. Its approach will be known by a perceptible warmth and vibration (If I may so term it). It should not be allowed to come through or even to chip the enamel. Although a diamond drill is almost a necessity for this kind of work, it may be done by a properly shaped and tempered steel drill, when assisted by a little spirit of turps as a lubricant. The cutting edges of the drill should slope in opposite directions, two facets only, as in Fig. 4, representing two sized drills. In starting the holes the drill may be guided by the fingers, or a piece of metal with a hole in may be held down in position as a guide for it. The wire used for riveting should be of brass or copper, well tempered and accurately shaped and fitted. The rivets should have a little spring, so as to catch under the holes on the inner sides, as at B, Figs. 1 and 5. The rivet faces should be filed flat, so as to set close. For cement, use a little white lead or well made putty, and force it firmly into the cavity, after the rivet is set in its place.

It will be found of great advantage in repairing a compound breakage and materially add to its strength if a little transparent cement, made of acetic acid and isinglass, is applied to the edges of the china before the final job of riveting; or, if time will allow, the broken parts should be firmly attached to each other an hour or two previously. The parts should all be perfectly clean, and be slightly warmed before applying the cement. If they are not heated, the cement gets cooled, and, instead of adhering, forms a hard, loose skin-like substance, which prevents a close fit, and is perfectly useless in its place.

The parts can be effectually and safely heated by immersing them in hot water, and wiping dry on the removal. The job should be done quickly, and the parts brought together immediately the hot cement has been applied, as it sets quickly. All that exudes can be removed when cold. Fig. 6 shows an article much broken which has been strongly mended and made thoroughly useful again, with a comparatively small number of rivets. Fig. 7 shows a very handy form of bow drill, the handle of which contains the drills not in use, the end of it unscrewing. The socket of the drill is keyed into the handle, and revolves with the bow and wheel. For very large articles this form is exceedingly useful, as it can be held in any position. Glass goods are mended in a precisely similar way to china, extra care only being needed on account of the brittleness and thinness of the articles generally. Stems of wine glasses may easily be joined together by melting the broken ends in a clear gas or other flame, and pressing together when perfectly plastic. The blowpipe will assist in getting the heat up. Glass is such a slow conductor of heat that no fear of burning the fingers need be entertained, unless the worker is an immoderate time at the job, so that the parts can be held by the fingers without danger to them. When mending glass goods in this way, the surrounding air should be kept perfectly still, and all possibility of a sudden draught of cold air falling upon the heated glass guarded against. A draught of cold air upon the junction would prove fatal to it. The stem can be set upright while the glass is soft. Let all cool gradually.—*Eng. Mechanic.*

## IMPROVED BOAT-LOWERING APPARATUS.

The necessity of an efficient boat-lowering apparatus must have been impressed upon any one who has from time to time read of marine disasters, in which the loss of life has been doubled by the imperfection or disarrangement of the boat lowering apparatus. In fact, it may be said that too frequently the sole cause of loss in such cases is the lack of proper appliances of this character.

We give below an engraving of a new apparatus for lowering and raising boats, recently patented in this country, also in Canada, England, France and Germany, by Mr. R. H. Earle, of St. Johns, Newfoundland. In the engraving Fig. 1 shows the boats being lowered. Fig. 2 shows the davit in use as a life ladder resting against the ship's side. Fig. 3 shows the davit with the cradle detached, containing a man who is in the act of picking up a child. The davit is shown lifting a boat full of people in Fig. 4. Fig. 5 shows the davit acting as a spar keeping the boat from the ship's side, and taking persons on board during a storm; and Fig. 6 shows the appliance in use as an ordinary davit.

This apparatus, while very simple in its construction and easily operated, performing all the functions of the ordinary davits, is at the same time efficient in so many other ways as to place it at the head of devices of its class.

It is a very much needed invention, and its adoption will undoubtedly be the means of saving thousands of lives not only at sea but wherever boats are used. The inventor informs us that expert sea captains who have examined this appliance assert that every boat on a ship fitted with this device could be filled with passengers and lowered within from one to two minutes from the time of the occurrence of the accident.

This apparatus is not only wonderfully rapid in its operation, but it guarantees absolute safety to the passengers. After launching the ordinary ship's boat the life rafts may be lowered, or if the ship is so fortunate as to be equipped with the well known collapsible boats invented by E. L. Berthon, M.A., of England, these boats could be readily placed in the cradle, filled with passengers, and quickly launched, thereby saving many lives that would otherwise be lost.

The preparations necessary to lower the boat with this apparatus are exceedingly simple. When an accident occurs the covering attached to the boat is thrown off, when the passengers take their seat, and all is ready. Then the levers which hold the boat and the lowering appliance rigidly to the deck are instantly unloosed, and the boat is immediately lowered to the water. Clearing the decks thus quickly quells excitement and gives assurance of safety to passengers, enabling the officers of the ship to maintain order and discipline, a thing of rare occurrence when the ordinary and tardy means of boat lowering are employed.

The dashing of the boats against the ship's side, lowering one end of the boat before the other, jumping into boats, the cutting of the boat's ropes by sailors and rowing away without passengers, are all impossible where this improved appliance is employed.

In this improved system of boat lowering a great saving in labor is effected. With the ordinary plan it requires ten to fifteen persons to lower and attend to each life-boat; in the new apparatus no lifting is required, and four or five persons are sufficient to the task. This is extremely important, especially in the case of steamers, where comparatively few men are employed.

For military transport, where rapidity, safety, and secrecy are indispensable, this invention will prove of great value. And in times of collision the swinging davits will be of inestimable value.

Further information in regard to this invention may be obtained by addressing R. H. Earle, 216 Water street, St. Johns, Newfoundland, or Earle, P. O. box 1177, New York city.—*Scientific American.*

A Small Ice Machine.—An ice machine suitable for private houses, especially in India and the Colonies, or for steamers, ambulances, and so on, has been devised by M. Raoul Pictet on the principle of his larger machine. It is capable of producing 2 lbs of ice in 15 minutes, or about 10 lbs. per hour, with an expenditure of less than a horse-power of energy. It consists of a compression pump actuated by the motor employed to yield the power; a freezer surrounding the cylinder of the pump; and another in which are placed the vessels containing the water to be frozen. These parts are all grouped into a machine standing about 4 feet high and 18 inches square. The process is as follows:—Sulphuric anhydride is placed in the feezer around the cylinder, and on working the pump the evaporation absorbs a large quantity of heat from a well of glycerine constituting the freezer by which the water to be frozen is surrounded. The sulphuric anhydride is carried by the pump into a condenser where it is liquified, and in the act yields up a certain quantity of heat. The condenser is kept cool by the circulation of water.—*Engineering.*

# Miscellaneous.

## LONGEVITY AS A MEASURE OF HAPPINESS.

During his last expedition to Central Asia, Professor Vambéry managed to interview the Emir of Samarcand—a sort of Mohammedan prince-cardinal and primate of the Eastern Sunnites. As Imam of the local lyceum, the Emir appeared to take a natural interest in the progress of European science, but when his guest expatiated on the material prosperity of the Western Giaours, he interrupted him with a less expected question.

"The happiest people on earth, you call them? What age do they generally attain to?" Vambéry seems to have returned an evasive reply, though he admits that the query was not altogether irrelevant—at least from the stand-point of an Oriental who values existence for its own sake. But, even in the less unpretending West, longevity is not a bad criterion of happiness. Misfortune kills; nature takes care to shorten a life of misery—for reasons of her own, too, for, in a somewhat recondite (but here essential) sense, the survival of the happiest is also the survival of the fittest. The progress of knowledge tends to circumscribe the realm of accident and with it the belief in the existence of unmerited evils. In spite of pre-natal influences and unprecalculable mishaps, the management of the individual is the most important factor in the sum total of weal or woe. If we could see ourselves as Omniscience sees us, we would probably recognize our worst troubles as the work of our own hands; and we thus recognize them now with sufficient clearness to be half ashamed of them. Most men now-a-days dislike to confess their bad luck. We have ceased to ascribe diseases to the malice of capricious demons, and even in Spain the commander of a beaten army would hesitate to plead astrological excuses. Polycrates held that a plucky man can bias the stars, and the popular worship of success may be founded on an instinctive perception of a similar truth. Sultan Achmed went too far in his habit of strangling his defeated pashas, but the world in general agrees with him that there must be something wrong about a generally unsuccessful man. After two or three decided defeats, the partisans of a popular leader will give him up for lost, and after a series of disasters the damaged man himself generally begins to share their opinion and lose heart, or, as the ancients expressed it, admits the decree of fate—that is, his own inability to prevail in the struggle for existence; and it is curious how swiftly a physical collapse often follows upon such a giving way of the moral supports. The storms of every political, social and financial crisis extinguish hundreds of life-flames; lost hope is a fatal (though a silent and sometimes an unconfessed and unsuspected) disease. Good luck, on the other hand, tends to prolong life; the longevity of pensioners and sinecurists is almost proverbial, and there men who continue to live in defiance of all biological probabilies, merely because existence somehow or other has become desirable, as a liberal supply of external oxygen will nourish a lamp in default of the inner oil. At the beginning of the Franco-Prussian war, King William and his chancellor and staff-officers were already gray-headed veterans, and it is no accident that they are nearly all alive yet; while nearly all the ministers and marshals of the exploded empire have followed their leader—"weary of life and tired of buttoning and unbuttoning," as a captain of H. M. S. explained his suicide.—*Manufacturer and Builder.*

## THE CHANNEL TUNNEL.

Work on the tunnel between England and France, begun at a point near Dover, is steadily progressing. The depth of the shaft, which is a pit 9 or 10 feet in diameter, is about 160 feet, the bottom being about 100 feet below the level of low water. Very little water makes its way through the crevices between the planks with which the shaft is lined, the moisture trickling down all coming from near the surface. At the bottom and within the tunnel, apparently throughout its length, the hard, homogeneous gray chalk was found to be quite dry, and no signs appear even of such inconsiderable springs as are tapped in the fissures of the corresponding strata on the French coast at Sangatte. The tunnel has been driven beneath the seaward base of Shakespeare's Cliff—that is, in an easterly direction, towards the head of the Admiralty Pier, for a distance of over 1,100 yards, or nearly two-thirds of a mile, with a slope downward of 1 foot in 80, the furthest point where the boring is now going on being about 140 feet below the level of the sea. The shaft is approximately two miles from the head of the Admiralty Pier, and when the tunnel has been carried about half the distance or a mile from the shaft, a bend will be made towards the French shore. At the eastern end of the tunnel through the cliff, perhaps three-quarters of a mile from the shaft hitherto spoken of, another shaft, called No. 3, is being sunk. Here, when the works have made a little more progress, will be the engines for pumping the air into the tunnel, and for pumping out the water which always finds its way into tunnels of any great length. This point, it will be observed, is commanded by the heavy gun at the head of the Admiralty Pier and by the guns on the land fortifications. At the end of the tunnel a Beaumont cutting machine is at work. The length of this machine from the borer to the tail end is about 33 feet. Its work is done by the cutting action of short steel cutters fixed in two revolving arms, seven cutters in each, the upper portion of the frame in which the borer is fixed moving forward five-16ths of an inch with every complete revolution of the cutters. In this way a thin paring from the whole face of the chalk in front is cut away with every turn of the borer, and a circular tunnel is formed having a diameter of 7 feet. A man in front shovels the crumbled débris into small buckets, which, traveling on an endless band, shoot the dirt into a "skip" tended by another man. The skip, when filled, is run along a tramway to the mouth of the shaft. At present these trolleys, each holding about one-third of a cubic yard, are drawn by men, but before long it is expected that small compressed air engines will be used for traction. The rate of progress made with the machine is about 100 yards per week, but Colonel Beaumont anticipates no difficulty in making the machine cut its way at the rate of three-eighths of an inch per revolution, and getting five revolutions per minute, which would give a rate of advance of two inches per minute.

A very important question has been raised with regard to the supply of compressed air. Carried in 4-inch pipes, it now reaches the machine with a pressure of about 20 pounds, the pressure at the compressor at the shaft mouth being from 30 to 35 pounds; but by increasing the diameter of the supply-pipe to 8 inches the loss of working value by friction would be greatly diminished, if not rendered inappreciable. The liberated and expanded air given off by the machine serves to ventilate the tunnel sufficiently at present for the workers, and one advantage which it is held would be gained by the use of compressed air engines, is that the pure sea air compressed at the surface would be given off, when it had done its work in driving the engine, in more than sufficient quantity to supply the fresh oxygen required by the travelers in a train. Each engine, being charged with 1,200 cubic feet of air at a pressure of 70 atmospheres, or the equivalent of over 80,000 cubic feet of free air, would, argues the inventor, while traveling at the rate of 30 miles an hour, and giving out 4,000 cubic feet per mile, supply 2,000 cubic feet of fresh air per minute.

The work in the tunnel is carried on by the light of Swan's incandescent lamps, the electricity being generated by Siemens' machines.—*Manuf. and Builder.*

## DESIGN FOR A DOUBLE COTTAGE.

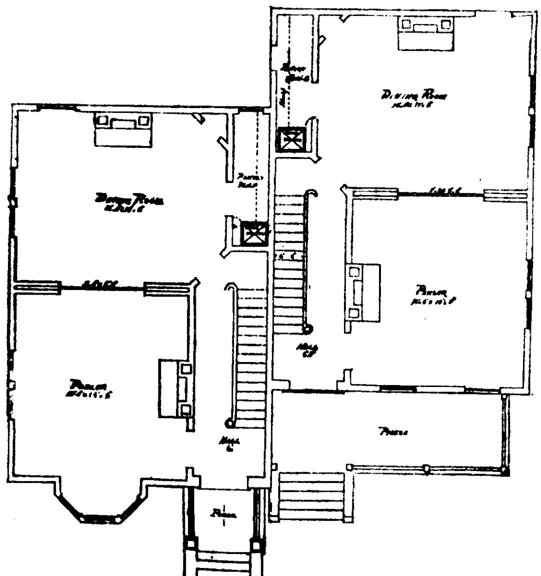
Our architectural illustration this month is for a double cottage, intended for occupation by two families. The whole structure is so arranged as to look like one building, thus making quite a pretentious villa, being a decided improvement on the plan of building two alike side by side, and also being somewhat cheaper than building two separate ones. Building village houses in pairs has not only an advantage in cost, but secures more room on the usually somewhat limited lots, and a better appearance generally, consequently enhancing the value of the property. Three houses can be arranged together also with advantrge.

The arrangement of the apartments, which is a very convenient one, is so well shown on the plans that explanation is unnecessary.

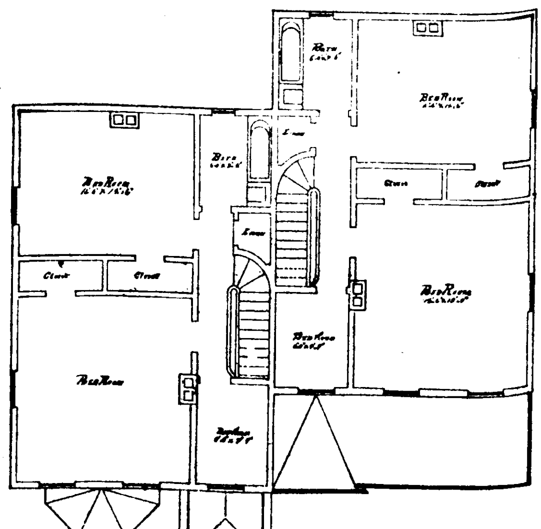
The estimated cost of erection of this twin cottage is about $5,000. It can be built, if desired, at a less cost. The same house, thoroughly built in a good locality, would be a desirable residence for a prosperous merchant.

The plan is by J. A. Wood, architect, of 240 Broadway, New York, the architect of E. B. Sutton's park and cottages at Babylon, L. I., and deer range at Islip, where one of the most complete farm houses in the country is just being completed.—*Manufacturer and Builder.*

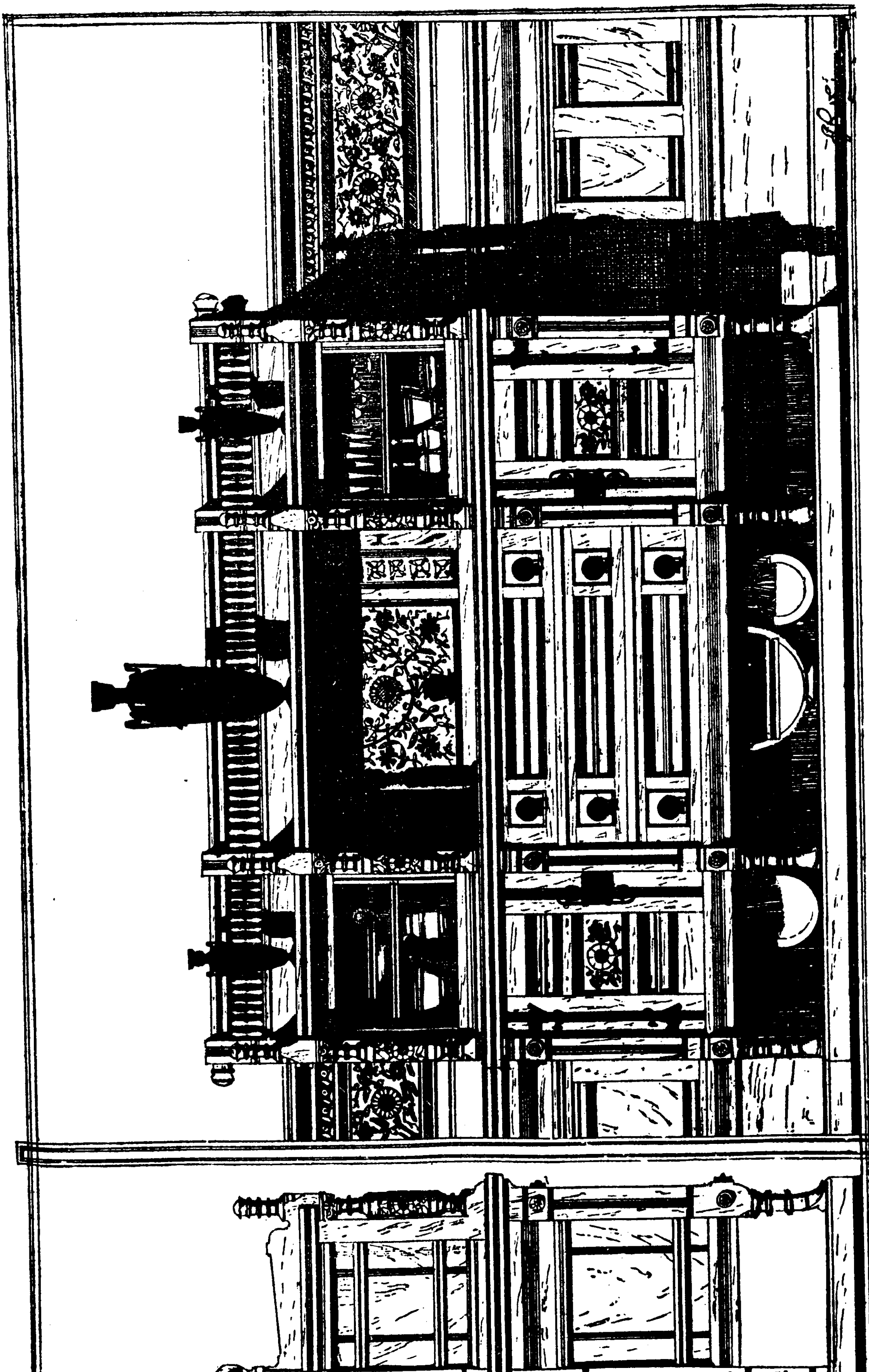
DESIGN FOR A DOUBLE COTTAGE, COSTING $5,000.



FIRST-FLOOR PLAN.



SECOND-FLOOR PLAN.



SIDEBOARD.—From a Design by J. Ph. Rinn, Architect, Boston. (Details of this will appear next month.)

# Cabinet Making.

## SIZING AND GILDING WOOD.

Take a pound of parchment cuttings, or of the leather used by glovers, or old white kid gloves cut small; place in six quarts of water and boil until reduced to two quarts, or until the fluid becomes a firm jelly on cooling, which may be determined by dropping a little on a cold stone; strain this while hot through a flannel, and it will then be ready for use. This is called priming size, and is used not only as a cement to bind the gold to the groundwork, but also as a priming. The next thing is to prepare the work. This is done by rubbing the work you are about to gild with fish-skin and Dutch rushes, excepting those parts that are sharp and fine, which it would be liable to injure. Then prime the whole with warm priming size, mixed with as much dry, finely-powdered whiting as will give it a good body of color, taking care not to get it too stiff, and stirring all the time. Repeat this several times, working it well into the hollows of the carved work. After the last coat is applied and before it is quite dry, pass a camel's hair pencil, wet with water, over the whole, to remove any inequalities. A water-polish should now be given to the parts that are to be burnished, by rubbing them gently with a fine linen rag wet with water.

The work being now prepared, it most be covered with two or three coats of gilding size, which prepare as follows: Bole ammoniac, in fine powder 1 lb.; black lead, 2 oz.; mix them well by grinding, and then add 2 oz. of olive oil and 1 oz. of beeswax, melted together; then repeat the grinding until all is well mixed. When required for use dilute with warm size, mixed with two-thirds of water. While warm spread with a brush over the whole of the work and then allow to dry; recoat in this manner twice. When repeating this process for the last time, rub with a soft cloth, until perfectly smooth, and even in those parts which require to be burnished. Some mix a little vermilion in the size, to give a depth of color to those parts where the gold leaf cannot be laid in easily. The work being now ready for gilding, place it a perpendicular form, and have the gilding size, brushes, cushion knife, etc., by your side, together with a basin of clean water. Wet the uppermost part by means of a large camel's-hair pencil, dipped in the water, and then lay the gold leaf on the part so wet, in the same manner as in oil gilding—*i. e.*, from the book—until the part is covered, or too dry to take the gold, and repeat the process until the whole is finished, taking care that is of a uniform thickness. Avoid as much as possible wetting the perfect gilding, as it is likely to cause it to turn black. If any of the hollow parts require it, they should be matted when the work is dry. This process consists in grinding a little vermilion with white of egg and red lead, or yellow ochre and red lead mixed wfth parchment size, or the terra di sienna, slightly burnt and mixed with a very small proportion of red lead, and applied with a camel's hair pencil. It has an excellent effect. After the work has been gilt about twenty-four hours you may proceed to burnish those parts that require it. This is done by polishing with a dog's tooth or agate burnisher. First, be particular in ascertaining if the work is in a proper state for the purpose, by rubbing it with the tooth in several parts, and if it takes the polish well without the gold peeling off it is ready. If the gold does not polish after much labor, it is too dry, and should be cleansed to moisten it. After gilding do not place it in a draught or near a fire.—*American Cabinet Maker.*

## IDLERS AS INVENTORS.

It is popularly supposed that, in order to invent a machine for any particular purpose, one must be an expert in the particular business for which the machine is designed. To a certain extent this belief is correct, but it somehow happens that many of the most valuable inventions have been brought out by persons who had no practical experience whatever in the use of the machinery appertaining to the business for which their inventions are designed. It is not denied that many of our most valuable inventions are the works of mechanics and operatives of machinery; but it is asserted that a great many valuable inventions have been brought out by men who had no pratical experience either as mechanics or operatives in the line of their inventions. It frequently happens that persons who have no special knowledge of machinery, when looking at the performance of some engine or other machine, discover a chance for improvement and drop suddenly into the highway to fortune.

The writer has just had an interview with a young man recently graduated at a medical college. His mind is not on pills or amputations; but he fancies he can see opportunities for improvements all around him, and he is now developing several important railway inventions, a sheet music turner, and several other devices not in any manner connected with his chosen profession. One would suppose that his inventive genius would turn to surgical and dental instruments, artificial limbs, etc.; but he, like thousands of others, leaves his chosen path, seemingly led astray by some invisible power over which he has no control. A man with no calling or profession is usually styled a "loafer;" yet many valuable inventions have been produced by such men.

One of the greatest inventions the world has even seen was whittled out by an idler in a few minutes. He caught the idea by seeing a man trying to get an implement repaired. He saw the affair was imperfect, improved it, and revolutionized the world in its most important industry. He was no longer called a loafer, and although long deceased, he is now, and will be as long as the world exists, regarded as one of the greatest inventors ever known. It is by no means meant that all inventors are men of no steady occupation; but it is an undeniable fact that many of out most valuable inventions are from the brains of men who were considered as idlers and of no account.

This is not mentioned here to cast any reflections on inventors as a class; for it is well understood that we are wholly indebted to them for the wonderful progress the world has made and is making, but to encourage that class who have no faith or confidence in their inventive abilities and therefore make no efforts. In many communities the man who gives his time to perfecting some device is styled a "good for nothing;" but when he finds himself successful his old acquaintances are pleased to know him. It will be seen that our inventors range from millionaires down to loafers, or rather *vice versa.* Perhaps the term "loafer" is hardly appropriate; but as there are so many of them who ultimately take their places in the ranks of the industrious and wealthy, some allowance may be made for the seeming slur on a very worthy class of people.

The mechanic who has to win bread for himself and family has hardly time to devote to inventing; but the idle man who has nothing to do, if he keeps his eyes open, carries off the prize in many instances. But there are many who have an idea that they cannot invent because they are not possessed of means to develop their ideas. They look ahead to those who have been successful and say, "They have been lucky, and have means to handle their inventions, while I am without a dollar and can do nothing." Most of our successful inventors have been those who had no means in the shape of cash, but they had its substitute—*pluck.* There are hundreds of men who might pick up some valuable ideas and work them into shape if they were possessed of the requisite pluck. It will not do to sit down and say, "I wish I could invent something." Our successful inventors were not of this stamp. This is written to encourage all who have a taste for invention to strive for a successful development of their ideas and put them in practical shape. To conclude: Our inventors are men of pluck, and may be regarded as our best citizens, even if they were once idlers.—*Scientific American.*

A Jointed Axle for Tramcars.—A tramcar axle has been recently patented by a Dane, the object of which is to allow the wheels to pass round sharp curves without grinding. For this purpose the axle is divided in the centre, the end of one-half having a hollow, and that of the other a corresponding projection, somewhat similar to a ball-and-socket joint, the necessary stiffness being given to the axle by a tube which surrounds the axle and extends between the naves of the wheel, against which it bears by gun-metal collars. At the centre, between the tube and the axle, is a gun-metal bearing, in which the axle can revolve. The wheels act in such a manner that in running along a straight line the wheels and axle turn together, as in an ordinary pair of wheels, but on passing round a curve the axle slips round in its joint, so that the wheel on the inner radius of the curve is retarded and the outer wheel accelerated in proportion to the sharpness of the curve, great smoothness being obtained in the vehicle, and less wear and tear of the tire and rail.

# Fine Arts.

## THE GEOMETRIC SLIDE-REST.

BY J. H. EVANS.

The present forms a most interesting subject for all amateur turners, inasmuch as an unending variety of patterns may be produced, some of the most beautiful character, especially those with fine lines. This instrument was invented by Capt. Padsey Dawson, a gentleman of great mechanical ability, and a very fine ornamental turner. The slide-rest was patented in 1870, but I regret to say that, owing to its being somewhat costly, the patentee was not in any way a gainer by it. As I am about now to explain the instrument, I trust it will be an incentive to some of our amateur ornamental turners to have it added to their lathe; and if they are already possessed of the spiral apparatus, it will not be, of course, such an expensive addition after all.

The invention relates to the arrangement of apparatus for producing figures, designs, and devices of an ornamental and geometrical nature upon wood, metal, and other materials, also to the employment of cams, templates, or pattern-plates in a special manner upon a lathe, which templates, etc., effect the automatic movements of the upper slide of slide-rest, and so give motion to the cutter or tool that is being used. Although this apparatus can be readily adapted to almost any lathe, it was designed more especially for such as are generally known as ornamental turning lathes.

As will be seen, the geometric slide-rest works in connection with the spiral apparatus, and it is by the different changes of the various wheels that such a vast number of patterns can be executed; for instance, if the simple eccentric cam is placed on the transverse arm, and the wheels used are 144 on chuck, 16 and 120 on double arbor, gearing into a 24 on the spindle, the effect would be quite a different thing to using the same wheel, and either reducing or increasing the eccentricity of the cam, or to use the same eccentricity and place the 144-wheels where the 120 was used, and so on. I am quite certain that it is impossible for any one ever to work out the uses of such a tool, as they are perfectly inexhaustible.

To proceed. The apparatus is made on the same principle as the ordinary slide-rest for ornamental turning, with the exception that it has two slides; the upper one carries the tool-box or holder, in which the tools, such as eccentric cutter, drill, spindle, and universal cutter are held, also, of course, the fix tool for line patters. The tool-holder being the ordinary standard size, any of the ornamental cutters, in fact, can be used with the apparatus. The top slide has two screws in the usual way, one to traverse the tool-carriage and the other to form the stop for the depth of cut. The lower slide has a spiral spring in the place of the ordinary screw, which is secured to the right-hand end by a steel pin; the other end of the spring passes through a small hole in the end of lower slide, and is kept in its place by a small nut on the end of it, and when the slide is pressed against it it oscillates from the elasticity of the spring. At the back of the tool-box, under the adjusting-screws for regulating top slide there is an arm firmly fixed to the metal part of lower slide, and at the end of this arm or lever a small steel rubber is fixed, made so as to revolve freely. This when at work acts against the edge of the various templates that are used.

On the left hand of the lower slide is a transverse slide, which moves to any part of the slide, and can be fixed with a thumb nut wherever required; this slide carries a spindle, and the end nearest the lathe-head is turned down to fit any of the change-wheels and pinions, which are held on their places by a steel nut and washer; the large wheels are filled up with a loose pad with a small hole and a large washer, just in the same way as they are used on an ordinary slide-rest.

The motion is given to the spindle by a tangent-wheel and screw when the revolving-drill is being used; but when the fixed tool is in use the motion is given by a winch-handle on the end of the spindle, and the tangent-screw, of course, thrown out of gear. On the end of the spindle opposite to that which carries the wheels a metal flange is fitted, which carries the various templates, guides, etc.

In order to make the apparatus more easily understood, I have given two or three illustrations of it, and by reference to the various figures in the drawings it will, I hope, become perfectly clear to our readers as far as its application to ornamental lathes is concerned. Figs. 1 and 2 represent a face and plan-view of it respectively, A being the mandrel-frame and B the mandrel, fitted in the usual way to hardened steel collars, H, Fig. 1, being the eccentric chuck, the only difference in this part being that I now make them with tangent wheels instead of ratchet wheels; D represents the material about to be worked upon, and is held in a cup chuck. In front of the lathe-head, Fig. 1, is seen the slide rest Z, being the shoe into which the socket of the lower slide is fitted; the slide C is planed up in the usual way, and on to it is fitted the metal slide F; this must be made to slide evenly and freely, in order to be acted upon by the spring; the slide L is also fitted to the one F, but this is actuated by a screw X for adjusting the tool to various positions and parts of the work.

The slide rest is, of course fitted to a cradle in the usual way. Letters R and U, Fig. 1, show where the radial arm is fixed, T being the nut and screw to fix it in the position required. M is the index peg, as seen in the drawing, but this, although shown, cannot be used when the apparatus is in motion, as the pulley is constantly on the move. N shows where the eccentric action is obtained for throwing the metal conductor into gear with the steel guide for screw cutting. J, K L represent the pulley; A with a star illustrates the segment apparatus.

We now come to the plan, Fig. 2, which gives a representation of the apparatus as connected to the spiral ready to work, and it will be readily understood by careful reference to it. Fig. 4 shows the metal piece J, which is fixed to the slide E, in whatever position it is wanted by the thumb nut, *i* being the spindle which passes through the same, having on the one end the metal flange B, to which is again fixed the cam H, and when deep cutting is required to be done the tangent wheel K is used in order to create a slow and more powerful motion. On the other end of the spindle *i* a nut is fitted to fix the various wheels on, the distance being made up by numerous metal washers to bring the wheels into a line with those on the radial arm. Referring to Fig. 2, they will be seen in gear. Having so far put the apparatus together, the wood D should be surfaced over with the top slide, a fixed tool being placed in the top slide; and while this is done, it is better to put a strong tension on the spring, and place the fluting stop P against the end of the slide. When the work is surfaced, over the stop P may be removed and the cam H brought to bear against the small steel roll on the arm *g*. We will take as a beginning the plain eccentric as a cam, and if this is set out to about ¾ eccentricity, and one whole revolution of the tangent wheel taken, the action of the whole apparatus will immediately display itself, inasmuch as it will be clearly seen that, while the mandrel is making its revolution, the tool slide is moved backwards and forwards by the cam bearing against the projecting arm G. Very beautiful patterns are thus produced, and as I have before said, the variety is unending. The cams that up to the present time have been most used are the plain eccentric, the ellipse—two of which placed across one another produce most beautiful effects — and the heart shape. I have worked considerably at these, and find that I can get a different production at almost every move; and that one of the most difficult things to obtain is a reproduction of any particular pattern, unless the settings are most accurately taken—that is, the exact wheels, precise amount of eccentricity of the cam, and the adjustment of slide of eccentric chuck, if it used. Fig. 3 shows a face view, the dotted lines giving the position of radial arm and wheels in gear, also the heart shape cam. When only very fine line patterns are required, the tangent wheel K may be thrown out of gear, and a winch handle placed upon the end of the spindle behind the cam, and the motion obtained by it. When using the plain eccentric cam, this motion is very regular; but when such cams as have undulated edges are used, the tangent screw is quite necessary to get a smooth cut and to prevent an uneven pressure occurring through the cam slipping suddenly into a deep recess of the cam.

To cut deep mouldings round the various figures, such as 3, 4, or 5 loops, the drilling instrument O, Fig. 2, is used, and having a variety of drills fitted to it, increases its capabilities; and it is, as I say, more essentially necessary to use the tangent wheel when deed drilling is being done. The fixed tool, however, is used when fine line patterns for printing from are required, and the tool should have the under side well cleared, as the work itself has to turn sharp corners, so to speak, and if the tool is at all thick, it forces it to cut away the sharp corners of the different patterns. Another way to vary the pattern is to use the fluting stop P; when this is arranged so that the slide when brought forward by the spring butts against the stop, instead of completing its movement, the end

FIG. 1

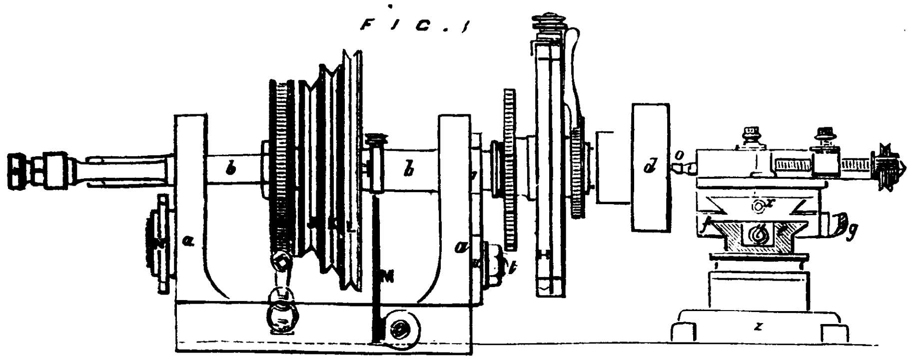


FIG. 2

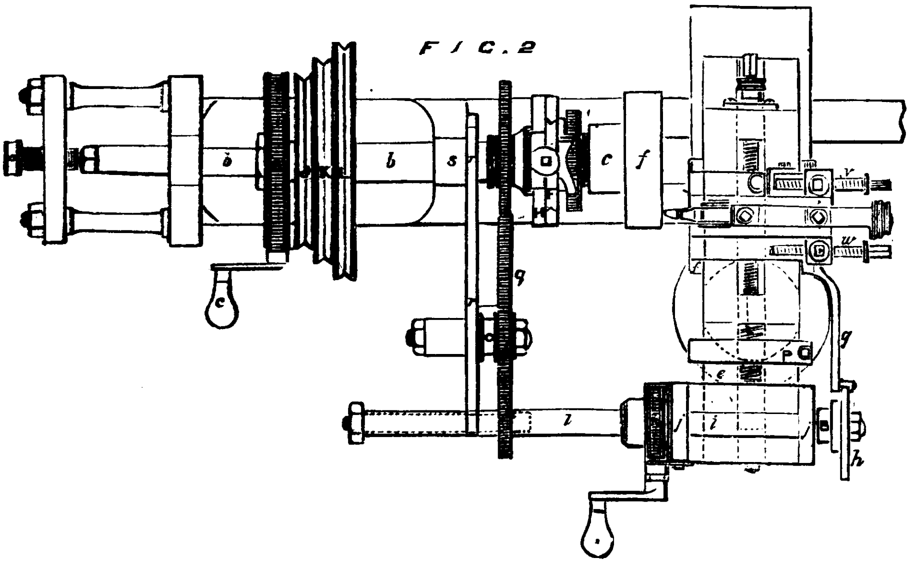


FIG. 4

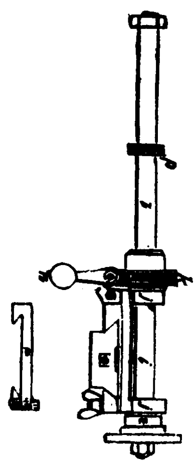
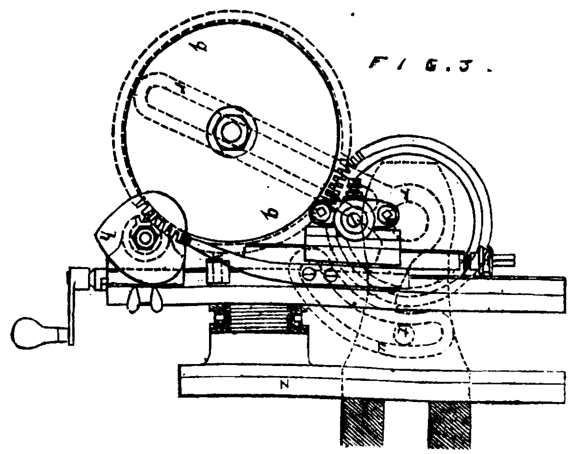


FIG. 3.



of the pattern cut becomes square, or rather of a very slight curve, according to the diameter of the pattern, but quite a different termination to what it would if the stop were removed; the top slide can also be adjusted by its screw, so that any number of cuts upon a surface may be made, each one differing from the other. If I wrote for a month upon this subject, I could tell little more, but one practical lesson would clearly illustrate what it will do; it is certainly much easier to work than the geometric chuck, and will produce an equally interesting variety of patterns. The inventor, who devoted a considerable amount of time, has, in conjunction with other apparatus, produced some most beautiful effects, and although Capt. Dawson has spent so much time upon it, I am sure he will agree with me that it is not yet half worked out. I am indebted to the Captain for my knowledge of the apparatus, and I trust that some of our readers will take advantage of it also, as it is an addition worthy of any ornamental lathe, and will afford quite as much amusement as a geometric chuck.

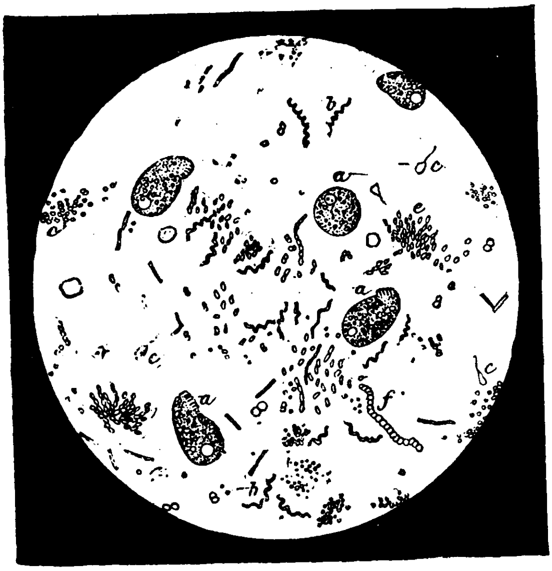


FIG. I.—ANIMALCULES IN AN INFUSION OF HAY.

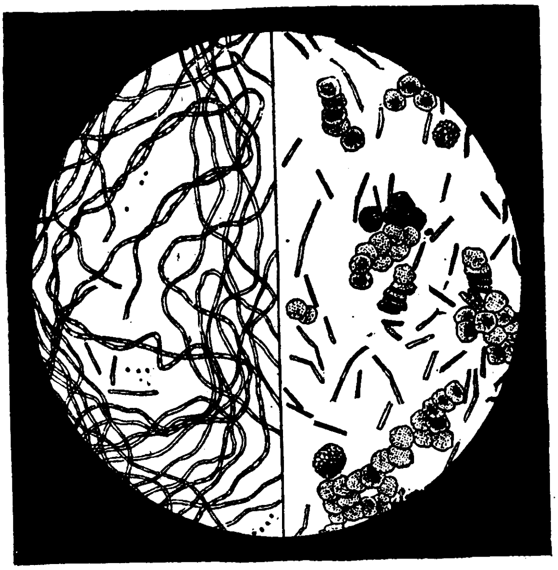


FIG. 2.—BACTERIA OF CHARBON.

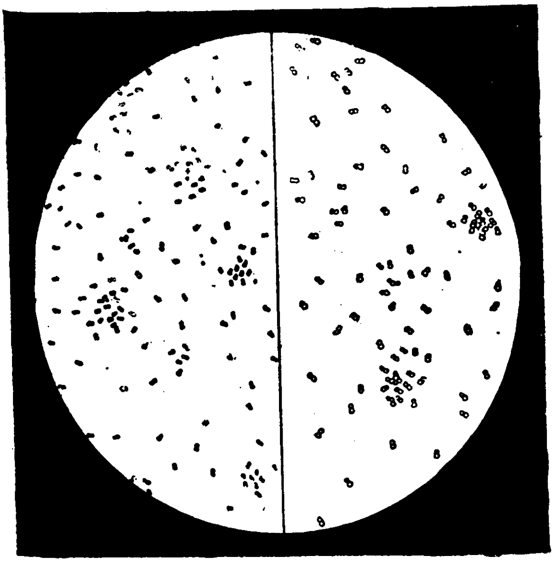


FIG. 3.—MICROBIA OF CHICKEN CHOLERA.

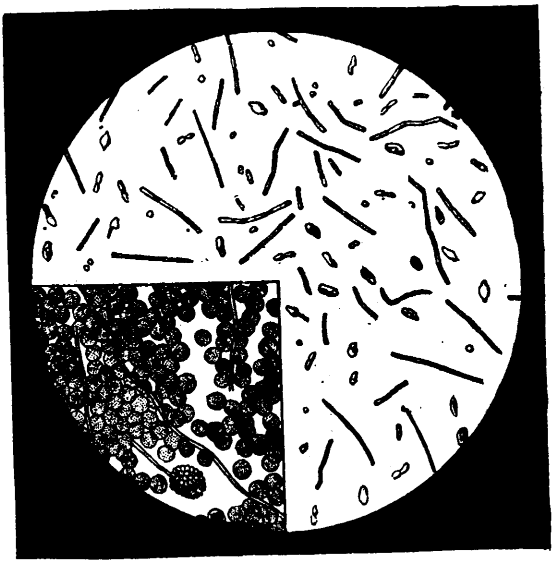


FIG. 4.—SEPTIC VIBRIOS.

## Chemistry, Physics, Technology.

### FERMENTS AND DISEASES.

"There are scourges that the human species bring upon itself and there are others that it suffers; and that it considers as being more inevitable than the former. Among the latter, epidemic diseases stand in the first rank, and to these man is accustomed to furnish unmurmuringly immense hecatombs, and it is difficult for him to imagine a world in which there is no pest, nor cholera, nor typhus, nor yellow fever, nor syphilis, nor scarlatina, nor many other diseases that I might name did I not limit my enumeration systematically to those whose contagious nature is known and accepted by all. Twenty years ago nothing at all was known about all such diseases, and, had some one taken it into his head to allege that a day would perhaps come when the human species would be rid of them, he would have been met with only a smile of incredulity or even of disdain. To-day, however, such a dream assumes shape, such a hope does not seem unrealizable, and those who do not accept it have no longer the right to consider it as foolish and to reject it with disdain."

Thus expresses himself Mr. E. Duclaux, at the beginning of the remarkable work that he has just published, under the title of "Ferments and Diseases," and in which he gives a complete *exposé* of those modern labors and doctrines of which Mr. Pasteur was the initiator. Our readers are assuredly acquainted with the principles that have been revealed to this illustrious chemist through the study of these innumerable, infinitely small, organized beings which swarm in nature, which make their appearance where the life of superior animals is extinguished, which multiply with a rapidity and fecundity that bewilders the imagination, and which appear to be the true cause of the most dreaded contagious diseases.

There is no one who has not heard speak of the bacteria of charbon, of microbiums, or of vibrios; but those infinitely small beings have not been seen under the microscope by everybody, and it has, therefore, seemed to us that it would be of interest, by making use of the beautiful plates in which Mr. Duclaux's book abounds, to present a few specimens to our readers. The annexed illustrations were drawn under the microscope, and represent magnifications of from 500 to 800 diameters.

Fig. 1 shows the organisms that appear in an organic decoction or infusion, such as that of hay or beef broth, for example exposed some time to a free contact with air. On examining a drop of the liquid by the microscope there is found in it a myriad of living beings of diverse forms, such as monads and thin corpuscles (*c*, Fig. 1), which are reproduced by fissiparism, that is to say, each of which divides through a median furrow into two beings that separate and afterwards lead an independent life. There is one species known in which the division does not take more than six or seven minutes for its accomplishment. A single individual might consequently produce more than a thousand offspring in an hour, more than a million in two hours, and in three hours more than the number of inhabitants on the globe. Alongside the monads are perceived small granules (*c* and *f*, Fig. 1), which are called *Micrococci;* and, at *a* of the same figure, there are seen infusoria of large dimensions, called *Kolpodes.* These are the beasts of prey of the microscopic world that we have just described. Their origanization is quite perfect; they have a mouth and a stomach and they live at the expense of the smaller beings which they devour; and they even possess contractile vesicles that it is manifestly impossible not to liken to a heart.

This is the world of microscopic beings that was first known, and among which was implanted that doctrine of spontaneous generation that Mr. Pasteur, through irrefutable experiments, has utterly annihilated.

We should like to follow Mr. Duclaux in the complete enumeration that he gives us of this microscopic world; but his book should be read in its entirety, for there is nothing in it that can be abridged; and, in calling attention to it, we shall content ourselves with representing a few other organisms whose role has been most studied in recent times.

In Fig. 2 we have represented, to the left, the bacteria of carbon in artificial cultures, and, to the right, the same in the blood of an animal afflicted with the disease. In Fig 3 we have the celebrated microbium of chicken cholera—a young specimen being seen to the left and an old one to the right; and, finally, in Fig. 4, we see the septic vibrio that accompanies septicæmia.

On opening the body of a dead septic animal we find therein extensive disorders, which are manifested by a general swelling. On examining by the microscope a drop of the liquid or serosity which fills the abdomen, we find therein, in multitudes, (as shown in Fig. 4), moving vibrios that are sometimes very elongated and sometimes very short. The active motions of these organisms, and their abundance, scarcely permit them to be overlooked, and there is reason for surprise that they should have escaped all scientists who occupied themselves with septic diseases before Mr. Pasteur. The refraction of the vibrio, being very near that of serum, renders it difficult to find it; but it is discovered at length, however, flexuous, crawling, and gliding along amid the globules of blood, like a serpent among dead leaves.

Such are a few of the microscopic beings, those dreaded enemies which for ages have passed unperceived, and which science has revealed. Mr. Pasteur has already triumphed over some of them—if not in causing them to disappear, at least in rendering them inoffensive. The road is for the future laid out, and, as Mr. Duclaux says, at its terminus will be found the preservation to their families and country of thousands of existences.—*La Nature.*

## IRRITATING EFFECTS OF STINGS IN THE ANIMAL AND VEGETABLE KINGDOM.

By Prof. August Vogel, of Munich.

It is well known that the effect of a stinging nettle on the skin agrees very closely with the sensation produced by the sting of a bee or wasp. But the great similarity is not limited to the feelings it causes, but, what may not be so well known, the cause of the irritation produced on the skin is essentially the same. It may be considered as definitely settled that formic acid is present in the poison sac of the bee sting, in the so-called bee poison. The same corrosive acid also occurs in the sting of the nettle. Some species of caterpillars have formic acid in some of their hairs, which they seem to be able to shake off at will, and when a person touches such a caterpillar the poison penetrates the skin wherever it is moist and causes burning, itching and inflammation. These poisonous members preserve their irritating powers even after the death of the worm. This accounts for reliable statements that visitors to collections of caterpillars have suffered from exanthematous eruptions on the neck. "Many hairy caterpillars cause itching and burning of the skin when touched, and sometimes it gives rise to swelling and redness. This depends on the fine hairs, which produce the same effect when they float around in the air. Many ladies who visited the caterpillar room of the naturalist Reaumur had a breaking out on the neck."

In the sting of the bee, wasp, hornet, etc., a minute drop of a transparent liquid may be observed on the sting and is called "bee poison" (formic acid). It penetrates into the wound produced by the sting, and causes the well known effects. It would, however, be a great mistake to assume that the only object of this is to increase the effect of the sting, that is, that it serves only to injure. It has a far more important purpose, namely, to prevent fermentation and decay. The celebrated bee cultivator, Holz, reports that in his long experience with honey, that which came from what are called "rancorous swarms" (boshalt) had peculiar properties. It always had a bitter, harsh taste, and its smell was sharp too. How can the character of the swarm effect the smell and taste of the honey they gather? We know that bees, when they are disturbed, run out their stings, on the ends of which may be seen a tiny drop. This little drop, as we have already said, is bee poison, formic acid. When the disturbance is at an end they draw in their stings again, but the little drop of liquid does not go back with it, but is wiped off on the comb, and sooner or later gets mixed up with the honey. This explains how honey from such excited bees must taste and smell sharper than from peaceable bees. Excitable bees will rub off this little drop of formic acid more frequently than other bees; perhaps a larger drop is formed by nervous bees than by those that are not nervous, and hence the honey is richer in formic acid. This acid is never absent in genuine honey, but the amount differs. This contamination is not only uninjurious but very useful, in fact necessary, for it keeps the honey from spoiling; we know, indeed, that purified honey, from which the formic acid has been removed, very soon ferments, while unpurified honey will keep unchanged for years. Nature furnishes the bees with this knowledge instinctively, and therefore they do not carry this drop of formic acid away out of the hive. Bee connoisseurs assure me that the bees add it to the nectar which they collect that is free from it so as to make it keep, and they do this in places where they are not disturbed too.

Bee stings are often spoken of in agricultural and popular papers as a remedy for rheumatic affections, and numerous cures are adduced to prove it. If the formic acid that accompanies the sting can be looked upon as the principal agent in the cure, it would be worth while to try the experiment of rubbing the spot with this acid or injecting it under the skin, so as to avoid the somewhat inconvenient method of applying live bees.

Two hundred years ago formic acid was made from the brown wood ants, by triturating them with water and distilling it. The acid liquid was used to irritate the skin. The reddening of the skin, by using baths of pine leaves, is also due to the action of the formic acid. The anti-fermentative action of formic acid has also long been recognized.

As regards the irritative action of sting nettles and other similar vegetables, it depends, as already stated, on its formic acid. The point of the nettles is brittle as glass, and by the lightest touch penetrates the skin and breaks off, pouring out its acid and causing the burning sensation.

In this little notice frequent mention has been made of formic acid. In conclusion it may be stated that it gets its name from the ant (*formica*) because it was *first* found in them. If it had been found first in the bee or nettle it would have received another name. If an ant runs over a piece of blue litmus paper he will leave a red streak. Put a stick in an ant hill and they will squirt strong acid on it.—*Humboldt.*

Deadening Sounds.—The following plan for deadening floors is reported to have been made the subject of a recent patent. It is exceedingly simple, and not materially unlike plans that have been before proposed in this journal. A 3 by 6 inch plank is directed to be inserted betweed each joist, 2 inches from the bottom of the joists, and projecting 4 inches beneath them. The ceiling boards are nailed to these intermediate planks, and the space between is filled with sawdust to within one inch of the joists.

# Scientific.

## FIELD TELEGRAPHS.

In an article on "Field Telegraph without Battery" the *Electrical Review* gives a summary of some of the principal systems in use. In certain cases, under favourable conditions, telegraph lines can be extended to the battle fields. However, notwithstanding their lightness, they cannot be moved easily enough to follow up the manœuvres, and very frequently their fragility would render their preservation a matter of difficulty in the midst of military operations. On the other hand, it would be useless to employ the telegraph at a less distance than six kilometres from the front of an army in action, because it would be quicker to send messengers, and, moreover, it could not be worked under fire. However, for communications between the main guard and sentinels and between the batteries and posts of observation, endeavours have been made to fit up light telegraphs, capable of being conveyed by a few men, and these may be called advanced-post telegraphs. Each installation contains 1 kilometre of cable, which enables lines 2 kilometres in extent to be filled up between two stations. At the time of the discovery of the telephone it was thought it was destined to take the place of these telegraphs; but the experiments during the Russian-Turkish War showed that the noise of an army almost always, except in the silence of night, prevents the voice from being heard. The most perfect instruments, however, at that time were the Siemens and the Gower. The microphone even does not amplify sounds sufficiently to render them perceptible under all conditions It requires a battery, which is cumbersome, and the necessity of a certain regulation of position in relation to the vertical is inconvenient; finally, it must be placed in a fixed stand, for it produces deep sounds when vibrations are communicated to its supports. It has therefore been rejected altogether. The telephone, it has been admitted, can be of service, and in the greater number of armies it has been added to the light telegraphs already in use. The Prussian telegraph of Bückoltz is employed by the Company of Belgian Compaigning Telegraph Operation. This apparatus has a return wire and is worked by a continuous current, that is, when there is no transmission the current passes through the line, and gears the clockwork mechanism; the signals are then produced by the interruption of the current, which throws the mechanism out of gear; consequently, directly the cable is cut the operators are aware of the fact. The instruments work together, the despatch being recorded simultaneously at the two stations. The Russian system of Derevinkine is very similar, but the earth is employed as return conductor. These are the only field telegraphs in use which give permanent signals. In America, on almost all the permanent lines, the despatches are sent by sound alone, and in campaign telegraphy it is very seldom that important orders are transmitted of which it is necessary to keep a copy. The optical systems employed are the Trouvé, which is a miniature, about the size of a watch, of an ordinary dial telegraph; the Wheatstone one-needle system employed by the Spanish army; the Prussian needle telegraph with earth battery, used in the war of 1870, the current being supplied by two pieces of zinc and copper buried in damp earth. Of the above the Trouvé is very delicate; the two others are more solid and better suited for military operations; but it is difficult to read the Morse signals indicated by a needle, and it cannot be used at night. As a sound can be heard at any time, sounders are preferable to optical instruments. The sounders adopted are—The Caton, used exclusively in the military telegraph of the United States. It is simply a magnet, the armature of which forms the sounder. It is contained in a moderately small compact case, and the battery is composed of sulphate of copper elements. The sounder of the French army is very like it but smaller in size, and a wet or reversible battery is employed. Derevinkine's Russian sounder is similar; as is also the Spanish sounder. The Trouvé sounder has the appearance of a large watch, and its accessories are the same as those of the portable telegraph by the same inventor. All these sounders have the inconvenience of requiring a somewhat powerful, and consequently cumbrous battery. At the time when it was shown by experiment that the telephone was of little use to reproduce speech of the vanguard of an army, it was found that under the influence of battery currents, and especially of the high tension currents of induction coils, this apparatus gave sounds of great intensity. When a current is sent into the circuit of a telephone the magnetism of the magnet which constitutes it varies, and the result is a variation in the action of this magnet on its diaphragm of soft iron; two different sounds are then heard, one when the current is established, the other when it ceases, and thus long emissions can be distinguished from short ones, as in the Morse sounder. In order to produce a sound of greater intensity, serving to warn the correspondent that the transmission is about to commence, the interrupted current of a little Ruhmkorff coil is employed; a continuous current can also be sent into the line, the interruptions being produced by the plate of the telephone itself by arranging it like the armature of a trembling bell. The instruments constructed according to these principles are Racagni-Guglielmini, in which the induction coil is either arranged in the handle of one of the telephones, which also contains the manipulator, or on the reversible battery, which has the form of a cartridge-box. The Mangenot is identical in principle with the preceding, but the inventor, recognising the inconvenience of this battery, proposes to substitute Clarke's machine, and in the event of its proving impracticable to hear sounds, he suggests the receiving of the same by the sense of touch, by placing the lips on the terminal of connection of the telephone. A very skilful telegraph operator in 1870 received a message in this manner by a cable across the Seine, but this feat would require no common degree of skill to perform. All these instruments have the drawback of requiring cumbrous batteries which the slightest accident would render useless. M. Mangenot proposes to substitute for this class an induction machine, which, however, is very heavy, and presents the disadvantage of requiring a man to turn the handle. The solution of the problem will be probably found in telephonic sounders without batteries. Of this class is Colonel Jacobi's telekal, which requires for its complete installation a long-distance telephone, and a case called the telekal weighing from five to seven kilos. It is furnished with a Morse manipulator, worked in the ordinary way, and by means of a little handle the manipulator can be made to ring a bell to call the correspondent; or the trumpet call with which long-distanced telephones are commonly supplied can be used. The telekal, however, is clearly both heavy and bulky, and we have still to look for some apparatus which should offer the like advantages, but with less weight and bulk. The magneto-sounder constructed by Richez of Brussels, has much promise. The apparatus only weighs 200 grammes more than the magnet which forms part of it, or 750 grammes in all; it can be contained in a box about a foot long. In order to use it a terminal is connected to the line and to one of the poles of a Bell Telephone, the other pole being connected to earth. When used in active service the magneto-sounder is suspended on the breast by a strap, and the hilt of a sword stuck into the damp soil forms an earth. The operator then works with his right hand, as with the Morse, and applies the telephone to his ear with his left hand. The new apparatus can be, it is said, substituted for the Morse sounder in all its applications. It has the advantages of being very light, of not requiring any battery, and of being very sensitive. Finally it comprises a telephone which can be used in the ordinary manner. An account of this instrument has been published in the *Revue Belge de Technologie Militaire*, by Lieut. Wissenbruch.

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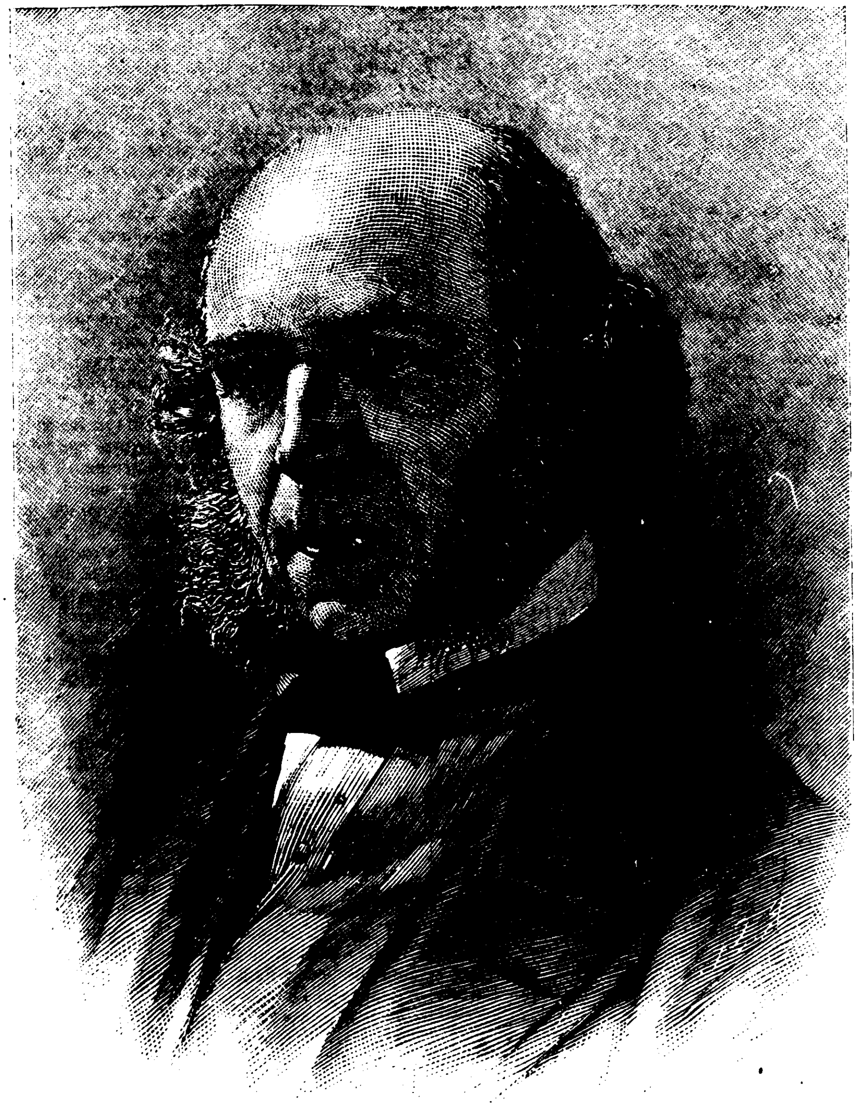
A Rainfall Recorder.—An ingenious apparatus for recording the total duration of rainfall in the course of a day or a still longer time, has been devised by M. Schmeltz, formerly professor at the Lycée de Lille. It consists of a box having a rain funnel in its top, by which the rain can enter and drop upon a band of travelling paper which passes below within the box. This paper is the usual Morse strip treated in a solution of sulphate of iron and dried carefully, then brushed with tannic acid or powdered cyano-ferride of potassium mixed with resin. A roll of it is placed within the box, and it is unwound on to another roller outside the box. The latter is driven by a chain from the hour-hand of a common clock, so that it rotates once in an hour. In this time, therefore, the paper has been pulled along beneath the rain funnel a length equal to the circumferance of the roller. The falling drops dye the paper and indicate where the rain began and left off. Correction is made for the increasing diameter of the winding roller as the paper is wound upon it. The instrument is said to work well, and to indicate fine showers, which are lost upon the ordinary pluvio-meter.

West Virginia produces nearly one-quarter of all the nails made in the United States.



HERBERT SPENCER. (See p. 290).

## SHALL THE KNOWING ONES UPSET OUR NOTIONS?

Is the missionary in India, who proved by the microscope to the holy brahmin that he was destroying animal life in every draught of water he drank, only a prototype of the men of modern times who disclose the horrors that may follow from using too freely of "Mrs. Winslow's Soothing Syrup," or other popular patent medicines? Who explain with awful clearness that the ruddy tomato, long thought the best of vegetables, is surcharged with a deadly bane; that the free use of ice is the beginning of a series of untold and harmless chances in our system.

Then comes the agonies of popular science. For years people have used chlorate of potash in solution as a family specific for cankered mouth and throat, or for colds, when suddenly it is denounced as a deadly poison. We all ought to have died years ago, only, with the proverbial stubborness of facts, we didn't. But that innocent pint vial is regarded now as the skeleton in the closet, and will be labeled with a skull and crossbones just as soon as may be.

Then there is wall paper. Red or green in these pretty decorations is or may be arsenic! No more roses or red hawthorne sprays on the otherwise dingy old walls! No climbing clustering vines or gay tropic birds. We must take refuge in browns or blues and yellows. What an outlook!

And for food, here is glucose to delude the very bees. We have feebly congratulated ourselves that men could not at least make those shapely, dainty, delicate cells in which the sweetness of a thousand flowers is stored by our busy purveyors, and so have filled our mouths with wax and honey as well as delight; but now we are assured that the comb and honey are manufactured of glucose! Who is safe?

Then there is terra alba in our sugar; plaster of paris in our flower; lard and suet manipulated and reformed into our butter, once the firm, cool, primrose tinted outcome of dewy grass and odorous clover, bearing the handmark of the neat-handed dairy maid, and fit accompanist to the "finest of wheat" and "honey out of the rock." How can one eat his daily food except in a condition of malignant doubt and dismay?

We have not referred to any of these cheap exhibitions of knowledge in an entire spirit of levity. There is really a chance for well founded outcry against some of these harmless things; but we think most of them will quietly work their own cure.—*American Inventor.*