Scientific American.

ESTABLISHED 1845

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS TO SUBSCRIBERS

One copy, one year, for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845) .... $3.00 a year.
Scientific American Supplement (Established 1876) .... 5.00 "
Scientific American Building Edition (Established 1885) .... 2.50 "
Scientific American Export Edition (Established 1878) .... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.

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MUNN & CO., 361 Broadway, corner Franklin Street, New York.

NEW YORK, SATURDAY, DECEMBER 9, 1899.

AIRSHIP OR AEROPLANE—WHICH

The quest for a successful means of aerial navigation has been prosecuted along two different lines, according as the inventor aimed at the construction of a navigable balloon or airship, or a flying machine or aeroplane. The early flying machines, in which suspension and forward motion were attempted by imitating the flapping wings of a bird, were futile and wofully fatal. In later years they have given place to the scientifically conceived soaring machine and motor-driven aeroplane. On the other hand, the old pear-shaped balloon, which depends entirely upon the wind for propulsion, has developed into the modern, cylindrical, screw-propelled airship. The progress of invention in aeronautics has been marked, sometimes by a preference for the aeroplane, sometimes for the airship type. To-day, it must be confessed, the latter is most in the public eye, chiefly because of the stupendous proportions of the Zeppelin airship, now nearing completion on its floating dock in Lake Constance.

The popularity of the aeroplane, and the widespread conviction which was noticeable a few years ago, that this type would be the machine of the future, were based upon the fact that it was built upon the principles which govern the flight of birds. Since we now understand the laws of flight, and improved materials of construction have enabled us to build flying machines that are gradually, if very slowly, approaching the bird in their ratio of power to weight, it was argued that the production of a successful flying machine was a matter of time merely. It is probable, however, that in coming to this conclusion, sufficient importance has not been attached to the human element, upon which the successful operation of the aeroplane is absolutely dependent. It would no doubt be possible to build an aeroplane that would carry a person at a fairly rapid speed through the air, provided the occupant of the machine possessed that God-given faculty by which the bird is able to preserve its equilibrium, adjusting the position of its weight and the inclination of its wings to the ever-changing velocity and direction of the wind, and the varying speed and direction of its own flight.

This matter of equilibrium is determined, in the aeroplane, by the inter-relation of several factors, such as the speed, the inclination of the supporting planes, the position of the center of gravity with regard to the center of area of these planes, and the inclination of the guiding tail. It requires rare quickness of perception and judgment to keep all these factors in the harmonious equipoise necessary to equilibrium, even under the favorable conditions of a perfectly still atmosphere; but when we remember that every change in the direction and strength of the wind calls for an instant readjustment of the machine, and that a moment's hesitation might result in a sudden dive earthward, the perils of aeroplane navigation will be evident. The fatal mishaps to Lilienthal, Pilcher and others were due to a failure to control the equilibrium, and the present indications are that as long as the balancing is dependent upon the sensations and voluntary control of the operator, aeroplane navigation will remain a very hazardous and fatal form of recreation.

It is evident that some method of automatic mechanical control is necessary, and the results achieved by Professor Langley on the Potomac River indicate that such control is within the possibilities of the future. In perfectly still air the Langley steam-driven aerodrome achieved a steady flight of three-quarters of a mile at a speed of thirty miles an hour. But although this was a truly wonderful result and speaks eloquently for the skill and unconquerable perseverance of the inventor, the aerodrome is to-day nothing more than a wonderfully ingenious toy. It is a far step from that to a machine of commercial or military utility, capable of carrying its freight in any direction in all possible conditions of wind and weather.

The airship (using that term to include all gas inflated machines), though not by any means so attractive as a scientific problem, seems to be at present the more practicable. For in this type the question of suspension in mid-air has no necessary relation to the speed, as in the case of the aeroplane, and the efforts of the operator may be devoted entirely to steering and propulsion. Given a sufficient volume of gas and a containing cylinder of the proper strength, there is theoretically no limit to the weight which may be lifted. It is in providing a motor sufficiently powerful to propel the huge structure against a strong opposing wind that the difficulty lies. This has never been accomplished as yet, and there is no expectation that even the mammoth Zeppelin airship will be able to make headway against anything stronger than a moderate breeze. Its proposed speed is 22 miles an hour, and hence it will be helpless against a wind of that velocity. Nevertheless, if this distinguished German succeeds in achieving this speed with an airship capable of carrying a crew of several men, he will have placed the problem of aerial navigation on a practical basis which it has never hitherto reached.

The Zeppelin airship, which is illustrated and described in the SUPPLEMENT of November 11, 1899, is of unprecedented size. It consists of a conical-ended cylinder 39 feet in diameter and 410 feet long, carrying two parallel, boatlike cars below it, in which are placed two 15 horse power benzine motors for driving the propellers. The hull consists of an aluminium framework surrounded with a strong netting, within which will be 17 separate, independent, airtight gas balloons, the arrangement resembling that of the watertight compartments of a steamship. The ship will be trimmed by means of a weight sliding on a cable suspended below the cars. By sliding the weight aft, the bow will be thrown up and the reaction of the air will cause the ship to rise; the contrary movement of the weight will depress the bow and cause the ship to sink. Unless some unforeseen difficulty arises, we may expect to learn the results of the trials of this Brobdingnagian at any moment, and their publication will go far to determine the possibilities of aerial navigation on a practical and commercially useful scale.

THE DALMENY EXPERIMENTS.

The great problem for the British farmer, and in fact the farmer in any old country, is how to produce the best possible crop at the least possible cost, so as to compete with the enormous quantities of grain and other agricultural products which are sent in from the United States, Argentina, and other cereal-producing countries. Artificial fertilizing is absolutely essential to successful farming in Great Britain, and the great importance of the subject was recognized early in the history of modern scientific agriculture. In 1843, the renowned Rothamsted experiments were started by Sir John Bennet Lawes, who has provided a heavy endowment fund, so that experiments can be carried on in perpetuity. For fifty-six years the same kind of grain crops have been grown on the same plots and the same kinds of fertilizers year after year, each section having one or more plots upon which crops have been grown continuously without any kind of manure. The value of these experiments has been very great, and was an inspiration to make many public bodies, societies, etc., establish similar experimental stations.

In recent years bacteriological science has proved beyond the possibility of cavil that in the great cycle of change, from the organic matter in the soil to the elaborate products which are absorbed by the roots of the plant, the bacteria of the soil are the great, and indeed the only agents employed. It is now a proved scientific fact that the decomposition of organic matter in the soil is due to bacterial action and to the action of various crops of soil organisms. It is also a proved fact that the wart-like excrescences on the roots of leguminous plants are the camping grounds of myriads of bacteria which possess the property of being able to absorb the free nitrogen of the atmosphere and render it favorable for the use of plants. This science has also shown that caustic lime will destroy the nitrifying and other advantageous soil organisms, whereas carbonate of lime is highly beneficial to them, and, in fact, where the organisms are found in the greatest numbers and greatest activity, it is absolutely essential to the due discharge of their function. Therefore, the bringing about in the soil of those conditions which favor the development and action of those nitrifying and other advantageous organisms is the great aim and end of scientific fertilizing; for the farmyard and artificial manures applied to the soil are not taken up direct by plants, but go in the first place to feed the crops of soil bacteria, which in turn provide the highly elaborated material to be absorbed by the roots of the plants. For several years it has been held as a proved scientific fact that the oxidation of organic matter in the soil, which was formerly held to be a purely chemical change, was due to the action of soil bacteria. The Nineteenth Century has just published a most interesting article by Mr. D. Young on the "Dalmeny Experiments," from which we obtain our information.

Some eighteen years ago, the two founders of what is called "New Soil Science" were interested in the study of soil bacteriology; one of them was John Hunter, and the other Professor M'Alpine. The discoveries of Pasteur and other investigators as to the paramount importance of having the right crops of yeast plants in the production of beer was doubtless the means by which Mr. Hunter was led to recognize the equally great importance of having in the soil the right crops of soil bacteria. The nodules on the roots of the Leguminosæ were first investigated, and as a result Messrs. Hunter and M'Alpine demonstrated the fact that the bacteria in these root nodules did possess the power of absorbing the free nitrogen of the atmosphere and render it available for the use of the plant. They then proceeded to carry out a series of investigations in regard to the nitrifying bacteria. At an early stage in their work they found there were several well-defined sets of bacteria concerned in the work whose final end is nitrification. They succeeded in isolating and cultivating the nitrous germ and they also isolated what they believed to be the nitric germ, but in the case of the latter they were for a time puzzled to find that they could not, from it in any ordinary culture media, produce nitrates. Finally they remembered the plan by which Napoleon was able to secure from the old mortar in the Paris stables a supply of nitrate for the manufacture of gunpowder. They accordingly added a small supply of mild lime in the form of mortar to the culture media, with the result that the nitric germs produce nitrates quickly. The experimenters thought that the old dressings of hot lime were a mistake, but that a small annual or biennial dressing of lime compost to the surface soil was essential in successful and scientific fertilizing.

Naturally their views were bitterly opposed, but at last the time came when the doctrines of the New Soil Science could be tested under the most favorable conditions. The post of land agent on Lord Roseberry's estates becoming vacant, a pupil of Mr. Hunter's, named Drysdale, was appointed. The latter commenced experimenting on a small scale with various fields, and with such satisfactory results that Lord Roseberry decided to extend the work. In 1895 a well equipped experimental station was established on his lordship's farm at Dalmeny Park, with Mr. Hunter as scientific adviser. The results of the experiments were carefully tabulated and would fill a good-sized volume. With a moderate dressing of farmyard manure supplemented with 4 cwt. of ground lime, applied at the working of the land, followed by 4 cwt. superphosphate, 1 cwt. of fermented bones, 2 cwt. of kainit and 1 cwt. of ammonium sulphate, the Dalmeny home farm produces crops which are the admiration of all.

The "Dalmeny Experiments" are of far-reaching importance. There are now, at least, six lime works which are kept constantly at work grinding lime owing to the ever-increasing demand for that substance, and the scientific authorities who had at first considered the new soil science as a heresy have been obliged to admit that nothing succeeds like success.

THE SECRETS OF OUR SUCCESS IN THE STEEL TRADE.

When the statistics of the steel trade of the United States for the year 1899 are completed, there is every probability, judging from the records for the past ten months, that this country will have produced a grand total of between twelve and thirteen million tons. This is equal to the total production of the whole world in 1871, and is fully one-half of the world's production ten years ago. We have not only outstripped every competitor, including Great Britain itself, but so rapid is the growth of the American industry, that the time is within measurable distance when even that country will be but a poor second in a comparative list of production.

It is now nearly half a century since the Hon. Abram S. Hewitt, who has always shown a firm grasp of the economics of the industry with which his name is so closely associated, stated that the essential conditions to building up an iron trade commensurate with the importance of the United States and the enormous demands of the future, were three. First, there must be an adequate supply of the raw materials, ore, coal and limestone; second, they must be so far contiguous, geographically, that they can be brought together at the furnace at small cost of transportation, and the product be cheaply placed at the various markets; and lastly, there must be no stint of capital to build, equip and carry on the works. Now, in view of the fact that these words of Mr. Hewitt, spoken in 1855, do actually describe the present favorable conditions in the United States, they may be taken as being truly prophetic.

As a matter of fact, everyone of these conditions is not only present, but it is fulfilled with a completeness far beyond the most sanguine forecast. In the first place, the United States possesses in the Lake Superior and adjacent iron mines the most extensive and most easily worked deposits in the world. Nature could not have placed the raw material in a more ideal and convenient form for cheap and expeditious recovery from its geological resting place; and science and art have nobly responded in providing the necessary excavating tools for the cheap mining and transportation of the ore to the smelting furnace. The iron mines of Lake Superior are matched by the vast coal fields of Pennsylvania, and the genius of the American engineer has devised a system of transportation by ship and rail which enables the two raw materials to be brought together at the furnace at a low cost of transportation which cannot be matched in any part of the world. The lake steamer, with its engines placed at the stern and the whole of the hull available for carrying the ore in bulk, the vast systems of ore pockets equipped with labor-saving machinery in the way of hoisting cranes, cableways, etc., and lastly the American system of cars and locomotives, enabling vast loads to be hauled by single units of exceptional power, all combine to give to the industry a long lead in the race, even before the raw materials have been mixed ready for smelting.

But the economies do not stop with the mining and transportation, but are continued throughout the whole process of smelting, blowing, and rolling into finished shapes ready for the market. European ironmasters who have come over to study the cause of our cheap production, have frankly admitted that by our peculiar system of management and persistent endeavor to substitute mechanical for manual labor, we have succeeded in producing a larger output from a given plant than is possible under their own methods.

As to the last essential to success mentioned by Mr. Hewitt in 1855, the necessity for abundance of capital to build, equip, and carry on the works, it is enough merely to call to mind such vast industrial concerns as the Carnegie consolidated interests, representing an aggregate capitalization of $500,000,000, to realize that our position in this respect is as strong as in every other. The commanding position of the iron and steel industry in this country in respect of its geological and geographical advantages alone would be sufficient to secure a response to any possible demand for capital.

There is every reason to expect that our growth in the future will at least keep pace with that of the past. Of course, our competitors will gradually approach us in the matter of management and improved methods of handling; but in the wealth of our natural resources and the facilities due to geographical position, we shall always hold a commanding and unassailable position.

THE DANGER FROM THE IMPORTATION OF ANIMALS.

An abstract of J. S. Palmer's essay on "The Danger of Introducing Noxious Animals and Birds" appears in Our Animal Friends. There are several societies in this country for the express purpose of purchasing and importing European birds. One society in Cincinnati has contributed $9,000 to this object, and other cities have raised considerable sums. Our contemporary thinks it would be well that all such experiments should be made under the sanction of government experts of the Department or Agriculture. In addition to voluntary importations, it often happens that animals are unintentionally brought into the country, as trading vessels have carried the European house mouse all over the globe, and the introduction of rabbits into Australia is perhaps the most striking example of the dangers of unconsidered importations. They were introduced for purposes of sport, and were liberated near Melbourne in 1864. Within twelve years they had spread over the country and became a veritable plague, and millions of dollars have been spent for bounties, poisons and other methods of destruction. Thousands of miles of rabbit-proof fences have been built, and in 1887 no less than 19,182,539 rabbits were destroyed in New South Wales alone, and the rabbits seem to be on the increase. The little Indian mongoose was imported into Jamaica to cope with a plague of rats and proved most effective, but after it had destroyed the rats it turned its attention to the domestic animals and poultry, so that the islanders would now be glad if they could get rid of the pests. Such are a few examples of the danger of disturbing nature's balance.

WIRELESS TELEGRAPHY TESTS IN SWITZERLAND.

A series of interesting experiments in wireless telegraphy has been carried out between Chamonix and Mont Blanc in order to find out the effect of the high altitude and different atmospheric conditions of those regions. This work was undertaken by two French engineers, Messrs. Jean and Louis Lecarme, who afterward made a report to the Academie des Sciences. The experimenters wished to find out also the effect of the atmospheric electricity, and whether the absence of moisture in the frozen soil would render the earth connection impossible. The tests were carried out for several days in succession, commencing with the 25th of August; it was found that the signals were easily transmitted and read with a distance of two centimeters between the spheres of the oscillator. It was found that the absence of moisture in the soil did not interfere with the earth connection, and also that clouds interposed between the two stations had no appreciable effect upon the signals. The action of atmospheric electricity made itself felt at times, but on the whole the effect was not sufficient to prevent the practical working of the apparatus. It was also observed that the operation of the alternating current dynamos of the Chamonix lighting station had a marked effect upon the apparatus, and it was impossible to work while the dynamos were running. These machines are of the three-phase type and give 2,500 volts.

IMPORTANCE OF PATENTS AND TRADE MARKS IN GERMANY.

The afternoon session of the fifteenth day of the International Commercial Congress, at Philadelphia, was devoted chiefly to the question of international trade marks. Papers of great value were read by Commissioner Duell and by Mr. Francis Forbes, one of the committee of three appointed by the President to revise the trade mark laws so far as they relate to foreign commerce. Commissioner Duell's paper was printed in the SCIENTIFIC AMERICAN of November 11. In the discussion of Mr. Forbes' paper on "Present Trade Mark Needs in International Trade," the Hon. J. C. Monaghan, United States Consul at Chemnitz, Germany, referred to the value of patents in Germany as follows:

I do not know that just what I am going to say is exactly germane to any particular paper; but after long experience abroad, I have come to the conclusion that it would be wrong for me to omit so excellent an opportunity to call the attention of American inventors and manufacturers to the importance, the very great importance, of securing letters patent in Europe, and particularly in the German Empire.

I have sometimes been accused of calling the Germans a race or nation of imitators. While they are one of the greatest nations of imitators in the world, I would not be understood as saying that they are not great originators. Any person familiar with the fact knows that they have practically given gunpowder to the world through their monk Schwartz, and the printing press, the greatest probably of all inventions, through Gutenberg, Schoeffer and Faust, and that they are to-day in chemistry and in various branches of the sciences and arts, leaders among all nations.

I repeat, when one is familiar with these facts, it becomes impossible to deny to the Germans the credit of being great inventors and great originators. What has stood particularly in the way of their progress as a race of inventors in the past is this fact, that prior to the year 1878, when Germany had passed her Imperial Patent Law, it was absolutely necessary to take out Letters Patent in Saxony, Wurtemberg, Bavaria, Mecklenburg, etc., etc., and some twenty-eight or thirty petty states and sovereignties. The Imperial law has got away with that fact, and since 1878, she being number fourteen among the inventive nations on the earth, has become, if I remember, mentioned among the first, second and third nations, being led by our own people. But the point I wish to make is this: That American manufacturers and inventors, being magnificent inventors, neglected patent rights in the German Empire, and the law is that the clever genius of that people, watching, as perhaps no other people on the face of the earth, the scientific progress of the world, took out patents. In my city I suppose there are dozens of men, manufacturers, who take the patent papers and the various technical papers of this country, and keep themselves posted as to everything that occurs here. The technical school of my city, the leading technical school, has on file the leading patent papers of our country and the records which they give here, and they see our machines of all kinds. They buy more or less and take them home, where they take them apart and use them as models.

I had in my mind the case of a manufacturer in this city, one builder, who invented the finest gear cutter probably there is in the world. He sold the machine to the leading toolmaker in my city and sent a young man for the patent and set up the machine. They bought another, and then another, and had some correspondence. I am told—in fact, I know—they could not take one machine apart, and they are now constructing a machine for themselves and selling them.

Now, Mr. Chairman, I do not want to be understood as finding fault with that concern for doing that thing. The point I want to make is that Mr. Fletcher, or any inventor in this country, who has taken care to ask an American patent lawyer to have the patent taken out in the German Empire, will be protected, and I think these gentlemen here who are more familiar with the patent laws than I am, know there is no patent country, except perhaps ours, where an inventor has better protection than in the German Empire when he does get a patent.

THE AUTOMOBILE IN BUENOS AYRES.

The use of the automobile in Buenos Ayres is rapidly increasing, and vehicles of the electric and petroleum types are now frequently met with in the streets of that city. These include not only private carriages and tricycles, but also heavy delivery wagons for the use of large stores. The fact that facilities for making repairs are lacking has been hitherto a drawback in the use of these vehicles, but as a result of their adoption there is no doubt that these facilities will soon be provided, and besides, the condition of the roads is beginning to improve. A further step in advance has been the formation of the Argentine Touring Club, which has been founded not long since by a number of influential amateurs and commercial men. The new society will devote itself to the question of automobile interests, and one of the first steps taken has been that of the establishment, in all the provinces of the Argentine Republic, of roads which are specially reserved for bicycles and light automobiles. These roads have already commenced to radiate from Buenos Ayres to a distance of 60 to 70 miles, and it is intended to continue the work until a good system of roads is established throughout the country.

END OF THE CREUSOT STRIKE.

The Creusot Works, which has now recommenced operations after the recent strike, is one of the great European centers of production, and not only transforms the ore received into iron and steel, but also produces in its extensive factories a great variety of manufactured products, such as cannon, shells, boilers, locomotives, armor plate, and also builds different types of dynamos and other electrical apparatus. As is of course necessary in a large establishment of this kind, everything is carried out upon an improved plan with an extensive and modern equipment; the great pieces are handled and transported with ease by the cranes arranged for the purpose, and a well studied system reigns throughout the entire establishment.

The factory covers an extensive area, and is situated in a plain or basin surrounded on all sides by hills, and under these the railroad penetrates by a tunnel to reach the extensive system of tracks which have been laid for the handling of the ore and finished products. The establishment was founded as far back as 1808, and started at that period as a glass works; from that date to 1818 it was under the direction of the Société Perrier. The venture was not a paying one, however, and the losses of the company during the ten years of operation reached as high as 14,000,000 francs. It then passed into the hands of M. Chagot, who came out of the affair with a loss of one million; an English company, Manley & Wilson, then spent without success eleven millions upon the plant, and it was not until 1836 that under the direction of the Schneider Company the Creusot Works began to assume a prosperous condition. From that time to the present there has been a continual progress up to the flourishing condition which is now to be seen. There are over 9300 workmen employed in the different shops, and these are distributed as follows: Forges, 2827; machine shops, 2131; steel works, 1450; artillery, 568; blast furnaces, 513; mines, 388; electrical machines, 341; besides different auxiliary services, which are estimated at 1085.

The working day is of ten hours, and day and night turns are taken each alternate week. The wages paid vary from 2·50 francs to 3·75 for the laborers, which includes a quarter of the personnel; from 4·50 to 8 francs for skilled labor; and for special kinds of work as high as 10 to 15 francs are paid. These figures must naturally be compared with the cost of living, which is much lower in France than in the United States. The workmen have established six mutual aid societies and twenty or more co-operative establishments and stores; the bakery, for instance, supplies 3,500 families. Up to the time of the last strike the works were in full prosperity, with an abundance of orders from all quarters, and there is no doubt that within a short time the normal state of affairs will be restored. The production of electrical apparatus is now an important branch of the establishment, this being materially facilitated by the abundant supply of metal, and the attention which has been given to the production of magnetically good iron and steel for the machines. The production of armaments and ammunition of all kinds is one of the principal features of the establishment, and orders are received from the home government and the different nations of Europe.

The company owns extensive mines, but these do not suffice for the supply of coal and minerals necessary to carry on the work, and in consequence, extensive importations are made; a large part of the coal, for instance, is brought from England. In order to facilitate the handling of materials, the company is now erecting a branch establishment at Cette, an important sea port of the Mediterranean, and from these works the heavy products may be put directly on board, thus eliminating railroad expenses. At the same time, coal will be landed from the Algerian mines as well as from those of other Mediterranean countries. The yearly consumption of materials may be observed from the following figures for 1898: Coal, 510,000 tons; coke, 150,000; ores, 200,000; pig or cast iron imported, 40,000 tons. As to production, the figures for the same year show cast iron of all kinds, 105,690 tons; steel, 125,680; wrought iron, 46,740. When the works at Cette are finally installed, the Creusot establishment will keep only the steel works, artillery, and electrical machinery.