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 "
American Homes and Gardens.....3.00 "
Scientific American Export Edition (Established 1878).....3.00 "
The combined subscription rates and rates to foreign countries will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, NOVEMBER 24, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE CONGESTION AT THE PATENT OFFICE.

There is no sign of improvement in the serious congestion that hampers the work of the Patent Office, which, more than ever before in its history, stands badly in need of a larger staff, receiving better remuneration for its services. Even as far back as the first of January of the present year, there were, in the thirty-nine divisions of the Patent Office, 17,353 applications awaiting action; while at the present writing there are about 21,000 cases on file which have not yet been examined. Moreover, the office is falling behind at the rate of from 250 to 300 cases a week.

As was to be expected, the delay is greater in some than in other divisions of the Office. In the more important divisions the delay varies from about five months, with nearly 500 cases on hand, in steam engineering, to nearly twelve months, with over 1,000 cases on hand, in the division of hydraulic motors, pumps, and sewerage appliances.

The arguments in favor of the exercise of a more liberal policy on the part of Congress toward the Patent Office are so obvious and weighty, and the appropriation that would be necessary to straighten out this miserable tangle would be so moderate in proportion to the benefit conferred, that the persistent indifference of Congress to the needs of this great institution is beyond all comprehension.

EXTRAORDINARY CONDITIONS IN THE STEEL INDUSTRY.

Rarely, if ever, in the history of modern industries, either here or abroad, has there been witnessed such an extraordinary condition as confronts the steel industry in the United States. Already the rail mills are crowded with orders to such an extent that their total output up to the end of next year will barely serve to meet the present demand; and the mills which are devoted to the production of structural steel are overloaded with work, and must be pushed to the very utmost to fill orders that are due to be delivered before the spring of 1907. Even more acute conditions prevail at the plate mills, the demand for whose output is to be attributed very largely to the growing popularity of steel cars. These mills have sufficient orders on the books to keep them going at full pressure, practically for the whole of next year. There are many evidences of the prevailing industrial activity; but none, we think, speaks so eloquently as this. Who would have predicted, at the time of the formation of the United States Steel Corporation a few years ago, that within so short a time not only that great aggregation, but also the independent concerns, would be taking orders for material which could not possibly be delivered for twelve months or more from the date of signing the contracts?

GROWTH OF THE SALTON SEA ARRESTED.

Recent reports from the locality of the Salton Sea indicate that the flow of the Colorado River from its natural channel into the Salton sink is at last under control, the recent rise in the Colorado having failed to imperil the dam which the Southern Pacific and government engineers have constructed at the break in the river's banks. Before its control the river had risen until it covered an area of several hundred square miles, and in the bottom of the depression it had a depth of between seventy and eighty feet. When the waters first reached the tracks of the Southern Pacific Railway, the latter were moved back for a distance which was thought sufficient to place them beyond danger from further encroachment. Yet it was not long before the waters were again lapping at the ties; and in spite of the fact that the tracks had been several times driven back by the ever-widening sea, the railroad, we understand, was contemplating the expense and trouble of another retreat. Recently the only indication of the original location of these tracks was the tops of the telegraph poles, which projected above the water far from the present shore line. As it is, the company was obliged to build an entirely new detour line, forty miles in length, at an elevation of about seventy feet above the old line, and nearly forty miles of the old line had to be abandoned. It is now stated that comparatively little actual damage was done to the cultivated section of the valley.

GUN TRIALS OF THE "DREADNOUGHT."

So great has been the interest aroused in the "Dreadnought," that our recent article upon this ship would be incomplete without some statement of the manner in which she behaved under the very severe gun trials to which she was recently subjected. These trials are of special interest to the naval constructor and the ordnance expert; for the former has freely predicted that when the ship came to trial, it would be found that too much had been attempted, and that the wide arcs of training through which it was claimed the 12-inch guns could be used, would have to be reduced, unless the ship were to be badly wrecked by the concussion and blast. It was freely asserted that the designed end-on fire of six 12-inch guns could never be realized, for the reason that the blast would be certain to distort the framing of the decks and vertical bulkhead forming the embrasures through which the guns, when trained dead ahead, would have to be fired; and instances were quoted where serious damage of this character had resulted to ships both of our own and the British navy. As a matter of fact, the scantling of the "Dreadnought," in those portions of the deck and superstructure that would be exposed to the blast, had been built of heavier section and weights to meet the resulting stresses; and after the gun trials, careful examination revealed no material injury to the ship. Eight of the guns were fired simultaneously on both sides of the ship, the guns being all laid at the maximum elevation of a little over 30 degrees. In spite of the fact that the aggregate energy of the broadside was 384,000 foot tons, or sufficient to raise the "Dreadnought" bodily 21 feet into the air, the roll of the ship under this heavy recoil is said to have been very slight. The forward pair of guns on the forecastle, and each pair of guns in the two turrets on the broadside, were fired simultaneously dead ahead, and each pair of guns in all the barbettes was fired on various bearings through its own arc of training; but no structural defect was revealed. Similarly, each of the guns was fired at various degrees of elevation and depression with satisfactory results. As the result of the trials, it was considered by the trial board that the whole of the ten 12-inch guns for broadside, and the six 12-inch guns for bow and stern fire, can be used effectively in any position.

THE SIZE OF OCEAN WAVES.

The latest investigation of the question of the size of ocean waves is that made by the eminent naval architect, M. Bertin, who agrees with all the qualified students of this subject in stating that the size of the largest ocean waves has been greatly overestimated. According to this authority, of the several methods by which the length of a wave may be determined, the most reliable is that of deducing it from the theory that there is a simple relation between the time of complete oscillation and the length. The longest wave of which M. Bertin has knowledge measured 2,590 feet from crest to crest, and its period was twenty-three seconds. The long waves, however, are not unusually high, and in deep water the height of a wave 2,590 feet in length would be not more than one-fiftieth of its length, or say about 50 feet. Observers, particularly those who were situated on small vessels, claim to have witnessed waves much higher than this, but their observations are not of much value, for the reason that the deck of such a vessel floats parallel to the surface of the waves instead of parallel with the plane of the horizon, and the inclination of the deck will thus give the observers an exaggerated impression of the height of an oncoming wave. M. Bertin accepts as reliable, records taken where this source of error was carefully eliminated, which show the highest waves in open water to have measured 50 feet from trough to crest, although he is of the opinion that in the southern seas waves of even greater height than this may occasionally be met. As the waves enter shoal water their period decreases and they become higher, so that on striking a shoal, a 40-foot wave will climb to a height of 50 feet or more. Should it meet an obstacle that approaches the vertical, it may easily be thrown up to a height of 100 feet or more; as at the celebrated Eddystone Light off Plymouth, where solid green water has at times been known to reach a height of 100 feet. Although the period of the longest waves may occasionally reach twenty-three seconds, and its length 2,500 feet, such waves are exceedingly rare, the common length of a long wave being something over 500 feet and the period ten seconds. The average period is from six to eight seconds, and the length from 160 to 320 feet. It is rarely that the height exceeds 33 feet.

PROGRESS OF THE PENNSYLVANIA EAST RIVER TUNNELS.

Interest has been so largely centered upon the construction of the Pennsylvania Railroad tubes beneath the Hudson River, the completion of which was recently announced, that the public is in comparative ignorance as to the extensive work which is being done by the railroad company in tunneling the East River. Altogether, four separate tubes are being driven, which are known respectively as tunnels A, B, C, and D. Of the four, tunnel A, the northernmost, is the least advanced. The tube has been driven for only about 150 feet, and the men are now beginning to get out of the solid rock into the sand and gravel. Tunnel B is the farthest advanced, the shield having been pushed out into the river bottom for a distance of over 900 feet from the shaft, which is located near First Avenue on Manhattan Island. Tunnel C is about 600 feet out from the shaft, and tunnel D a little less than 900 feet. It is gratifying to learn that the company is using every effort to protect the men from the effects of working in compressed air, a number of devices having been adopted for this purpose. The latest of these is the provision of an independent supply of compressed air for each lock; an arrangement which has the advantage that, in case of fire or accident in a lock nearer to the shore than the one in which the men are working, they will continue to receive fresh air independently of the disabled portion of the tube. In tunnel B, at a point about 500 feet from the shaft, a new bulkhead is being built for the installation of an additional set of locks. When these locks have been constructed, the air pressure back of them, that is, on the land side, will be reduced. The advantage of this arrangement is that a much smaller chamber will be maintained under high pressure, and the lowering of the pressure within the completed portion of the tunnel will afford a test of the tightness of the cast-iron tubes against the surrounding water.

SANTOS DUMONT'S LATEST FLIGHT.

A cable dispatch from Paris announces that Santos Dumont, at 4 o'clock on Monday afternoon, November 12, made a new record with his aeroplane, "14-bis," which we illustrated in flight in our last issue. This time he flew against a slight breeze for a distance of 210 meters (689 feet), or a trifle over one-eighth of a mile. The machine was in the air for 21 seconds, which corresponds to a speed of 22.36 miles per hour. Thus the machine did not show as much speed as in the previous trials, doubtless because it was flying against a slight wind. The machine showed good stability, and apparently had the capability of making a much longer flight. It also showed that it was capable of being steered with ease. M. Dumont made a sharp turn to the right, with the intention of describing a circle, but so great was the crowd of people on all sides, that, fearing for their safety, he shut off power and descended. The flight was at length made after several unsuccessful attempts earlier in the day, in which the motor failed to operate perfectly. At 2 o'clock there was a strong breeze blowing, and it was decided not to try to fly against it. By 4 P. M. the breeze had died out considerably and a number of attempts were made to fly with the wind. The machine rose in the air, but only for a distance of 270 feet. The flight occupied 7 1-5 seconds, and 82.6 meters were covered, corresponding to a speed of about 25.66 miles per hour. Finally, a flight against the wind was attempted, with the result noted. M. Dumont expects to make further trials in private, so that he will not be hampered by a crowd of spectators. He hopes in the near future to win the $10,000 prize for a flight of one kilometer in a circle. In the flight of the 12th, he won the $300 prize for the first flight of 100 meters.

While they give Santos Dumont great credit for being the first publicly to demonstrate the practicability of the aeroplane flying machine, American experimenters, who have done the most work in this line, do not believe that the stability (and therefore practicability) of Santos' machine under all weather conditions is by any means assured. The fact that he did not attempt to fly it against a strong wind, when this is just what is needed to aid in getting such a machine up in the air, shows, they argue, that he does not have much faith in its stability. Santos, on the other hand, is so elated by his success that he prophesies that aeroplanes for private transportation will soon be in use in large numbers. He admits that his present machine (which, he says, has 80 square meters, or 762 square feet, of supporting surface) is somewhat inefficient, but he thinks that others will soon be built intended for higher speed and which, with greater horse-power and less supporting surface, will be capable of transporting individuals quickly from place to place. He says that the only danger to be feared is breakage of the rudder, and he seems to forget alto-

gether that if the motor stops, the aeroplane will immediately settle down upon *terra firma.* In his enthusiasm the Brazilian aeronaut forgets also that at least three experimenters in America (Herring in 1898, Whitehead in 1901, and Wright brothers in 1903), Maxim in England (1896), and Ader in France (1897), have already flown for short distances with motor-driven aeroplanes, and yet no really practical machine of the kind has as yet been produced and demonstrated. Langley's experiments showed which was the most efficient shape of plane, and how much a given-sized plane would lift at different speeds; but with all this data to build upon, no one has produced an automatically stable machine, i. e., one with which the occupant has only to run the engine and to steer.

In view of these facts, we do not look for the sudden perfection of the aeroplane flying machine. The public successful flight of Santos Dumont will increase the interest in such machines, and stimulate inventors to further research and experiment in the science of dynamic flight without buoyant gases.

WHAT DO THE BIRDS EAT?

BY HELEN LUKENS GAUT.

In order to determine the harmful or beneficial relations of birds to agriculture, horticulture, and all plant life, a remarkable work is being carried forward by Prof. F. E. L. Beal, who is in charge of the Division of Economic Ornithology of the Biological Survey, United States Department of Agriculture at Washington, D. C. Prof. Beal has alone examined over thirty thousand bird stomachs, the greatest work of the kind ever accomplished by a single man, while his assistants have examined an equal number, making over sixty thousand in all. A seemingly endless task it is, investigating with a microscope each minute particle in each of these thousands of stomachs, yet all this has been accomplished in a period of seventeen years. When one considers that to do this intelligently and successfully requires a thorough knowledge of the anatomy of bugs and insects, and a familiarity with characteristics of the seeds of both domestic and wild plants, the labor assumes formidable proportions to the uninitiated. To increase their knowledge, workers in this line must spend much time in woods, gardens, and fields, studying hundreds of species of insects, worms, and bugs. The results of these investigations, which are invaluable to science, and of great practical importance to the American farmer, have led to a movement that can intelligently favor the increase of such bird species as are best adapted to preserve the proper balance of nature, and reduce the number of those that prey too greatly on the products of orchard and field. Ornithologists from all parts of the country, and in many instances special field agents who have been engaged for the purpose, forward great numbers of bird stomachs to the department, and thus aid in the practical and scientific research.

It is difficult, almost impossible, to determine what a bird eats by his actions, as he frequently goes through all the motions of eating a hearty meal without taking a thing. The "proof of the pudding" is found in the bird's stomach. If he is loaded with garden seeds, cultivated fruits, or beneficial insects (parasites on other insects), he is relegated to the black list; but if examination reveals a goodly number of bugs, worms, and insects that are injurious to plant life, he is hoisted high upon the pedestal of usefulness, and woe betide the human who does him bodily injury, or tries to besmirch his character.

The contents of a bird's stomach consist of a pulverized, soggy mass, and it is necessary to separate and study each minute particle in order to determine to what species of fruit or insect it belongs. Caterpillars are sometimes recognized by their skins, always by their jaws, and the tiny chitinous plates that surround the breathing holes. The presence of ants and wasps is discovered by the hard thorax, spiders by their mandibles, and sometimes by their eyes, which sparkle in the stomach mass like rubies. Angleworms have hard, indigestible spicules, which project from their sides. Beetles have fierce bony jaws, grasshoppers hard mandibles and tiny leg-armor plates, and so on through the entire insect world. The greatest difficulty is experienced in determining the species of fruit found in stomachs. Usually it is crushed, and if it contains no seed, the only method of examination available for the investigators is to place particles of skin under a microscope and discover the texture. Grain can be recognized by the shape of the starch granules when other methods fail.

"Most astonishing things have been found in the stomachs of birds, everything but diamonds," says Prof. Beal. "A bird stomach which had been kept in alcohol for two years, waiting its turn to be examined, contained poison oak berries, which are the favorite food of many birds. The man who examined this stomach was badly poisoned. Vicious and deadly-poison spiders constitute a favorite bird food. The mere touch of a blister beetle would scorch the flesh of a human, yet in the stomach of one king bird, fourteen of these fiery creatures were discovered. Caterpillars with stinging spines, beetles with acrid secretions that are bitter and burning, bugs with an odor so fierce that a skunk is fragrant in comparison, and fruit bitter and rasping as quinine, and thousands of other obnoxious things, are consumed greedily by the feathered throng."

While sojourning in some localities, certain species may do inestimable damage to crops, after which they migrate to other fields, where they charm with their sweet music, their good nature, and their innocent and harmless demeanor. For instance, the bobolink ravages the rice fields of the South, annually destroying millions of dollars' worth of rice; then, as if remorseful, he wings his way to the North, where he is thoroughly well-behaved, where, with his sweet voice, immaculate decorum, and his propensity for eating bugs and other insects injurious to crops, he earns an enviable reputation. But after the fashion of "Jekyl and Hyde," his methods change with abruptness, and he becomes an incarnate fiend when he returns to the southern rice fields. So great a pest is he to the planters, that in one season 2,500 pounds of gunpowder were used on one plantation in an attempt to reduce his numbers.

After examining hundreds of linnet stomachs, the investigators have passed the verdict that this bird is an abominable pest, with but few redeeming qualities. He ignores insects that are injurious to plant life, and gleans his living by robbing the wealth of orchard and field. He works with systematic energy, defoliating trees, eating fruit, and scratching up seed. He is a cheery, well-groomed little fellow, but he is wicked, deserving all the bad names and gunshot bestowed upon him. Birds are most seriously harmful to crops when a single species is super-abundant in a certain locality, and there is no remedy other than an unsparing use of powder and shot, else orchards will be devastated, the labor and hopes of the farmer be lost, and families left financially destitute.

Crows do immense damage in New England corn fields, and about the only method of protection is to tar the corn before it is planted. The efficiency of this scheme was demonstrated by Prof. Beal, who planted several acres to corn. Toward the end of the planting the supply of tar ran out, and he was compelled to finish without it. The areas planted to tarred corn were ignored by the crows, while the untarred patch furnished a glorious picnic ground for the croaking banqueters. Though crows are ravenous corn eaters, it is stated that this fault is more than counteracted by their usefulness in destroying harmful insects. In one crow's stomach the investigators found the mandibles of ninety grasshoppers, showing that these birds are partial to such food. Robins steal fruit with a vengeance, and many an eastern farmer has been near distraction because of the ravages of these birds. It has been discovered, however, that they prefer wild fruit, and that whenever it is obtainable they scorn fruit that is useful to man. In the stomachs of three hundred robins were found the seeds of forty-two species of wild fruits, and only four or five domestic. Because of this preference, the department suggests that wild fruits be planted in close proximity to orchards, so that birds may be attracted and kept out of mischief. As many of these wild growths are ornamental, the advantages of having them about would be doubled.

Woodpeckers are both harmful and useful. The good they do is in excess of the injury. Flickers thrive on ants. In a single stomach were found five thousand of these little pests. The ants best liked by the flickers are those that befriend plant lice, carrying them from one growth to another, as each becomes defoliated. The red-bellied woodpecker, common in the north of Pennsylvania, causes some disturbance in the orange groves of Florida by pecking holes in the ripe fruit. The yellow-bellied woodpeckers, indigenous to the northern part of the United States and the Alleghany Mountains, have an exasperating trick of girdling trees, and pecking holes in the trunks in order to obtain a sap that exudes from the bruises. They also eat insects that become imprisoned in the glutinous sap.

On expanding leaves and flower buds plant lice accumulate, and most of the warblers perform a work of benevolence for the farmer by going over orchards systematically, and gleaning the offensive and destructive insects. They are indefatigable insect exterminators, and are of great value to the world of agriculture. Meadow larks and cuckoos are helpful, and have no black marks against their names in the ornithological records. The worst insect enemies of the fruit grower are caterpillars, cankerworms, fall webworms, tussock moths, and codling moths. All these creatures the cuckoos dispose of with gusto and dispatch. Few other birds will eat the hairy caterpillars, because the stiff hairs pierce the inner lining of most bird stomachs, and produce discomfort. But the cuckoo experiences no bad result, though sometimes his stomach is completely furred with these hairs. As the food rotates in the stomach, these hairs are brushed round and round like the silk nap of a silk hat. In the stomach of one cuckoo the remains of two hundred and fifty tent caterpillars were found. Bushtits and other small birds are found invaluable for ridding orchards of scales and minute insects that destroy the value of crops. The microscopic eyes of these birds detect the tiniest insect eggs and every species of life, and they perform tasks in insect extermination that would be impossible for man. It is said they can be attracted to orchards by hanging meat on trees.

Hawks and owls are useful to orchardists, for they prey on gophers, ground squirrels, field mice, rabbits, and many other rodents that do great mischief in girdling trees and stealing seeds. True, these birds sometimes feed on small birds and poultry, but their chief food consists of harmful rodents. This was proved by examining two hundred and seventy stomachs. Out of the seventy-three species of these birds to be found in the United States, only six were found to be really harmful. Some States have offered bounties on hawks and owls, while rabbits are allowed to go their mischievous way unmolested. Rabbits are found to be of more harm to farmers than they are of value as food. Owls and hawks are helpful, and it has been suggested that the bounty be placed on the head of the erring rabbit, and removed from those of the enterprising birds.

SCIENCE NOTES.

Free ammonia in water always indicates organic matter in the process of decomposition. In polluted surface waters it is rarely high, being removed almost as fast as formed by vegetable and animal organisms in the water, and an amount of nitrogen as free ammonia above 0.05 milligramme per liter is unusual, and if it does occur the water cannot be considered as an unpolluted water unless that fact is clearly established by other data.

According to the recent experiments which have been made by Prof. Niccolo Vaccaro, connected with the physical department of the University of Genoa, relating to the spectrum of nitrogen in a magnetic field, he finds that when applying the field so that the lines of force run transversely through the tube containing the rarefied nitrogen, in which the electrodes for the discharge are placed at each end of the tube, the phenomena vary to a considerable degree according to the pressure in the tube, the latter being connected to an air-pump. The present researches, which were made with considerable detail, show in general that when using pressures which are relatively high, the spectrum in the tube of rarefied gas increases both in luminous effect and in the number of lines under the influence of the magnetic field. But for very low pressures the effect is seen to be clearly inverted, and the magnetic field has a weakening effect. He finds that there is a critical point at which no effect is observed from the field, and this is at a pressure of 0.02 inch of mercury in the tube. At this point the magnetic field has no appreciable influence upon the spectrum of the rarefied gas.

A French chemist, L. Ouvrard, has formed a series of new compounds, the boro-stannates of the alkaline earths. He has also succeeded in reproducing the mineral nordenskioldine by artificial means. Researches upon the metallic borates led him to form the boro-stannates by different methods, and among these is the boro-stannate of calcium, which is identical with the above-mentioned mineral. First, he tried by fusion, in chloride of calcium, of a mixture of boric acid or borate of lime and broxide of tin. Here the reaction is not decisive, and no doubt there results a chloro-borate. A better method is to mix in a platinum trough, the precipitated borate of lime, corresponding nearly to $CaO, 2B_2O_3$, with a small quantity of broxide of tin coming from the calcination of meta-stannic acid. The trough is placed in a porcelain tube and brought to a white heat, while passing a slow current of hydrochloric acid vapor. After three-quarters of an hour he finds a melted opaque mass, covered with hexagonal scales, some of which are also deposited upon the trough. These scales, when isolated, are found to be the boro-stannate of calcium B_2O_3, SnO_2, CaO. This body is colorless and transparent, and not easily melted. It scarcely dissolves in hydrochloric acid, even when concentrated. The crystalline scales are fragile, with a glassy lustre, and resemble the natural mineral. Some of the largest ones are 0.05 inch wide and 0.0004 thick. This compound is identical with the mineral nordenskioldine, which was described by Brügger in 1887. By an analogous process, he was able to form the corresponding compounds of strontium and barium. These, however, are more difficult to produce. Using as above a current of gaseous hydrochloric acid at a red heat he obtains some scales of boro-stannates mixed with numerous crystals of casserite. By reacting upon stannic chloride the results are generally better, and he was able to form the new compounds of barium and strontium in a nearly pure state. These are crystalline bodies having about the same appearance as the calcium compound.