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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 PASSING OF THE "OREGON."

And now it is the "Oregon" that has to go the way of all battleships, and pass from the first to the second line of defense, to do duty in home waters. This announcement will occasion not a little sentimental regret among the American people, who will ever bear in mind the long voyage of this battleship from the Pacific coast to Cuba, and the brilliant part which she played in the chase of the Spanish squadron on its flight from Santiago harbor. It seems but a few years ago that the ships of this class ("Oregon," "Indiana," and "Massachusetts") were heralded as the most powerfully armed and armored battleships afloat. The claim was well made; for not even the big British ships of that day could match the combination of four 13-inch and eight 8-inch guns and 18-inch face-hardened armor found in the "Oregon" class. Yet these vessels possessed inherent defects as naval design and construction advanced, which were bound to tell against them. Chief among these was the fact that their displacement of something over 10,000 tons was altogether too small to effectively carry such a powerful aggregation of offensive and defensive elements. For in order to float such guns and armor at all, it was necessary to keep down speed, coal supply, and the supply of ammunition, to a point which was bound ultimately to render these ships unable to remain in our first line of defense. The trend of later battleship design is in the direction of giving a ship high freeboard, large displacement, and a generous supply of ammunition and coal, and the increased displacement of about sixty per cent of such a vessel as the battleship "Connecticut" over the "Oregon" has been given mainly to these features. The main battery of the "Connecticut" in numbers and weight is no greater than that of the "Oregon," consisting of four 12's and eight 8's as against four 13's and eight 8's. In the secondary battery there is an increase from four 6-inch to twelve 7-inch guns. The vastly greater power of the broadside is mainly due to the great increase in velocity, range, rapidity of fire, and energy of the guns. The length of the ships has gone up from 348 to 450 feet; the breadth from 69 1-3 to 76 2-3 feet, while the depth, on the other hand, has been reduced from 28 to 26¾ feet, a most important advantage for the later ships. Displacement has increased from 10,288 tons to 16,000 tons, and the speed has risen from 16 knots to 18. The normal coal supply has risen from 400 tons to 2,000; and although the "Oregon" is credited with a bunker capacity of 1,450 tons as against 2,200 tons for the "Connecticut," she cannot take on that amount without practically submerging the whole of her water-line armor. In the second line of defense, however, for service in home waters, the "Oregon" still has a useful life of many years' service before her, and in the naval annals of the country she is destined to be placed high on the roll of honor.

WEALTH OF OUR FARMS.

In view of the vast increase that has taken place during the past decade in the number and wealth of our industrial establishments and in the value of our manufactured products, it will be surprising to many people to learn that our farms still greatly exceed in value and as a source of revenue every other source of wealth, not even excluding our great manufacturing enterprises. The wealth production of the farms of the United States reached in 1905 the highest amount ever attained in this or any other country, the total figure being nearly six and one-half billion dollars. Four of the crops reached new records as to value, namely, corn, hay, wheat, and rice. Corn exceeds previous yields both in amount and in price, and hay, wheat, and rice reached new figures as to value only. The general average of production was high in the case of every crop, and the prices ran higher still. The Secretary of Agriculture estimates that in addition to the enormous yield of wealth, the farms of the country have themselves increased in value during the past five years by over six billions of dollars; and he puts the matter dramatically when he states that with every going down of the sun during the past five years, there has been registered an increase of three million four hundred thousand dollars in the value of the farms of the country. An analysis of the principal crops for the year shows that corn reached its highest production with 2,708,000,000 bushels, a clear gain of 42,000,000 bushels over the very profitable year of 1899. The hay crop is valued at 605 million dollars; cotton at 575 millions; wheat at 525 millions; oats, 282 millions; potatoes, 138 millions; barley, 58 millions, and tobacco at 52 million dollars. Very remarkable is the increase of 54 million dollars in the value of dairy products, which reached the total valuation of 665 million dollars. The farmer's hen, says the Secretary, is becoming a worthy companion to the cow, the annual production of eggs being now 20 billions. Poultry products have climbed to a value of over half a billion dollars, so that poultry competes with wheat for precedence. The total value of horses is estimated at $1,200,000,000. There are over 17½ million milch cows, valued at nearly half a billion dollars. During the year farm produce to the value of 827 million dollars was exported. During the last sixteen years the domestic exports of farm products have amounted to 12 billion dollars, or one billion dollars more than enough to buy all the railroads of the country at their commercial valuation. Clear evidence of the prosperity of the farmer is seen in the fact that under a recent amendment of the national banking law, allowing the establishment of banks with a capitalization of less than $50,000, there have been 1,754 such banks established in the last year, nearly every one of which, says the Secretary, is located in a rural community and the capital furnished by farmers. For the first time in the financial history of the South, the deposits in that region exceed one billion dollars. Should there be no relapse from his present position as a wealth producer, three years hence the farmer will find that the farming element, which forms thirty-five per cent of the population, has produced an amount of wealth within the preceding ten years equal to one-half of the entire national wealth produced in three centuries.

SINGLE-PHASE LOCOMOTIVES ON DIRECT-CURRENT TRACKS.

The announcement that the New York, New Haven and Hartford Railroad intended to operate single-phase locomotives over the direct-current section of the New York Central lines, which lead into the new terminal station, elicited a strong protest from Mr. Sprague, the inventor of the multiple system of control. He expressed regret that the company had not adopted a system more in harmony with that which was being laid out at such vast expense by the New York Central, and his letter suggested that there would be certain difficulties of operation attending the introduction of the single-phase locomotive into the new terminal. In the course of a reply by the vice-president of the New Haven road, it is stated that the new electric engines ordered by his company are of the interchangeable type, and that they are expressly designed to operate under all practical conditions within wide limits. They will be able to use both alternating and direct, high-tension or low-tension alternating current, to take current from the third rail or from overhead conductors at heights varying between 14 feet and 22 feet; and to operate with equal facility on either or both of the two track levels at the Grand Central station.

It is stated by this official that on sections equipped for direct current the single-phase locomotives will operate in every respect as direct-current engines of high commercial efficiency, and on sections equipped for alternating current, they will show still higher efficiency. The public is assured that the adoption of this most flexible type of engine by the New Haven Company will introduce no new features or difficulties in the track equipment or operation of the Grand Central terminal, and will not entail upon the New York Central the necessity for the expenditure of an additional dollar nor the transposition of a wire.

Now, the above is all very good as far as it goes, which is not very far. If the event prove to be as good as the prediction, both the New Haven Company and the traveling public will be subjects for congratulation. The latter, and especially those New York commuters whose rare good fortune it has been to use the New Haven line, may be pardoned for their solicitude lest that company, in any steps that they might be taking that would affect their suburban service, were actuated more by considerations of their own profit than of the convenience of the traveling public.

WATER POWER AT HIGH PRESSURE.

One cubic foot of water per second, falling 1,000 feet, develops more than 11 horse-power.

This striking fact may well call attention to the great, undeveloped water powers in all of the mountainous sections of the United States. Hundreds of such powers now go to waste almost unnoticed, because of the common idea that a large volume of water is necessary where much energy is to be developed. As a matter of fact, many an unpretentious mountain brook expends enough power in grinding its rocky bed to turn the wheels of a great city.

Proof of this is easily reached by considering the figures for rainfall, runoff, and elevation that apply to large parts of the country. Take, for illustration, an annual fall of rain and snow that amounts to 36 inches of water on a level, and is generally reached in the higher parts of the New England, Middle, and Southern States. With this rainfall each square mile of territory receives 83,635,200 cubic feet of water annually. This water must either soak into the ground and reappear elsewhere in springs, or evaporate, or else run off over the surface of the ground, and a part moves in each of these ways. That portion which runs off over the surface is available for power production. If a quantity of water represented by a depth of one foot on a level runs off over the surface of the ground, each square mile furnishes 27,874,400 cubic feet annually. This volume of water develops some 86,700 horse-power hours, if allowed to fall 1,000 feet. On the assumption that the flow of water will be regulated, and used during only 3,000 hours per year, the runoff of a depth of one foot from one square mile will generate 28.9 gross horse-power during 300 days of ten hours each, under the conditions named. With any variation of the water head from 1,000 feet, the power will, of course, vary in like proportion. That is, a fall of 500 feet would develop 14.4 horse-power during 3,000 hours with the volume of water named, and a fall of 2,000 feet would yield 57.8 horse-power. So too the number of horse-power hours will vary directly with the total quantity of water available. The ratio of the volume of water passing down the bed of a stream to the volume that annually falls on its drainage area, known as the percentage of runoff, is very irregular in different cases, and ranges from less than one-tenth to fully seven-tenths. For many of the streams in the mountainous parts of the States along the Atlantic coast a runoff of 50 per cent is not too high. With an annual precipitation of 36 inches of water on a level, a runoff of 50 per cent gives a stream of 41,817,600 cubic feet of water per year from each square mile of its drainage area, or a discharge of 3.87 cubic feet per second during 3,000 hours. This rainfall and runoff combined with a fall of 1,000 feet thus yield about 129,900 horse-power hours for each square mile of drainage area. If this amount of energy is used at a uniform rate during 3,000 hours, it develops 43.3 horse-power. From these figures it may be seen that a small drainage area will often supply enough water to develop a very large power, if a head of 1,000 or more feet can be obtained. A small mountain stream will often have between one and two miles of drainage area per mile of length, even where located in a very narrow valley, so that the runoff from twenty to fifty square miles is available within a few miles of its source. With a drainage area of fifty square miles, the runoff on the basis of the above moderate assumptions would develop 2,165 gross horse-power during 3,000 hours per year, or 6,495,000 horse-power hours.

In order to make this energy available for useful work, there must in every case be a large storage capacity, because the fall of water is very irregular from day to day and month to month. Small streams in mountainous country often show maximum discharge rates that are twenty to fifty times as great as the minimum, and this great variation in the discharge gives such streams small value for power production, before a relatively large storage capacity is provided. Take, for illustration, the case assumed above, with a drainage area of fifty square miles and an annual runoff represented by a depth of 18 inches of water on a level over this drainage area. With most of the annual rainfall concentrated in the smaller part of the year, it might be desirable to provide a storage capacity for one foot depth of water on a level over the entire drainage area. This would mean the storage of fifty times 27,878,400 cubic feet of water, or 1,393,920,000 cubic feet. With an average depth of 20 feet in this reservoir, its area would be 2.5 square miles, or one-twentieth of the drainage area. Such a reservoir might involve only a moderate investment in a hilly country with deep valleys.

California and the entire Rocky Mountain region afford the best opportunities for the development of water power under high heads, because of the great changes in elevation there, and numerous examples of such powers are to be found in these sections. One such is the hydro-electric plant on Bear Creek that delivers energy to the 33,000-volt transmission that runs to Los Angeles. At this plant the head of water is more than 1,900 feet, so that one cubic foot of water per second develops twenty gross horse-power. In Colorado, near Pike's Peak, an electric plant is operated with water under a head of 2,500 feet, which is believed to be the greatest in this country or the world, that has been developed. While such heads of water cannot, perhaps, be duplicated at developments in the East, numerous cities exist along the Appalachian chain of mountains, from Maine to Georgia, where water heads of 500 to 1,000 feet can be obtained for power plants. At a recent development in New England, a head of about 470 feet was procured for a pipe line some three miles long. The drainage area of the stream above the dam where the head of this pipe is located is only 15 square miles, and of this area the reservoir behind the dam covers 800 acres.

As there are 640 acres to the square mile, this reservoir covers 8.3 per cent of its drainage area. The storage capacity of this reservoir is 435,000,000 cubic feet, which represents a layer of water 1.01 feet thick on a level over its entire drainage area. In a case where the total drainage area is 24 square miles, the storage reservoirs cover 1,120 acres and have a combined capacity of 498,000,000 cubic feet of water. The generating station where the runoff from this 24 square miles is utilized under a head of 222 feet has a capacity of 1,600 kilowatts. Plans for a plant in the Berkshire Hills of Massachusetts, not yet built, show a water head of more than 800 feet.

THE DEVELOPMENT OF THE CAPITAINE PRODUCER-GAS MARINE ENGINE.

The application of the Capitaine producer-gas marine engine, the possibilities of which have been demonstrated in a very practical manner by the Thornycroft Shipbuilding Company, is being extensively developed in Great Britain. So far the utilization of this system of generating power has been confined to small vessels, the Thornycroft Company having only completed arrangements with the inventor to this end. The rights to manufacture and apply the invention to large vessels have been acquired by Messrs. Beardmore & Co., Ltd., who are carrying out some interesting experiments to this end.

This firm has under construction an installation of 500 horse-power, and this is by far the largest engine of this type that has been so far undertaken. Under these circumstances the construction of such an engine presents several problems that have not had to be encountered in the case of the smaller-powered plants. Yet there is a great opening for this type of engine, not only for propelling purposes, but for auxiliary machinery purposes, especially where weight of machinery and economy in coal consumption are of vital importance. The total weight of such an engine is about 75 per cent of the ordinary engines and boilers, while the fuel consumption is 50 per cent less.

This 500-horse-power plant will comprise five cylinders of the vertical type, working on the Otto cycle principle, and fitted with a suction gas producer specially designed to work continuously with ordinary bituminous coal. The framing of the engine is of plate steel exclusively with the exception of the cylinders, which are the only large parts of cast iron. By means of this design a rigid yet light construction is obtainable.

The builders have also designed a new type of reversing gear, which possesses several interesting and novel features. This gearing will enable the engine to run in either direction and dispense with feathering propellers, bevel gearing, and so forth for reversing. The gas producer is also being arranged so as to supply the engines with gas free from tar, and is to be fired by a mechanical stoker so designed as to prevent the formation of clinker when using bituminous coal.

When this engine is completed, it will first be submitted to exhaustive and severe trials on land under conditions resembling as near as possible those obtained at sea. If they should prove satisfactory, it will then be installed upon a Glasgow coasting steamship, and the firm will then proceed with the construction of an engine of 1,000 horse-power, for which the designs have been prepared, but the construction of which has been postponed until the results of the 500-horse-power engine have been obtained, so that any disadvantages or weak points that may develop may be eliminated from the larger engine. The engine now in hand will be completed and tested within the next two months.

That there are great possibilities for this system of generating power is evidenced by the practical interest that is being shown in the invention by the British Admiralty, who are also constructing a high-powered engine at Manchester, and which will also be subjected to a series of severe trials by the naval engineers. If the invention can be proved to be as successful in the larger sizes as it has been in smaller craft, it has a great future as the power generator in large vessels, and especially in bucket dredges and towing craft, where a maximum of power is desired at the minimum of expense, both as regards initial cost, space occupied, weight, and economical coal consumption.

HYBRIDIZATION OF PLANTS.

BY W. R. GILBERT.

It is a singular fact that it is only during the past century that hybridization, or cross-breeding of plants, has been practised.

Lord Bacon, more than 300 years ago, seems to have foreshadowed it, but it was generations before anyone attempted to solve the mystery.

Lord Bacon wrote: "The compounding or mixing of plants is not yet found out, which if it were, it would be one of the notable discoveries, for so you would have great varieties of fruits and flowers yet unknown."

Who was the first to cross a fruit or flowers we have no data to prove, but Mr. Knight, of Chelsea, England, was very much interested in, and practised the art of hybridization. When the secret was found out the practice soon became common, and some enthusiastic amateur horticulturists engaged in it. Since then the art of hybridization has been followed by many, and, as Bacon suggested, greatly improved and unknown varieties of fruits and flowers have been produced in rich abundance.

Perhaps in the amelioration of fruit it has been important, now marvels of the hybridist's skill are crowding upon us, and they seem to accomplish their aims with a certainty that is remarkable—for instance, in the case of the stoneless plum which Mr. Burbank, of California, after twenty-five years of study and experiment has been able to give to the world, and now the coreless apple of Mr. Spencer. It has taken these gentlemen years to accomplish the object they had in view, but to raise a new grain, fruit, or flower or vegetable of greatly superior qualities is worth a lifetime of patient and persevering effort, because it contributes to the welfare of the human race, and the comfort of the lower animals.

Cross-breeding is the most important, useful and fascinating branch of horticulture and sometimes very remunerative.

In order to obtain a new variety it is only necessary to exercise some judgment, and select two parents of certain qualities which are of the same, or of very closely allied species, and cross them for a new intermediate variety, which will blend the good points of both, and thereby effect an improvement; thus an early, but insipid pear, if crossed with one of fine flavor, but lacking the desirable qualities as to habit of growth or productiveness, will be likely to bring a variety which in some essential points will surpass either of its parents.

The "Goe's Golden Drop" plum was raised by crossing the Green Gage with the Magnum Bonum plum; the Elton cherry was raised by crossing the Byarrean with the White-heart, and the combinations have produced the two invaluable fruits mentioned.

The power to cross-breed is limited by a wise provision of nature to prevent the generation of monstrosities. A cross-bred plant is a sub-variety raised between two varieties of the same species. Some nearly allied species are capable of fertilizing each other and these are pure hybrids or mules, and, like animals so bred, are incapable of producing perfect seed. No one has ever succeeded in causing the pear to fertilize the apple, or the gooseberry the currant. Before people were so well informed on these subjects as they now are it was believed that wonders could be brought about by fertilizing an orange with a pomegranate or a red rose with a black currant, but these fancies are no longer accepted as being possible.

Now, as to the *modus operandi* of the artificial crossing of plants. Take the blossom of a cherry, for an example, which is directly connected with the embryo seed; the numerous surrounding threads are the stamens at the summit of which are little sacks which secrete the powder called pollen. The pistil has its base in the embryo fruit and at its summit is the stigma; the pistil is also called the style, and is the stalk or tube between the ovary and the stigma; on this stigma is a sticky substance, when it has arrived at maturity, to which the pollen adheres and thus the seed is fertilized. Now, if we fertilize the pistil of one flower with the pollen of another we shall obtain a variety with the characteristics of both parents.

The process of obtaining cross breeds is easily performed. When the tree blooms, which we intend to make the mother of the improved race, we select one of the blossoms not fully expanded; with a pair of sharp scissors we cut off the antlers or pollen sacks. As soon as the blossom is fully expanded, collect with a camel-hair brush the pollen from a fully blown flower taken from the tree we intend to be the male parent. Apply the pollen, and leave it upon the point of the stigma. It is safe to cover the flower thus operated upon with a bag made of thin gauze to prevent insects getting beforehand with us in applying the pollen. To sum up, the two essential points are: First, to be very careful to remove the antlers before they are sufficiently mature to have fertilized the pistil; second, to apply the pollen when it is in perfection, that is, dry and powdery, and when the stigma is moist and in condition to assimilate it. Seedless fruit is produced by removing the pistil before it has been pollenated, so that the fruit will form and contain but few if any seeds, and by selecting those which have the least seed and repeating the process in course of years seedless varieties will be the result.

SCIENCE NOTES.

For the purposes of studying the causes of sorotchte or mountain sickness, and the influence of the temperature and climate of high altitudes upon general nutrition, two eminent French medical authorities, Drs. Guillemard and Moog, during last July made a stay at the Mont Blanc observatory with the astronomer M. Janssen. According to the results of their investigations the diminished tension of the oxygen of the atmosphere clogs the process of oxidation, and this sets up an elaboration of toxic substances, the retention of which causes symptoms of autointoxication and accounts for the symptoms of mountain sickness. Acclimatization, however, results in a few days, and the symptoms pass away under circumstances resembling those accompanying the passing of the crisis in infectious maladies.

In the northern hemisphere the greatest cold seems to have been observed at Werchojansk, in Siberia, where it is stated that the thermometer goes down as low as —69.8 deg. C. However, according to the information which has been brought by the Russian artist Borrissoff, certain parts of Nova Zembla seem to show at least as low a temperature as the above. The Bulletin of the Société Astronomique states that in an excursion which M. Borrissoff made lately in the Strait of Matotchkin, he discovered underneath a case a box containing two thermometers, one a maximum and the other a minimum-recording thermometer. It is supposed that these instruments belonged to Höfer, an Austrian geologist, who made an expedition to this spot in 1872. One of the thermometers was found to have registered the temperature of +15 as a maximum, while the second instrument showed that the greatest cold had been —70 deg. C. This value seems to be the extreme cold which has been reached in this region for thirty years past.

The variations in the thickness of the hair upon the same individual have been studied by the Japanese scientist Matsura and he makes some interesting observations. It is known that in certain diseases we find among other differences of growth, very marked variations in the growth of the finger nails both in length and thickness. It is found that the hair is also influenced, and all the affections which act upon the general health bring about a diminution in the thickness of the hair. The medullary layer may even be interrupted and the hard layer which it contains may disappear. Observations made upon a hair will therefore show the variations in thickness according to certain maladies and the length of the affected part or the thinner portion of the hair gives an idea of the duration of the malady, and even of slighter affections. The variations are naturally more strongly marked in the case of coarse-haired races than for others. Provided the hair had never been cut, the subject would have his pathologic history written, so to speak, in capillary terms.

A new process for the manufacture of hydrogen gas has been brought out in Europe not long ago, and is designed to replace the usual method of sulphuric acid and iron or zinc. In the new process the reaction of the alkaline hydrates upon metallic aluminium is utilized. This reaction is $2Al + 3NaOH = 3H + AlO_3Na_3$. When once commenced, the metal is attacked by the soda solution with great energy. The gas is produced very rapidly and the liquid heats up to the boiling point. Theoretically we need 0.810 kilogramme of aluminium and 3.6 of caustic soda to produce 1 cubic meter of hydrogen, but in practice owing to the impurities in the metal and the soda, we require 4.68 kilogrammes of caustic soda. The process gives some advantage as to saving in material which is to be transported, seeing that we need but 5 kilogrammes of material per cubic meter of gas, while the acid process takes 7 kilogrammes. But the cost of production is much higher and comes to at least $0.72 per cubic meter. This process was used by the Russian aerostatic corps during the recent war.

An interesting effort to apply the Parsons turbine to locomotive propulsion is being made by Mr. Hugh Reid, a well-known British locomotive engineer. This inventor has designed a self-contained electrical locomotive, which will generate its own current by means of a boiler and a condensing Parsons turbine. He has also devised an air-cooled condenser of somewhat novel design for use with the same, and the forthcoming experiments with this locomotive are being anticipated with great interest by British engineers.