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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 LOSS OF THE "VIPER" AND THE "COBRA."

It is an extraordinary coincidence that, out of nearly two thousand torpedo boats and torpedo-boat destroyers belonging to the navies of the world, the only two that were driven by turbine engines should have been wrecked within a few weeks of each other—the "Viper" running upon the rocks, and the "Cobra" foundering in a heavy gale. On the face of it, the coincidence would seem to point to the turbine motors as being directly or indirectly the cause of the disasters; but as far as the facts have been made public, there is no positive evidence that they were even indirectly contributory to the loss of these valuable and phenomenal boats. The "Viper" was wrecked when running at high speed among the sunken rocks of one of the most dangerous stretches of water in the world. The rise and fall of the tide among the Channel Islands, where she was wrecked, amounts to 40 feet, and the tides sweep across the track of vessels steaming from these islands to the English coast at a velocity which in places reaches as high as 7 knots an hour. The list of casualties in these waters is a long one, and where the experienced captains of the regular Channel Island steamers have so often lost their ships, a naval officer less acquainted with the currents might easily be carried from his course and strike one of the many sunken rocks.

The "Cobra" seems to have been wrecked by breaking in two when she was being driven against a gale, and it is possible that the desire to make a record trip on the trial run led to the frail vessel being driven too fast into the head seas, with the result that her back was broken.

In each case the disaster seems to have been due to poor navigation, and the fact that both vessels carried turbine engines proves nothing against the new system of propulsion.

At the same time, the fact remains that for marine purposes the turbine engine is severely handicapped by its inability to go astern; and in the three turbine vessels that have been built, smaller auxiliary turbines are fitted for this purpose. This offsets, to a certain degree, the high efficiency of the turbine installation; yet, so great is the saving of weight that, even with reversing motors on board, the total weight of the motive power is only about 66.5 per cent, for a given horse power, of that required in reciprocating engines.

THE TANDEM COMPOUND LOCOMOTIVE.

Interest in the compound locomotive has been quickened by the success of a new type of locomotive built by the Schenectady Works, in which the pair of high and low pressure cylinders on each side of the locomotive is arranged in tandem, the high-pressure cylinders being placed in front of the low pressures and on the same axial line, a common piston-rod carrying the two pistons. This arrangement involves the use of four cylinders, in which respect the type corresponds to the well-known Vauclain system, which carries the two high-pressure cylinders above the low pressures, the two piston-rods on each side connecting to a common crosshead.

Although the compound locomotive has not met with the favor or made the advance in this country that it has abroad—and particularly in France, where the fastest trains are hauled by four-cylinder compounds, —the best designs of compounds that our shops have turned out have fully justified the claims of fuel and steam economy which are urged in favor of the compound as compared with the simple high-pressure type.

The disposition of our builders to preserve the simplicity which has been one of the excellent features of American locomotives led them to favor, in the earlier compounds, the two-cylinder type, an arrangement which conformed closely to the ordinary two-cylinder simple locomotive. The recent growth in size of locomotives, however, has necessitated increasing the low-pressure cylinder to a diameter which cannot be accommodated by the width of the tunnels and clearance of station platforms. Hence the use of four cylinders has become a structural necessity, to say nothing of the more advantageous distribution of weights.

Assuming four cylinders to be a necessity, the question is one of their location. In England and France, they have been arranged to work on four cranks, two outside and two inside the frames. In this country, with our traditional dislike to inside cranks, we have preferred to place all four cylinders outside the frames. The Vauclain system has proved its good qualities by ten years of service, and the new experimental tandem locomotive, built by the Schenectady firm for trial on the Northern Pacific Railway, has given such satisfactory service during the past twelve months, that an order for twenty-six more has been given, and forty have also been ordered for the Atchison, Topeka & Santa Fé Railway.

SOME OF THE ENGLISH ROYAL TREASURES.

In the forthcoming coronation of King Edward VII. of England there will be a display of royal treasures that has seldom been brought together at a single function in recent years. It is so long since England has had a coronation that not many of the people remember the exact amount of royal treasury stock in the shape of jewels, crowns, and scepters kept on hand. It will be an interesting inventory time for the English nation, and not a few will find out for the first time the magnificent collection of jewels kept securely in the Tower. A good deal of the value of the English regalia is due to the historic associations connected with the various pieces. The crowns and scepters that have been worn by many successive kings naturally have a value in the eyes of the people far above their actual intrinsic worth.

There is quite a difference in actual worth between the early crowns of England's monarchs and those of later date. Probably Queen Victoria's imperial crown was the most expensive ever made. King Alfred's crown, which long ago disappeared, was mentioned in early works as being worth £248 10 shillings. Compare with this Queen Victoria's magnificent crown, so sparkling with brilliants that the crown itself is scarcely visible. There are by actual count 2,783 diamonds in this crown, some of which are large, handsome stones, and others mere chips, but all cut and set to form a complete picture of wonderful brilliancy. In addition to the diamonds there are 277 pearls, 16 sapphires, 11 emeralds, and 4 rubies, besides one large ruby and sapphire of remarkable value. This large ruby is the great spinel ruby which belonged to the Black Prince in 1367, and it has been said to be worth £100,000. The big sapphire is also an historical gem of almost priceless value. It was the one worn in a ring by Edward the Confessor and buried with him at Westminster. These two stones alone make the crown of both historic and intrinsic value far beyond that of any other crown in existence.

This crown is of more recent construction than the other imperial regalia, and it shows its modern workmanship in the setting of the stones. Most of the royal treasures used for the coronation and state occasions were made in 1662. At the time of the Commonwealth all the crowns and royal regalia were destroyed except the golden pitcher used for holding the anointing oil, the golden spoon, and the ancient coronation stone. After the restoration all the ancient articles were remade by Sir Robert Vyner, the royal goldsmith. His work testifies to his skill as a goldsmith, and no jeweler since has been made as famous because of the fact he received the royal commission to restore the destroyed regalia. His ambition was to imitate as closely as possible the ancient relics. For this purpose he studied the old coins and great seals of former kings to get the idea of the orbs, scepters, and crowns. The ancient style of the jeweler's art was to set many of the jewels with enamels on gold open work. This style of work is particularly manifest on the scepters, where enameled and jeweled scrolls are the chief ornaments. The champlevé enamel on the royal bracelets represents good work done in the days of Sir Robert Vyner, but there is also some sign of recent touching up by modern goldsmiths.

Queen Victoria's imperial crown represents the highest skill of modern stone setting, and from the point of view of the diamond cutter it is said to be the perfection of design. It required a good deal of artistic skill to set so many stones in a crown of that size without ruining the effect as a whole. In fact, the setting of the stones is so light and carefully done that one is scarcely aware of the background. The setting is of silver, and the pearls are held with gold wire. The rim of the crown is not a solid metal ground, but the gems are arranged in clusters in open work. The effect is consequently very striking.

St. Edward's crown is the official crown of England, and this shows very different work from Queen Victoria's. The latter was made in 1838 by Rundell & Bridge, and the former in 1662 by Sir Robert Vyner. The official crown is of great size, and almost clumsy looking compared with its mate. The rim is of solid gold, and edged with rows of pearls of considerable size, with here and there clusters of colored jewels surrounded by diamonds and set on enamels of red and white. The effect of so many colors in the rim gives a rather brilliant aspect to the crown, especially in a light. The four crosses patées and fleurs-de-lis which rise from the rim and form an arch toward the center are likewise studded with diamonds and colored jewels set in red and white enamel. In fact, this whole enamel effect is apparent in every part of the crown, and shows to perfection the old method of setting stones. Even the center orb of gold is filled with stones, with enamel effects. From the center orb the cross patée rises upward and is tipped off with a large pearl and with extended arms containing drop-shaped pearls. On the whole the crown is very striking, though somewhat clumsy, and a good representative of the goldsmith's art of nearly three centuries ago.

The orbs and scepters of the royal regalia which are deposited in the Tower and brought out only for coronations, are fully as interesting as the crowns, for though dating no further back than 1662, they possess sufficient historical association to make them of great value to the English people. They are symbolical of times and personages which will forever live in history. There are two orbs in the collection made for monarchs in the past. The first and larger one was made by Sir Robert Vyner for Charles II. and the smaller one for Queen Mary II. The first has consequently always been accepted as the official one by the English people, and every monarch since has been crowned with it. The orb is held in the hand at the coronation, its distinctive meaning being of rather obscure Christian origin, borrowed evidently from the Roman emperors by the early Saxon kings. In the great seals of the early Saxon kings the monarch is represented as holding a simple sphere or orb in his left hand, and in some a cross and a dove surmount the orb. From the earliest time the orb has thus been representative of the sovereign, and all succeeding orbs have been imitated after these early ones. They have varied somewhat in ornamentation since Edward the Confessor's time, but in the main they retain the cross-and-dove effect.

Sir Robert Vyner, under instructions from King Charles II., made the official orb of 1662, which is in use to-day, six inches in diameter, with a fillet around the center surmounted with an arch and edged with pearls. Clusters of colored jewels and diamonds stud the band and the arch, while the red and white enamels inevitably appear. At the top of the arch is a fine amethyst cut in facets one and a half inches high, and on this stands the cross patée, edged with rose-cut diamonds. In each of the four corners of the cross is a large, handsome pearl, while at the foot there is a collar of diamonds.

The smaller orb of Queen Mary is made somewhat after the same pattern, but it is smaller and more delicate, yet ornamented with fully as many jewels and diamonds. The fillet of gold around the center is outlined with large pearls and handsome amethysts, sapphires, and diamonds. The small cross at the top is simply decorated with precious stones. This orb belongs to the royal regalia, and is kept with jealous care in the Tower. Though it is not the official one, it generally figures in every coronation.

There are also two scepters in the royal collection, either one of which is a superb piece of the goldsmith's art. The royal scepter with the cross is two feet and nine inches in length, while Queen Mary's scepter, made for her by King James II., her husband, is two feet and ten inches in length. The latter is of solid gold, and ornamented only with diamonds. The former is of gold, but very elaborately decorated and ornamented with colored jewels. The upper portion is wreathed and twisted, and very handsomely decorated. There are three white and red enameled bands dividing the scepter. The cross rests on an orb of gold, and a large amethyst stands on it, faceted and held in position by jeweled projections. The whole piece is studded thickly with costly gems, and the effect is brilliant in the extreme. This is one of the finest products of Sir Robert Vyner's art. Some parts of this scepter have been remade since the time of Vyner, but the part which represents his work is easily recognized from the later additions.

There are only three articles of the regalia that date back to a period more remote than the restoration. These three articles were in Westminster Abbey at the time the Commonwealth ordered the destruction of the royal treasures, and they escaped. One of these is the ancient coronation stone. The other two are the only royal treasures produced by the goldsmith's art to recall a very great antiquity of workmanship. They are the golden eagle or ampulla, and the coronation spoon. The eagle stands on a pedestal,

and measures from the base upward nine inches, and weighs, all told, ten ounces of solid gold. The head of the eagle unscrews, and a hole in the beak permits the oil to pour forth upon the royal head. When this golden eagle was made history does not definitely say, beyond that it was in use at the coronation of Henry IV., in 1399. From general appearances, however, it looks as if Vyner had made some recent changes and improvements upon it. Certainly parts of the eagle have been worked over in recent times with a chasing tool. The screw which holds the head in position is hand-made, which partly testifies to its remote antiquity.

The coronation spoon is thought also to have been made some time in the twelfth century, and its style of ornamentation appears to prove this. The spoon is of silver gilt, and has a curious rib down its center, dividing it so that it fits the two fingers of the right hand. The ornamentation is that known as champlevé, a form of preparing metals for enameling in vogue centuries ago. There are four pearls in the handle, but otherwise its ornamentation is simple and inexpensive. There are indications that Vyner, when he remade the royal regalia for Charles II., also touched up the spoon, especially the bowl part, which indicates a later style of goldsmithy than the handle.

G. E. W.

EXTENSIVE PROJECT FOR IRRIGATING EGYPT.

BY ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The English government is determined that barren Egypt shall be restored to its ancient fertility. A few weeks ago we published in the columns of the SCIENTIFIC AMERICAN a description of the irrigation works that were being carried out at Assiout and Assouan, on the Nile. Now that these two projects are rapidly approaching completion, the English and Egyptian governments are surveying the country to ascertain where similar projects might be profitably and successfully carried out. Sir William Garstin, the Egyptian Under Secretary for Public Works, has had charge of these surveys, and for the past three years has been busily engaged in studying the White Nile and its various affluents. He has now prepared and forwarded his proposals for various irrigation works to the English Foreign Office.

By the end of the present year something like $35,000,000 will have been expended upon irrigation works and drainage works on the Nile since 1885. The barrage at Cairo, which was designed by a well-known French engineer, but was insecurely constructed, cost $2,300,000 to be restored, and to be converted into a serviceable work. Subsequently, to enable more water to be stored, two weirs were constructed below the barrage, at a cost of another $2,430,000. The result of this section of the work has been the doubling of the cotton crop of lower Egypt, equivalent to a gain of approximately $25,000,000 per annum to the country. The expense incurred by this undertaking has been thus adequately refunded.

Upon the various works in connection with the delta of the river in the eastern provinces, a sum of over $3,350,000 has been spent. This section of Egypt is one of the most fruitful and most important portions of the country. The building of these numerous miscellaneous works has been attended with great success, and has proved of inestimable service to the country.

For the purpose of insuring a supply of water to Sharaki lands in years of low flood about $3,660,000 has been spent. This part of the work is practically completed, and the extent of its utility may be adequately gaged from the fact that after 1899 only 264,000 acres of land were left without water, whereas in 1877, when the flood was not so low as in the later year, over 800,000 acres of water-land were without water.

Drainage works have absorbed $5,000,000. Large tracts of land, which formerly were so heavily waterlogged as to be absolutely useless for agricultural purposes, have been efficiently drained and now raise good crops. The arrears of taxation, which formerly attained a high figure, have also been greatly reduced.

The Assiout and Assouan dams, which were described in the SCIENTIFIC AMERICAN of May 4, will be completed in 1902. The latter dam will store up the water after the flood has passed, and will increase the supply of the river in the summer. A great portion of the extra water will be devoted to the transformation of the basin lands of Middle Egypt, which at present raise a flood crop only. Pumping stations are to be erected to facilitate and to extend the cultivation of the sugar cane. These works will also enable a tract of land in the Fayoum Province, which is at present an arid barren waste, to be cultivated.

The foregoing is an epitomé of the irrigation works at present in hand. Lord Cromer calculates that the irrigation part of them should be paid for within the next two or three years. But even when these works are completed, Mr. Willcocks, the eminent civil engineer, who has made the irrigation of the Nile his special study, estimates that the country will still require 2,610,000,000 cubic meters of water every year, while Sir William Garstin is inclined to think this an underestimated quantity, and that over 4,000,000,000 cubic meters of water will be necessary. The question that arises is: Whence can so large a quantity of water be obtained? Sir William has two alternatives. A reference to the map of the lower Nile shows that at Khartoum the river bifurcates—one tributary, the White Nile, proceeding from Victoria Nyanza and Albert Nyanza, and the other, the Blue Nile, rising from Lake Tsana, in Abyssinia.

The area of Lake Victoria is approximately 70,000 square kilometers. If the level of this lake were raised but one meter, 70,000 millions of cubic meters of water would thus be stored, while if the level were raised by three meters, the quantity of water stored, after deducting loss by evaporation, would amount to at least 140,000 million meters cube. The first estimate, however, would supply more than sufficient water for the whole of the Soudan and Egypt. There is one disadvantage of damming the water of this lake. The shores are thickly populated, the native townships and villages stretching right down to the water's edge. Therefore, in the rainy season the water that was being dammed back would flood the villages and cause widespread inconvenience. Also, about one-half of the area of this lake lies within German territory, and naturally the Germans might object to the raising of the water-level of the lake.

With the Albert Nyanza, the case is entirely different. This lake has a superficial area of about 5,000 square kilometers. Sir William Garstin suggests that, by the construction of a regulating dam at a point on the river below its exit from the lake, water could be stored up in the lake during the rainy season and utilized during the dry season to maintain the river at a higher level. The lake has an extensive catchment area, and he considers that its level could be raised without much difficulty to the required height. There are one or two objections, however, which considerably militate against the realization of the scheme at this point. The principal is the frequent seismic disturbances to which this part of the country is liable. Then, also, objections might be raised against constructing large works in such a remote district, since no one who is familiar with the country through which the White Nile flows, would embark upon any extensive irrigation projects to render the country agricultural.

Sir William Garstin then deals with Lake Tsana as the most practicable means of solving the difficulty. This sheet of water, which has a superficial area of about 3,300 square kilometers, is situated high upon the plateau in Abyssinia. The lake is deep, and its shores are uninhabited, so that no ill-effects would result in raising the water-level. If the water-level of this lake were raised five meters, a storage of 132,000,000,000 cubic meters of water could be obtained after allowing the necessary deduction for loss by evaporation. This basin is far more suited for extensive irrigation purposes than the Albert Nyanza. The scheme would not present any abnormal engineering difficulties, and the objection that can be raised is of political significance only. The fulfillment of the undertaking would supply abundant water for the exigencies of the Nile and the Soudan, and would render the navigation of the Blue Nile possible in the summer months.

INVENTING GAMES AND FORMS OF ENTERTAINMENT.

One of the most fruitful sources of securing a good income is in inventing games and forms of entertainment for private parties, sociables, and receptions. The extraordinary demand for something new in the line of entertaining is evidenced by the number of new games and tricks put on the market every year. These multiply rapidly, but most of them, being merely variations of old games, attract little more than passing notice. But when a really new and original game, trick, or form of entertainment is invented, the public shows its appreciation by adopting it immediately as the prevailing fad. There are so very few original inventions of this nature that it is safe to say that anyone who has the genius to discover one will reap financial reward sufficient to support her for the rest of her life.

These new forms of amusement need not necessarily be elaborate and expensive in character. Sometimes the very simple ones attract the most attention and actually earn more money for their owners. Women in particular are finding this field an attractive one for testing their inventive abilities. Many who go into it find in a little while that they are unfitted for it. They have great adaptive powers, but not inventive faculties. The former will hardly win renown and financial returns in proportion to the amount of work put in the efforts.

The Patent Office at Washington is besieged by applicants for inventions that are made for the purpose of amusing and entertaining, and the list that is annually rejected because they infringe upon the rights of others is very great. Nevertheless, women have been very successful in the last two years in this direction, and according to statistics given they have equaled the men both in the number and popularity of their inventions to amuse. Last year fully a score of such patents were taken out by women who must have made comfortable incomes from the sales of the articles. One successful trick, game, or puzzle should in the ordinary course of events make a tidy income for a woman for several years.

It is somewhat surprising that women inventors have not invaded this field more numerously than they have, for by virtue of their associations, life-work, and aspirations they should be in closer touch with what children and societies need of entertainment than men. Until quite recently most of the toys and games were invented entirely by men, while women inventors seemed to turn their attention to other subjects. This now has been changed somewhat, and the toys that are annually brought out are the work of minds and hands of women as much as of those of the masculine sex.

The toy season is not by any means confined to Christmas. It is pretty well distributed over the whole year; but the toys differ according to the seasons, and the inventor who wishes to make money with her designs must anticipate events. Birthdays are happening every day in the year, and thousands of toys suitable for such occasions are bought continuously the year round. The popular birthday present is a feature of the toy trade that was never better appreciated than to-day. Heretofore the remnants of Christmas toys were supposed to answer the purpose, and disgusted parents would travel from store to store in a vain search for something unlike the toys that had piled up around the family hearth at the last midwinter holiday. Birthday toys are consequently in great demand.

Who can produce something appropriate for such occasions, suitable to man, woman, boy, and girl? The person who can accomplish this is sure to find a steady sale that will in the end more than aggregate the total Christmas sales. Souvenirs and table decorations of a novel form and shape are also as constantly in demand as the birthday presents, and, like the latter, they must be peculiarly adapted to the purpose. To invent such a gift or souvenir to sell well the mind must study out the question as carefully as if a mathematical problem was offered for solution. One must make herself more or less thoroughly familiar with all the material on hand, and with the inventions in the same field that have been made before. Without this necessary preliminary preparation the chances of successful invention will hardly be very great.

Social games and entertainments for young and old depend largely upon the character of the audiences for their success, and a study of human nature should be one of the first essentials for preparation in this line. A professional entertainer who goes abroad every summer to visit foreign lands to study the little methods of life and social intercourse in Europe always returns with a great fund of new ideas which she modifies and adapts to her American audiences. She is not so original as adaptive, nor so adaptive as tactful. She knows instinctively and by study what her audiences would like, and this she aims to give them. She invariably proves such a success that her entertainments are often repeated by request, and she makes a good income, and secures all the pleasures and advantages of travel abroad. She makes up her programme for the winter ahead of time, and always keeps a certain stock of ideas and plans ahead which she can use in an emergency. Sometimes the best made programme will prove a failure, and it is then that the resourcefulness of the entertainer shows itself. If unable to fall back on something else to make up for the failure she would soon lose prestige.

The professional evening entertainer is becoming more and more a social factor in our large towns and cities, and the demands for her services grow in proportion to the success of the efforts put forth. There are many young women to-day who are making their living in this way, using song, oratory, music, and mind to accomplish their purpose.

Prof. G. J. Peirce points out that the object of respiration in plants is not as in warm-blooded animals, the maintenance of a certain body temperature, together with the production of energy needed for doing work, but, as in cold-blooded animals, simply the latter purpose, says The American Naturalist. The diastase formed in the germinating seed dissolving the starch deposited in the seed as a reserve food-material and converting it into sugar makes the reserve food available for at least three purposes, viz.: (1) For the construction of nitrogenous compounds (amides and proteids); (2) for the formation of cellulose; (3) for the liberation of energy by respiration, nutrition, and growth. The enzymes formed by the lower plants are also useful in more ways than one; not the least important use being the conversion of non-respirable into respirable substances. The sulphur bacteria (*Beggiatoa*, *Chromatium*, etc.) obtain most if not all, of their kinetic energy by oxidizing sulphur compounds.