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.