STRIKING A LIGHT.

BY PERCY COLLINS.

Looking round upon the civilized races of mankind to-day, one's imagination is sorely taxed to picture a time when the ready means of striking a light was not available. Yet it is certain that such a time must have been—far back in the dim ages, when man roamed the wilds and dwelt in holes and caves of the earth, scarcely more advanced in his domestic arrangements than the beasts of the field. In what manner the value of fire as a servant first dawned upon the mind of man must ever remain mysterious. But at all times there must have been fires and great conflagrations kindled by natural means and entirely without the aid of man. Thus, the effect of the lightning stroke, of friction caused by falling rocks or the chafing of limbs and stems in the dense forests, or the volcanic overflow of the smoldering furnaces within the globe, would from time to time display the properties of fire before the wondering eyes of primitive mankind.

Probably man first feared fire, then began to worship it as a god terrible and omnipotent to destroy. Then, his fear departing from him, he began to employ fire to benefit himself and his tribe, using it for cooking and warmth. Notice that he did not at first *make* fire. He took it from Nature's hand, so to speak, just as he gathered fruit from the forest boughs. There is direct evidence of this in the traditional history of many races. For example, the T'lingit family of Indians in southeastern Alaska say that the raven gave them fire, and have an elaborate folklore descriptive of the bird and its flight through inky darkness bearing the divine spark in a box. The fire was religiously preserved and fed, and members of the tribe took of it for their domestic hearths. These and similar fables of the preservation of fire in a box, and its being borne from tribe to tribe, or family to family, are reminiscent of the unquestionable fact that man knew and employed fire long before he had discovered the means of making it for himself.

Probably the first essays of man as a fire-maker were confined to the friction of sticks. There are just three ways in which one piece of wood may be rubbed upon another, namely, by moving with the grain, or "plowing"; by moving across the grain, or "sawing"; and by twirling a pointed stick within a wooden socket, or "drilling." All these methods have been used by early man. Neither the first nor the second method, however, was brought to a high state of perfection—or, to be more precise, they both reached perfection in rudimentary form. The fire plow, which was widely used among the Indo-Pacific races, and sporadically in America, consists of two parts: first, a stout piece of thoroughly dried wood perhaps 3 feet long and 2 inches in diameter, which forms the hearth or stationary part; second, a smaller stick of the same kind of wood, about a foot long, cut wedge-shaped at its lower end, the edge forming a very obtuse angle. This constitutes the working part, or plow. It was rubbed violently backward and forward on the stationary piece, cutting a groove running with the grain for a distance of some four inches. Minute shavings were thus detached, and, in the hands of a skillful manipulator, these were soon heated above the point of ignition.

Fire-making by sawing was a Malay device, and has never, perhaps, been successfully employed save in countries where the bamboo flourishes, the reason being that bamboo is the only really suitable wood. Two pieces are taken, one with a sharp edge, the other with a notch cut in it nearly, but not quite, severing the substance. After sawing for a time, the floor of the notch is completely pierced, and the heated particles fall below and ignite.

But the most important method of primitive fire-making is that of drilling. In its most simple form a stick of dry wood is twirled vertically between the hands upon a very dry and partially decayed lower platform. It is extremely difficult to obtain fire in this way, as modern experimenters may prove for themselves. Yet there is a certain knack about the operation, and this once being mastered, smoldering wood dust may be created with comparatively little labor.

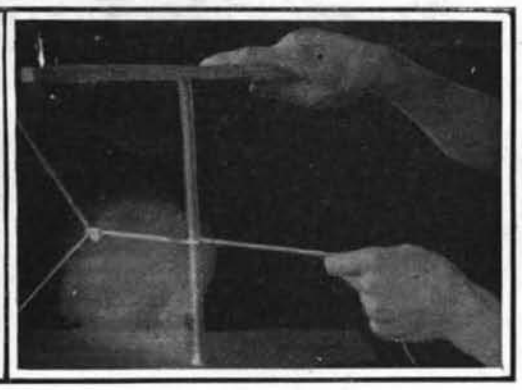
It is clear, however, that the fire drill could be made more effective and rapid in action in several ways. One such way calls for the co-operation of two individuals, one of whom supports the vertical spindle by means of a socketed rod, while the other wraps a cord about the spindle and pulls it backward and forward as rapidly as possible. No doubt a strip of hide took the place of a cord in primitive times, while if the reader will examine a collection of Eskimo men's tools in any museum, he will find that many of them have a cavity somewhere along the middle of the handle, enabling them to be employed as a socketed rod in this kind of fire-making.

A further complication of the fire drill was the application of the bowstring—similar to the drilling appliance used by the jeweler. The socketed rest for

"Plowing."

"Drilling."

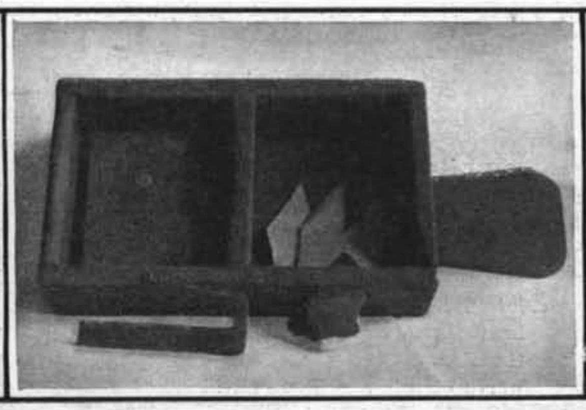
"Sawing."



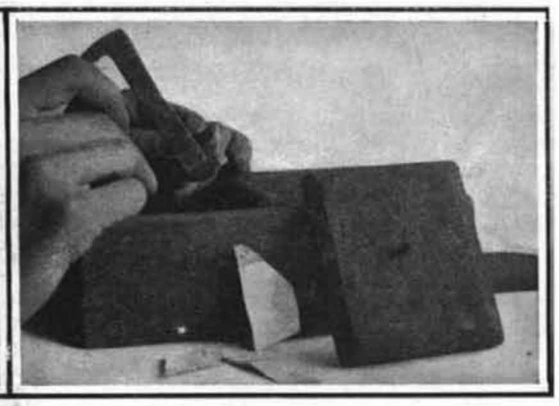
Drilling With Bowstring.

String-operated "Fire Drill."

Flint and Pyrites With Moss for Tinder.



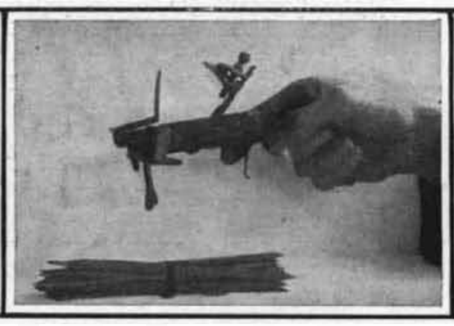
Flint and Steel Set With Paper Matches.



Using the Flint and Steel Set.

Metal Tinder Box With Steel and Flint.

"Chamak" Steel and Flint Set of the Himalayan.

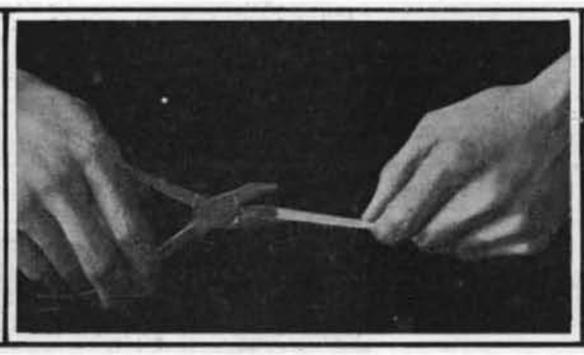


Pistol-like Tinder Box and Bundle of Sulphur-tipped Matches.

Method of Striking a Light With Flint and Steel.

"Oxymuriate" Match.

First Lucifer Match.



"Promethean" Match.

Modern Safety Match.

METHODS OF STRIKING A LIGHT.

the vertical shaft was then held by one hand, while the thong was alternately pulled and slackened with the other. Thus a saving of labor was attained. One worker was able to command results equal to those produced by two working without the bowstring. Still more elaborate and effective fire drills were evolved by savages. Among the Iroquois, for example, the pump-drill is reported. Its parts are the vertical shaft, the fly-wheel or spindle-whorl, the hand-piece by the up and down motion of which the drill is worked, and the string. The hand-piece is a stick held in the hand and attached at its extremities to the cord, which passes over a notch at the top of the spindle. The hand-piece is either perforated, the shaft passing through it loosely, or (in the ruder forms) it simply rests against the spindle. To set the apparatus in motion, the string is twisted once or twice about the shaft, and kept in motion by moving the hand up and down.

The forerunners of the comparatively modern flint and steel as a means of striking a light were flint and pyrites, or two pieces of pyrites. These were struck together, and the sparks thus generated were caught among a little dry moss. The Eskimos from Smith Sound to Behring Strait use this method. A very complete strike-a-light set, including flint, pyrites, tinder in dainty little bags, and a leathern pad to guard the fingers, comes from Cape Bathurst. Evans points also to Fuegia and the European archæological sites for the antiquity of this method.

Modern forms of the flint and steel are well known to most people from examples preserved in museums. Photographs of several of the more interesting varieties are here reproduced. There is the very old type of wooden box, perhaps the earliest strike-a-light set made by civilized mankind. With this are certain small angular pieces of stout paper, the tips of which are dipped in sulphur. These are the most primitive kind of match known. They were used for generating a flame, by application to the smoldering tinder. Genuine specimens of these matches are now extremely rare, though "faked" ones are often offered for sale by dishonest dealers in curios.

Another, and more compact, type of tinder box is of metal. In the bottom is seen the old dry rag, used as tinder, and upon this the flint and steel reposed when the box was not in use. Still more interesting is the ingenious strike-a-light made in the form of a pistol. The flint is worked by the trigger, and strikes upon an upright plate of steel, throwing the sparks through an opening upon the tinder contained in a narrow box which takes the place of what would be the barrel in the case of a pistol. This contrivance is a relic of the old stage-coach days. By means of it a light could be struck in a high wind. The matches which were then used were strips of thin pine wood, the ends being dipped in sulphur. One other tinder box may be mentioned, namely, the "chamak"—still in use among the Himalayan tribes. It is a little leathern pouch containing flint and tinder, while the steel is a strip of metal riveted along one side of the pouch. It is of small size, suitable to be carried about the person.

In conclusion, we may dwell briefly upon the developments of the match proper, as perfected by civilized man. Phosphorus was discovered by Brandt in the seventeenth century, and was used as a means of obtaining fire shortly afterward. But its costliness, together with the danger attending its use, militated against its popularity. But in the year 1805, the Parisian Chancel introduced the so-called oxymuriate match. It was a slip of wood tipped with a mixture of chlorate of potash, sugar, and gum. To ignite it, the match was thrust into a bottle containing a piece of asbestos saturated with sulphuric acid: an awkward arrangement, especially in the dark.

Then came the "Promethean" matches, whose career was short-lived. They were a kind of paper cigarette, dipped in a mixture of sugar and chlorate of potash. Rolled within the paper was a tiny glass bulb filled with sulphuric acid. To strike these matches, the tip was compressed between the teeth or pliers. By this means the bulb was broken, the acid liberated, and subsequent chemical action caused ignition of the paper.

The first really practical lucifer match, however, was invented by John Walker, of Stockton-on-Tees, in 1827, and by him named after Sir William Congreve, of rocket fame. It consisted of a splint of wood first tipped with sulphur, and then with a chlorate mixture. These matches were drawn rapidly through a piece of folded sandpaper to ignite them. It is curious to note that a tin box containing seven dozen of them, together with the necessary bit of sandpaper, cost one shilling.

Finally, after endless experimenting, inspired by handsome prizes offered by America, England, and other enlightened countries, the non-phosphorus safety match was brought into being, putting the top stone, as it were, upon man's monumental struggle with the problem of striking a light.

It is a curious commentary on the old world's slowness of inventive genius that the first practical match should have been made less than a century ago.

Tests of Balloon Envelope Fabrics Under Severe Weather Conditions.

Some interesting experiments were carried out recently by Carl E. Myers at his well-known balloon farm in Frankfort, N. Y., nine miles east of Utica. These experiments had in view the better retention of hydrogen gas in balloon fabrics, the handling and decanting of hydrogen from one vessel to another speedily without loss, and the operation of captive balloons and airships for long periods, exposed to all variations of weather, good and bad. The extreme hot, cold, rainy days, with wind and thunder storms, of the past few weeks, which wrecked farms and buildings throughout this section of the country, have been utilized to test the balloons exposed out doors almost constantly to whatever weather occurred. The extension of the use of captive balloons in the army, to which Mr. Myers has contributed over a hundred, and the late attempts of the French and German governments to make longer flights than two hours with airships, have demonstrated the necessity of approved methods for retaining hydrogen gas in balloon fabrics.

During the week of July 4 Mr. Myers operated his captive balloon, carrying hundreds of passengers, and concluded with a cut-loose voyage by himself and assistant, landing an hour later, and anchoring till morning, when the same balloon arose again, carrying Mr. and Mrs. Myers, who made a six hours' journey. This continuous use of a hydrogen gas balloon during five days, both as captive and free, has never been equaled. Since July 6 this balloon and another like it have been almost continually inflated out doors at the balloon farm, exposed to all kinds of weather.

On Monday morning, July 29, a motor airship was substituted, with which the same evening Mr. Coughlin, of Dayton, Ohio, made several flights to learn its control, followed by three free flights for practice. Tuesday evening the same airship made several flights over the balloon farm grounds with Mr. Coughlin, for further practice. Wednesday the hydrogen from this airship was decanted into another of exactly the same pattern, and Mr. Coughlin, who had bought the former airship, left with it for Columbus, O., where he expects to use it for exhibition. Mr. Myers' latest airship remains anchored out doors at the balloon farm, exposed without harm to the rain and thunder storms prevailing since, which prove the worth of this airship in all kinds of weather.

On August 2 a terrific storm of wind, rain, and hail passed over the balloon farm, but did no damage to the new airship. Not a puncture was made by the thousands of hail stones of all sizes dancing on and rebounding from the elastic envelope, which retained its hydrogen without any loss. Half an hour later the warming sunshine had re-expanded the contents, which had been shrunken by the chilling storm, and the gas bag had now to be allowed more space within its netting to avoid possible rupture. This test is regarded as the most marvelous in this line of experience.

Green and Blue Gold.

When precipitating by means of cathode projection thin transparent films of gold on a glass plate, two kinds of deposits can be obtained according to the method used. One kind of film is found to be green in transmitted light and yellow in reflected light and is optically identical to hammered gold foil. The other film is deep blue in transmitted light while showing, like the former, a metallic brilliancy in reflected light, but of a paler yellow.

Prof. L. Houllevigue, of Marseilles, by his recent researches on these two varieties of gold, an account of which he presented to the French Physical Society, has found that the latter variety, while being stable at ordinary temperatures, will be transformed into green gold on being heated beyond 130 deg. C. (266 deg. F.), and at the same time will lose 7 to 8 per cent of its weight, while its electrical conductivity is increased considerably.

As the green and the blue gold cannot be chemically identical, Houllevigue ascertained the chemical composition of the latter variety, which was found to be identical with gold hydride. In fact, when using a film of blue gold as anode in a voltameter containing acidulated water, the oxygen evolved at the surface is found to reduce the gold film to the state of metallic gold, the film becoming green. If, on the other hand, some blue gold be inserted in a Plücker tube which, after being exhausted and carefully dried, is sealed, this tube, when excited by electric discharges, will not give the spectrum of hydrogen; the latter will, however, appear if the tube has been raised to the temperature of conversion at which the blue gold is decomposed into metallic gold and hydrogen.

The character of a deposit obtained by cathode projection mainly depends on the temperature of the room in which the experiment is made, blue gold being obtained in the case of a low temperature and green gold in that of high temperatures. According to these phenomena, the cathode would project normally gold hydride, which is either decomposed or remains unaltered. This accounts for the fact that blue gold is obtained by operating slowly, and green gold by hastening the process, and that deposits of variable thickness are generally blue in the thinner and green in the thicker portions. The same fact affords an explanation of the aging of cathodes, a gold cathode which when new gives blue gold, yielding exclusively green gold after some prolonged usage. In fact, if one-half of this cathode be lined with galvanoplastic gold, blue gold is found to be precipitated by cathode projection on the newly gilded portion and green gold on the other half of the cathode. The more hydrogen a cathode contains, the less hard will the tube be and the lower the temperature in the parts surrounding the cathode.

Geologic Work in National Forests.

The United States Geological Survey, in connection with its other work in the West, has undertaken to examine geologic conditions in the national forests. It has been the policy of the government to encourage mining in the areas included in the national forests, but many fraudulent entries have been found, which cover non-mineral lands or deposits that by no possibility could be developed into paying mines, and it is clearly in the interest of legitimate mining enterprises to prevent "wild-cat" mining companies from obtaining titles to the lands covered by such claims.

The work of the Survey will be of practical value both to the Forest Service and to the miners, for the reports of the geologists will enable the Forester to make recommendations to the Commissioner of the General Land Office on the character of mineral locations. The policy of the Survey will be to require its geologists to assist in every way the claimant who is acting in good faith and to help the officers of the Forest Service in their task of protecting the mining industry and all other interests which benefit by the proper administration of the national forests.

A New Extinct Elephant from Africa.

In the final report of a recent geological survey of Natal and Zululand, Dr. W. B. Scott, the well-known palæontologist of Princeton, New Jersey, gives a description of the two last lower molars of an extinct elephant obtained from a deposit of late Tertiary age in Zululand. For the elephant the author proposes the name of *Elephas zulu*. Its teeth have their constituent plates more numerous and thinner than are those of the existing African species, and they are described by Dr. Scott as being to a great extent intermediate in this respect between the latter and those of the extinct European and Asiatic *Elephas antiquus*. To Mr. R. Lydekker, who writes on the subject in Knowledge and Scientific News, they seem to be much nearer the molars of the species last named. It is suggested that *E. zulu* may have been the ancestor of the living *E. africanus*, in which case it would almost be imperative to regard the molars of the latter as being of a degenerate type. This question requires very careful consideration; but, apart from this, the discovery is one of great interest.

The Current Supplement.

The opening article of the current SUPPLEMENT, No. 1652, deals with the giant floating dock which was recently sent from England to Trinidad. Mr. J. H. Morrison begins an interesting series of historical articles on the development of armored war vessels. Col. C. W. Larned's excellent paper on the history of map-making and topography is completed. Curious examples of old maps are published with the text. The Paris correspondent of the SCIENTIFIC AMERICAN writes on European automobile fire apparatus. A very complete account of Dr. Cushman's theory of the electrolytic corrosion of iron is published, and will be continued in the next number. Prof. James Swinburne contributes an excellent paper on incandescent illuminants. The fuel-testing plant of the United States Geological Survey at the Jamestown Exposition is described and illustrated. George M. Little writes on new developments in arc lamps and high-efficiency electrodes, and gives some interesting comparisons between metallic and carbon arcs. An historical review of chemical conceptions is given by Prof. Charles Baskerville.

The cultivation of bamboos on an extended scale is contemplated by the Japanese residents of Victoria, B. C. Experimental growths have proved very successful, and during the coming winter many roots will be imported from Japan. The cultivators hope to develop a big trade in bamboo furniture; and also to introduce the use of bamboos as water pipes, a purpose for which they have long been in use in the Orient. Bamboo cultivation is a profitable industry in Japan, where the returns from an acre yield from $20 to $90.