stem toward the chiefs, each was allowed to take a smoke. The pipe was beautifully ornamented, and was used only at the sun-dance. Some of these pipes are of great value, the one seen costing fifteen of the best horses in the tribe, and these were used for hunting the buffalo. The women have one important ceremony to perform; namely, the preparation of the tongues. In former years, when buffalo were in abundance, as many as two thousand buffalo-tongues were used at a single sun-dance: now the Indians have to be contented with two hundred tongues of domestic cattle. These are slightly boiled and dried, cut in slices very carefully, taken in sacks to the sun-lodge, and guarded by two young men. This rite partakes of the nature of a sacrament. None but virtuous women are allowed to go up and take a piece of tongue. After the persons devoted to the sun have partaken of the meal, the rest of the tongues are distributed among the people as a religious ceremony.

At this time a young Indian went to an old medicine-woman and presented his sacrifice to the sun. During the year he had gone on a horse-stealing expedition, and, as is customary on such occasions, had prayed to the sun for protection and success, offering himself to his god if his prayers were answered. He had been successful, and he now presented himself as a sacrifice. The old woman took his hand, held it toward the sun, and prayed; then, laying a finger on a block of wood, she severed it with one blow of a knife. She held the portion of the finger cut off toward the sun, and dedicated that to him as the young man's sacrifice.

One of the principal features of the sun-dance is the self-torture of those who are admitted as warriors. Dr. McLean witnessed one of these ceremonies. Two young men, having their whole bodies painted, wearing the loin-cloth only, and with wreaths of leaves around their heads, ankles, and wrists, stepped into the centre of the lodge. A blanket and a pillow were laid on the ground, and one of the young men stretched himself upon them. As he lay, an old man came forward and stood over him, and then in an earnest speech told the people of the brave deeds and noble heart of the young man. In the enumeration of his virtues and noble deeds, after each separate statement the musicians beat applause. When the aged orator ceased, the young man arose, placed his hands upon the old man's shoulders, and drew them downward, as a sign of gratitude for the favorable things said about him. He lay down, and four men held him, while a fifth made the incisions in his breast and back. Two places were marked in each breast, denoting the position and width of each incision. This being done, the wooden skewers being in readiness, a double-edged knife was held in the hand, the point touching the flesh, a small piece of wood was placed on the under side to receive the point of the knife when it had gone through, and the flesh was drawn out the desired length for the knife to pierce. A quick pressure, and the incision was made, the piece of wood was removed, and the skewer inserted from the under side as the knife was being taken out. When the skewer was properly inserted, it was beaten down with the palm of the hand of the operator, that it might remain firmly in its place. This being done to each breast, with a single skewer for each, strong enough to tear away the flesh, and long enough to hold the lariats fastened to the top of the sacred pole, a double incision was made on the back of the left shoulder, to the skewer of which was fastened a drum. The work being pronounced good by the persons engaged in the operation, the young man arose, and one of the operators fastened the lariats, giving them two or three jerks to bring them into position.

The young man went up to the sacred pole, and, while his countenance was exceedingly pale, and his frame trembling with emotion, threw his arms around it, and prayed earnestly for strength to pass successfully through the trying ordeal. His prayer ended, he moved backward until the flesh was fully extended; and, placing a small bone whistle in his mouth, be blew continuously upon it a series of short, sharp sounds, while he threw himself backward, and danced until the flesh gave way and he fell. Previous to his tearing himself free from the lariats, he seized the drum with both hands, and with a sudden pull tore the flesh on his back, dashing the drum to the ground amid the applause of the people. As he lay on the ground, the operators examined his wounds, cut off the flesh that was hanging loosely, and the ceremony was at an end. In former years the head of a buffalo was fastened by a rope to the back of a person undergoing the feat of self-immolation, but now a drum is used for that purpose.

From two to five persons undergo this torture every sun-dance. Its object is military and religious. It admits the young man into the noble band of warriors, whereby he gains the esteem of his fellows, and opens up the path to fortune and fame. But it is chiefly a religious rite. In time of sickness or danger, or in starting upon some dangerous expedition, the young man prays to the sun for help, and promises to give himself to the sun if his prayers are answered. Upon his return, when the annual sun-dance is held, he fulfils his vow, gives himself to his god, and thus performs a twofold duty. Of course, the applause of the people and the exhibition of courage are important factors in this rite, but its chief feature is a religious one. Instead of being a time of feasting and pleasure, the sun-dance is a military and religious festival, in connection with which there are occasions for joy, and the feast enhances the pleasure.

During the feast the entire assemblage will burst forth in songs of thanksgiving, and again a famous warrior will sing aloud the praises of a young man or some brave kinsman who merits the applause of the tribe. This is a kind of chant, in which the name and noble deeds are spoken of.

A SURVIVAL OF CORPORAL PENANCE. — The state of mind from which the infliction of self-torture arises is not confined to primitive people, but has manifested itself in all great religions of the world. In the middle ages the Order of the Flagellants was devoted exclusively to this purpose. A survival of this once powerful organization offers an interesting comparison to the practices of the Blackfeet, just described. This was observed to exist by Mr. O. H. Howarth in the village of Fenaês d'Ajuda on the Azores, and has been described by him in a recent number of the *Journal of the Anthropological Institute*. The Order of the Ferceiros in that place now consists of a body of from fifteen to eighteen lay inhabitants of the parish, who are admitted to it by election every seven years; the order being held in such reverence, and the efficacy of the penance so profoundly believed in, that vacancies are much sought after. The ceremony takes place annually in connection with the procession of N. S. dos Passos on the third Sunday in Lent. The costume of the Flagellants is a white linen tunic, with a large oval opening in the back for the purpose of flagellation; and the head of the performer is entirely concealed with a wrapper of white linen, so that his identity may be unknown to the general spectators. Mass is conducted by the priest, and the flagellation commences when the church is darkened in the course of the Lenten ritual, the order kneeling in two rows at each side of the chancel. It is continued throughout the procession which follows. The principal streets of the village are traversed, and the self-punishment is inflicted with special violence during pauses at the street-corners, when the members of the band seem to vie with one another in the severity of their discipline. The procession returns to the church; the flagellants resuming their former position, and continuing to scourge themselves with increasing vigor until the conclusion of the ceremony. The torture is carried to such extremities that the side walls, railings, and confessionals in the chancel are smeared and spotted with blood to a height of four or five feet. The type of the scourge and flagellum are such that the author concludes the institution to be kept up by unbroken tradition from the middle ages, the implements being of the same description as those used six centuries ago by the Flagellants.

ELECTRICAL NEWS.

SMALL ENGINES FOR ELECTRIC LIGHTING. — The Society of Arts in England having offered a gold medal for the best small engine to be used for electric lighting, some tests have just been published giving the results of the trial. There were four competitors, — three gas-engines, and a high-speed high-pressure steam-engine. As the machines are especially useful for isolated lighting plants, the results give some valuable data as to the cost of lighting by electricity as compared with gas. One of the three gas-engines,

the Otto, is well known in this country. A mixture of gas and air is admitted into the cylinder and ignited, the explosion giving the motive power. The arrangement is such that the engine receives one impulse in every two revolutions; so, in order to get a steady motion, an extremely heavy fly-wheel, or a countershaft carrying a fly-wheel, is necessary. Another of the gas-engines, the Atkinson, is of rather remarkable design. There are four strokes of the piston to one revolution of the fly-wheel, and these strokes are of varying length. The stroke which takes the charge into the cylinder is 6.3 inches; the next stroke compresses the charge, and is 5 inches in length, the charge being thus compressed into a space of 1.3 inches. The compression being effected, ignition takes place, giving the working stroke, which is 11.13 inches in length. This is followed by the exhaust stroke, which sweeps the products of combustion out, and is 12.4 inches in length. The cylinder is 9.5 inches in diameter. The third of the gas-engines, the Griffin, differs from the other two in several particulars. An impulse is given to the crank-shaft for every revolution and a half. The tests were made by Professor A. C. W. Kennedy, Dr. John Hopkinson, and Mr. Beauchamp Tower. Taking first the Atkinson engine, they found that the gas consumed per indicated horse-power was 18.8 cubic feet, and per brake horse-power 22.1 cubic feet per hour. The gas used for ignition was 4.5 cubic feet per hour, making a total per brake horse-power of 22.6 cubic feet per hour. The engine ran smoothly and with regularity. The mechanical efficiency of the engine was 85 per cent, and 25.5 per cent of the whole of the heat generated was converted into work. The Otto engine used 27.4 cubic feet of gas per hour for an available horse-power. The Griffin engine used 28 feet per hour for an available horse-power. These figures show, that, as far as the cost of gas is concerned, it is more economical to use it to drive an engine, and use the power developed for electric lighting, than to burn it directly. For instance: if we take 25 cubic feet of gas per hour as the average amount consumed per horse-power by a gas-engine, then we have, by burning direct, 5 16-candle-power gaslights; with gas-engine and dynamo, 12 16-candle-power electric lights. There are at present, however, so many additional expenses incident to an isolated electric plant, — interest, depreciation, breakage, attendance, etc., — that it is cheaper to use the gas directly. At the same time, the figures given suggest possibilities. The fourth engine tested was a Davy-Paxman steam-engine of about twenty horse-power. This gave some remarkable results. It is a compound engine, the cylinders being 5.24 and 8.98 inches in diameter, and the stroke 14 inches, the pressure used being 190 pounds. The result of one of the trials was an available horse-power for 2.08 pounds of coal per hour, — a remarkable result, considering the size of the engine. These results show, that, as far as cost of fuel alone is considered, a horse-power hour from a gas-engine, with gas at $1.50 per thousand feet, would cost 3.75 cents; and from a Davy-Paxman engine, with coal at $4 per ton, .8 of a cent.

ACCUMULATORS. — Judge Coxe has just rendered a decision in the United States Circuit Court for the southern district of New York, in which the Faure patent for improvements in secondary batteries or accumulators is held to cover any secondary battery in which an electrode is used having the so-called active material applied in the form of a paint, paste, or cement. The suit is entitled "The Electrical Accumulator Company *vs.* Julien Electric Company." The field for accumulators is very large, as shown by the fact that there are to-day no less than eight or ten companies engaged in that business. Among them are the Electrical Accumulator Company, owning the Faure patents, and the Julien, Gibson, Woodward, Pumpelly, and Macræon Companies, all of whose batteries, the Accumulator Company claims, are tributary to the Faure invention. In anticipation of a favorable decision, the Electrical Accumulator Company has already built a street-car to be propelled by means of batteries, and now has it on exhibition on Elkins & Widener's Philadelphia Traction Road in West Philadelphia. Its initial trip last Friday was a success, the car moving up a long five-per-cent grade at the rate of seven miles an hour. Brill & Co., West Philadelphia, are making six other cars to be completed in April and May; and the Electrical Accumulator Company is now prepared to occupy extensively the electric street-car field.

NOTES AND NEWS.

DR. R. W. SHUFELDT has moved from Fort Wingate, N.Mex., to Washington, D.C., where he will continue in his scientific pursuits at the Smithsonian Institution.

— The wind-pressure on the Forth bridge, or rather the effective area of a bridge exposed to a wind-pressure striking the work at different angles, was practically demonstrated by Mr. B. Baker, as described in a late lecture before the Society of Arts, as follows: a model of the bridge was made, and towed in water at different angles to the stream; the area of a flat board normal to the current was then determined, which exerted the same drag as the model; this area was then taken as the effective area of the bridge for the particular angle at which it was towed.

— M. Alfred Binet of Paris, France, will contribute to *The Open Court* (Chicago) of March 21 a paper on "Sensation and the Outer World." The article is part of an unpublished essay upon "External Perception," crowned by the Académie des Sciences Morales et Politiques. In the same number Professor Edward D. Cope of Philadelphia will present some considerations upon ethical evolution, including a review of the extent and significance of the utilitarian doctrine of morals. *The Open Court* of March 28 will contain an article by the German Sanscrit scholar, Professor H. Oldenberg, on the "Discovery of the Veda." The disclosures that this epoch-making event have led to, form the most interesting chapter in all philological science.

— The composition and evaporative power of Kansas coals have been investigated by Professor E. H. S. Bailey and Professor L. I. Blake, of the State University. The coal-measures that underlie the eastern part of the State of Kansas are being developed at the present time to a greater extent than ever before. With the increased population of the State, the introduction of important manufactories, and the extension of so many lines of railway, there is naturally a greater demand for fuel, and a greater interest in its economic supply. In the last "Report of the State Mine Inspector" (1887), there are mentioned about a hundred shafts, in the different regions, where mining is actively carried on; besides this, there are innumerable places where coal is mined or stripped in a small way to supply the local trade. The coal-beds seem to be divided into several groups, the lowest being in the extreme south-eastern part of the State. The coals depreciate in their steam-producing powers from the south-eastern part of the State toward the north and west. Professor Bailey finds they depreciate in the amounts of fixed carbon in a similar order.

—The Johns Hopkins Hospital will be opened to the inspection of the public, before the reception of patients, during the week beginning May 6, 1889. On Tuesday, May 7, at 11 o'clock in the morning, there will be appropriate addresses in the main administration building. Invitations to be present will be sent to the authorities of the city and State, to those who have rendered special services in promoting the plans of the hospital. to professors of medicine and surgery, to the chief managers of other hospitals, and to the representatives of the press. On Wednesday, May 8, between the hours of 12 and 6 o'clock, the buildings will be open to the medical profession of Baltimore, Washington, and the State of Maryland, to medical students, to the managers of the benevolent institutions of Baltimore, to the ministers of all religious denominations, and to other persons whose pursuits have led them to take a special interest in hospital-work. Cards of admission will be distributed in advance. On Thursday, May 9, and Friday, May 10, between the hours of 12 and 6 o'clock, the public generally will be invited to visit the hospital. Cards of admission may be obtained, on the days named, at the entrance-gate of the hospital, Broadway. On Saturday, May 11, the faculties of the various institutions in Baltimore, the teachers of public and private schools of every kind, the students of the Johns Hopkins University, the Baltimore City College, the State Normal School, the Woman's College of Baltimore, and the Eastern and Western Female High Schools, will be admitted between the hours of 10 and 6 o'clock upon the presentation of tickets, which will be distributed in advance. The dispensary will be opened for the treatment of out-door patients, Monday, May 13, at 10 o'clock. The hospital will be opened soon afterwards for the treatment of patients.