The writer was fortunate enough to observe a flying-fish (on the 9th of April, 1886) moving in a direction apparently parallel to that of the ship, and with equal velocity. By means of a Casella anemometer the velocity of the wind across the ship's deck was found to be 13.6 feet per second, and its direction was 20 degrees from ahead.

Referring to fig. 2, *b* represents the ship; *c*, the fish; and *a*, the angle of the wind. The true velocity of the fish through the air was then $13.6 \times \cos a = 12.78$ feet per second.

Let us take, for example, a specimen whose wings and weights would be a mean between the three specimens recorded.

Let A represent the area of its wings in square feet $= \frac{17.765}{144} = 0.1234$; V, its velocity in feet per second $= 12.78$; A′, the projected area of the wings; W, the weight of a cubic foot of air in pounds $= 0.075$.

In experiments with flying-machines (R. C. Buel, in Appleton's Cyclopaedia of mechanics, vol. i. p. 53), it has been ascertained that an angle of 54° 10″ is the most advantageous angle at which the vanes can be placed (these vanes are similar to the wing-fins of a flying-fish). Therefore $A' = A \times \sin 54° 10'' = \frac{1}{10}$ of a square foot, nearly.

The force with which the air will be pressed downward, or, what is equivalent, the lifting-power of these wings moving at V velocity, will be $\frac{V^2 A' W}{2g}$.

Substituting the numericals above recorded, we have $\frac{(12.78)^2 \times 0.1 \times 0.075}{64.3} = 0.0190507$ pounds, or about $\frac{0.019}{0.177} = \frac{1}{9}$ the weight of the fish in question.

The method of catching flying-fish on board the Albatross affords a means of observing some of their motions. When our submarine (Edison's) lamp is lowered a few inches below the surface of the water, these fish often approach it gradually. On such occasions they invariably have their pectorals and ventrals extended, but do not appear to use them as organs of locomotion: on becoming alarmed, they close these fins, and dart forward suddenly. The brilliancy of the electric light, no doubt, dazzles their eyes greatly, for they do not appear to see objects near them, and, when alarmed by the splash of the scoop-net, dart right forward by use of the caudal fin. Mr. Nye, quickly perceiving this habit, takes advantage of it by plunging the net directly in front of the fish, which he almost invariably catches. On one occasion a fish turned in its flight, and projected itself several feet vertically into the air, very close to the side of the ship, working its wings vigorously, which was distinctly seen by several people on deck.

G. W. BAIRD.
*Passed Assistant Engineer, U.S.N.*
Washington, June 24.

## An Indian snake-dance.

I have received a clipping from the New York *Commercial advertiser* containing a letter from a Mr. Trumble in reference to the article on the 'snake-dance' of the Moki Indians of Arizona (*Science*, vii. June 4). Mr. Trumble mentions the occurrence of similar performances among several Central and South American tribes, and discusses at some length the antidotes used. This feature was only touched upon in my paper for the reason that Dr. H. C. Yarrow of the army, who attended the dance at Wolpi for the special purpose of identifying the species of snakes used, and of determining whether they had been rendered innocuous, was present at the reading of the paper, and was kind enough to discuss it at some length. Perhaps the interest in the question would justify a few remarks on that phase of the subject. Dr. Yarrow identified four species of snakes, only one of which, however, was poisonous, — the spotted rattlesnake, or Crotalus confluentus. He descended into the snake *kiva* on the eve of the dance, and there examined the snakes which were to be used on the morrow. At his request a large rattlesnake, selected by himself, was held up for his examination by one of the Indians, and, upon prying its mouth open, he found the fangs intact and of large size. I may add, that, at the conclusion of the 1883 snake-dance, two rattlesnakes were captured, and sent to the national museum. They were examined soon after their arrival by Dr. S. Weir Mitchell of Philadelphia, who found them in perfect order: their fangs had not been disturbed, and the poison-sacks were intact and full of venom.

The snakes used in the dance undergo a very complicated course of treatment in the *kiva* where they are confined prior to their appearance in public. They are washed repeatedly in various kinds of 'medicine-water,' and are frequently handled or stroked with a downward, squeezing movement of the hand. Whether such treatment prolonged over a period of five or six days is sufficient to render innocuous a robust rattlesnake, is an open question. Both Captain Bourke in his book, and Dr. Yarrow in his remarks, mention seeing a large rattlesnake brought in from the fields on the day of the dance. These, at least, must have been capable of inflicting fatal wounds.

The Indians have the greatest confidence in the means they use to secure immunity. Dr. Yarrow, in an interview he had with the high priest soon after the dance, showed the old man a hypodermic syringe and a solution of permanganate of potassium, which he had brought along to use in case of necessity, and explained to him their use. The old man replied, "No doubt my brother's medicine is good, but we are quite satisfied with our own." The performers are very seldom bitten: I observed but one instance at Wolpi, none at Mashongnavi. Others, however, record two other instances at Wolpi, which escaped my attention: in both of these cases the bite was inflicted by non-venomous serpents. As the number of snakes used at that dance was about eighty, this is not a very high percentage. I am of the opinion that the Mokis rely on the previous treatment of the snakes, on their charms and incantations, rather than on any after-treatment of themselves. As Dr. Yarrow remarked, a snake which had been repeatedly handled, and had discovered that no injury was intended, would become comparatively tame, and this would account for the behavior of the snakes during the dance. In the hands of the dancers, they seem numbed and lifeless, and it was only when dropped rudely on the ground from the mouths of the dancers that they showed any disposition to fight.

The knowledge of the composition of the liquids used by the Mokis is confined to one man, a high priest; even the members of the order are ignorant of it: but, to provide against the loss of the secret, the knowledge is shared with an old woman of the tribe. The high priest keeps this knowledge to himself until he is, or thinks he is, on his death-bed;

he then communicates it to the successor whom he had previously selected, and to whom he had already taught all the other rights and ceremonies pertaining to the dance.

The various liquids or 'medicine-waters' are not procurable by those not in the order, as they are very jealously guarded. Wiki, the high snake-priest, in an interview held after the dances at a ranch in the neighborhood, was quite communicative for a while, but, when this subject was approached, became very much agitated. He said, that, were he to reveal the secret of the preparation of these liquids, his life would be the penalty. Dr. Yarrow succeeded, however, in obtaining a bottle of the liquid used after the dance, and it is now in the army medical museum.

It should be mentioned that these liquids are not looked upon by the Indians as antidotes. The liquid taken after the dance has no direct bearing on the question of poison. In reply to Dr. Yarrow's question as to the object of this ceremony (the vomiting after the dance), Wiki told him that "the presence of the snake between the lips of the dancer caused a profuse flow of saliva, which the dancer was necessarily obliged to swallow, and that if he did not get rid of this saliva, which was poisonous, his stomach would swell up and burst," — an operation, it is hardly necessary to say, which never occurred from this cause; and the account must have been derived, therefore, from some source outside the facts of the case.

Mr. Trumble speaks of gorging on the part of the participants in the dance; he also says the snakes are fed until they become inert, and finds in these practices a partial preventive of evil effects from snake-bite.

Neither of these apply to the Moki dances. The performers go into the dance after four days of what is practically fasting (they eat but one meal each day); and the snakes themselves, so far as I could learn, are given nothing whatever to eat. It is true that in Wiki's accounts the phrase, "and I bathed him, and gave him to drink of the liquid," occurs; but the giving of drink is metaphorical, and consists of sprinkling the snake with the liquid by means of a feather.

I think the study of the rites pertaining to serpent-worship, as they occur among the lower races of mankind, would throw much light on the serpent-symbolism which prevailed among quite highly civilized people; the Egyptians, for example: but our knowledge of the early phases of this form of worship is rather meager. Perhaps the tribes mentioned by Mr. Trumble may supply some of the needed information.

A writer in *Harper's weekly* (March 25, 1882), quoted by Captain Bourke, gives an account of a performance very similar to the Moki dance, but occurring among some Central American tribes. In this ceremony each performer has his own particular snake, which he has previously trained, and with which he performs various feats. This, however, is jugglery, an element which is entirely lacking in the Moki performances. On this point I cannot do better than to quote Dr. Yarrow's closing remarks: "I went to Wolpi expecting to find a good deal of humbug about the snake-dance; I came away convinced of the earnestness and fair dealing of the people, and without a doubt that they fully believed that their ceremonies would bring about the desired result."

I think Mr. Trumble is mistaken about the effects of curari; but the word has been applied to so many different varieties of poison, that it has come to have a rather vague meaning. Curarine, the active principle of curari, is said to cause paralysis of the motor nerves, and it has been used in medicine as an antidote for strychnine and as a remedy in hydrophobia and in tetanus. But this part of the subject I must leave for those better qualified for the discussion. The subject has excited much interest; and many eminent investigators, from the days of Sir Walter Raleigh (who published his account in 1595) down to the present time, have given it their attention. Probably the most complete account is that published by Dr. S. Weir Mitchell and Dr. W. A. Hammond in the latter's 'Physiological memoirs,' 1863.

There is a point in Mr. Trumble's letter which seems to deserve special attention: this is the use, by Indians, of antidotes against poisons. To the savage there is no unknown: every thing is explained; and this explanation is always the most simple, the most direct, and, as a rule, the most superficial, that could be applied. The savage can no more realize the physical causes of phenomena than he can the laws which govern the solar system. Instances of this are furnished in abundance by the Moki myths; but they need not be quoted here, as they occur in all tribes, and can be found in any work treating on mythologic philosophy. The inability to realize the facts of physical causation, the grandest which have yet been discovered by man, is not confined to savages, however, but is present, in a greater or less degree, in what we are accustomed to call the highest civilization. It follows, then, that poison as a physical cause of death is a conception which is beyond the ken of the savage mind, and such is actually the case. Poison, when it is conceived of at all by savages, — and this conception is rarer than is generally believed, — is not thought of as a substance containing in itself its fatal properties, but as being endowed with them by some outside power, — either human, as in witchcraft, or else supernatural. The antidote to poison as thus conceived consists of an appeal to the same powers which produced the poison, or, in other words, to charms, or prayers, or incantations.

COSMOS MINDELEFF.

## Prehensile-tailed salamanders.

It is not well to be hasty in accepting the idea that the tail of the salamanders is of so little value to them that they might get along quite as well without it. Observation proves the organ to be of constant use in pushing, when the animal makes its way among weeds, grass, rocks, or other obstructions. It is the main dependence of such as swim; and of climbing species its importance as a support and a lever is very manifest. Those suggested are general uses, common to all tailed batrachians. Particular species have the tail still more specialized. It is to some extent an organ for grasping in the long-tailed terrestrial species. A frequent practice of the 'spotted salamander,' Amblystoma punctatum, when taken up, is to curl the tail around the fingers or hand to prevent falling. Suspended thus, hanging head downward, it will again and again try to regain footing rather than drop. Peculiar serpentine curves, and the motions of the very flexible tip, often give the