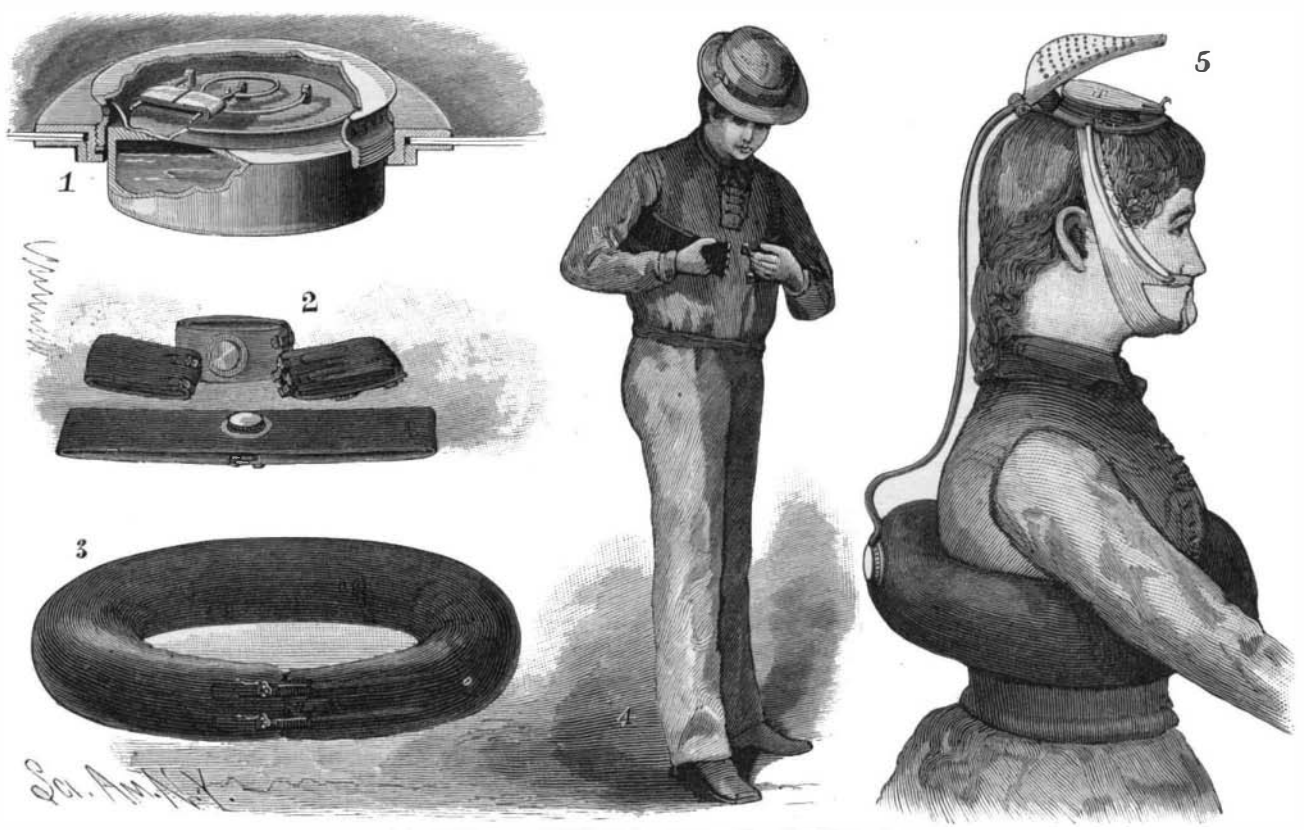
AN IMPROVED LIFE PRESERVER.

The life preserver proper consists of a long and narrow bag made of suitable waterproof material, and provided at the ends with catches, so that it may be passed around the body just below the arms, and the ends united. Secured in one side of the bag is a capsule containing a liquefied gas, such as ammonia. The mechanism for automatically liberating this gas to inflate the bag is held in check by a strip of soluble paper or its equivalent; the wetting of this paper releases the mechanism, which allows the gas from the capsule to fill the bag.

The capsule is cylindrical in form, and has a surrounding flange by which it is held in place by means of a screw cap around the side of which is a row of holes through which the gas escapes. The upper part of a rod passing through a hole in the center of the top is bent to form an arm, which is acted upon by a spiral spring, as shown in Fig. 1. The arm is held against the tension of the spring by a piece of soluble paper. When the capsule is immersed, the water flows through the side holes, wets the paper, when the spring is released and turns the rod to shift a suitable valve upon the interior, which allows the gas to fill the bag. To reach the paper, the entering water has to pass upward and over a curved brim, the object of which is to prevent the band from being moistened, should any drops of water enter the holes at any time when it is not desired to have the apparatus operate.

When the device is applied to a boat, raft, or other large vessel, to give it additional buoyancy in case of accident, the capsule is formed with two compartments, one containing a liquefied gas and the other a combustible powder and a frictionally ignitible preparation for lighting it. The combustion of the powder is an expedient for both liberating the gases and for generating additional gas and sufficient heat to prevent the freezing of the liquefied gases upon the pressure being removed. The liberating mechanism is changed to suit the altered conditions, but the paper band is employed as in the life preserver. When one capsule has been used, another is substituted for it, as is done in charging firearms with cartridges, and the empty capsule is recharged.



BADIA'S IMPROVED LIFE PRESERVER.

The empty preserver is much longer than the breast circumference of the wearer, to allow for the decrease in length when inflated. By means of a suitably arranged rubber strip, the bag is held with a slight tension snugly around the wearer, preventing it from slipping down; but when the bag begins to inflate, the elastic strip, now free, but held by the buckle, moves back toward the end of the preserver, both ends of which meet when the bag is full of gas.

When the preserver is to be worn by a swimmer, its construction is modified so that its action is null except in the event of actual danger. The upper of two thin spoon-shaped plates hinged together is pierced with holes, as shown in Fig. 5, for the passage of water, and is so formed as to leave a space between it and the lower plate for a bellows-like chamber when the plates are fastened together. A band of very elastic and thin rubber passes around the face of the wearer, being fastened on either side of the lower plate. A piece secured to this band is situated under the nose, and connected to pipes communicating with the interior of the bellows. The nose piece is hollow and has two nipples, which enter the nostrils, and in its lower part is a slit through which the air is forced to pass in breathing through the nose. The mouth is uncovered by the band, but when submerged it is covered by a thin rubber piece serving as an automatic valve. From a hollow rubber ring surrounding the capsule, extends a tube to a close elastic ball held at the hinge between the two plates. When the cover plate is brought down to engage with a catch, the ball is compressed, and the air in it is forced through the pipe and made to fill the ring, which closes all the holes in the capsule, thereby preventing the entrance of water.

If the bather should attempt to breathe while the head is submerged, the first inspiration would tend to produce a vacuum in the bellows. This would withdraw the catch to release the top plate, which would rise, when the ball would assume a spherical form, withdrawing the air from the ring, thereby allowing the water to enter the capsule through the holes. The apparatus is automatic, and its action depends only on the very acts a person would instinctively perform in case of danger.

This invention has been patented by Mr. Joseph S. Badia, of 327 Pine Street, Philadelphia, Pa.

This device may be used with advantage to save a drowning person who cannot be quickly reached by a boat, since it may be thrown to a considerable distance. The fact that the preserver does not expand or fill until it has been submerged enables it to be put into a very small compass and thrown by hand, by a sling, or a catapult almost any distance.

A SUBSCRIBER writing from Orlando, Fla., describes a magnificent lunar rainbow which he observed there not very long ago. It was seen at 3 o'clock A.M., in the east. The arch is described as being very perfect and the spectacle magnificent.

IMPROVED AIR ENGINE.

This engine derives its power from an alternate pressure of air contained below the working piston for the out stroke, and a partial vacuum for the return stroke. These different conditions are produced by changing the temperature of the air above and below a certain average temperature, which at any given time corresponds to the atmospheric pressure. When the temperature rises above this point, it gives a pressure correspondingly above that of the atmosphere, whereby the piston is forced up, and when the temperature falls below this average point, then the pressure within the engine falls below the atmospheric pressure, and the piston is forced down. The method of bringing about these conditions in an efficient and rapid manner, and at the proper time, and of controlling the same as to speed and regularity, constitutes the novel features of the engine, which are shown in the vertical section, Fig. 2.

In open communication with the cylinder, B, in which works the piston, D, is a chamber formed by the two concentrically corrugated plates, A A′, and a ring, A″, all firmly bolted together. Within this chamber is a diaphragm, E, composed of two plates, between which is a non-conducting material. Attached to the upper and lower surfaces of the diaphragm are concentric flanges, adapted to enter the inside corrugations in the plates, A A′. This diaphragm has a reciprocating movement, alternately with the working piston, by means of which the air inside is transferred back and forth between the upper and lower parts of the chamber, which is called the regenerator. Arranged around the periphery of the diaphragm, and between the plates, A A′, and within the ring, A″, are a great many strips of wire gauze, F, through which the air passes in its way back and forth within the regenerator. The upper working parts of the engine are secured to the plate or ring, N, which is bolted to lugs upon the plate, A, thus making the engine self-contained. The lower plate, A′, rests upon the upper edge of the drum, G, which in turn rests upon the base plate; these parts are firmly bolted together.

Within this case is the furnace, which is a drum lined with fire brick, J, having the grate, C, and a deflecting plate formed with flanges, H, that guide the products of combustion in close contact with the plate, A′, into the annular flue, S, whence they escape into the chimney through the opening, M. The lower edge

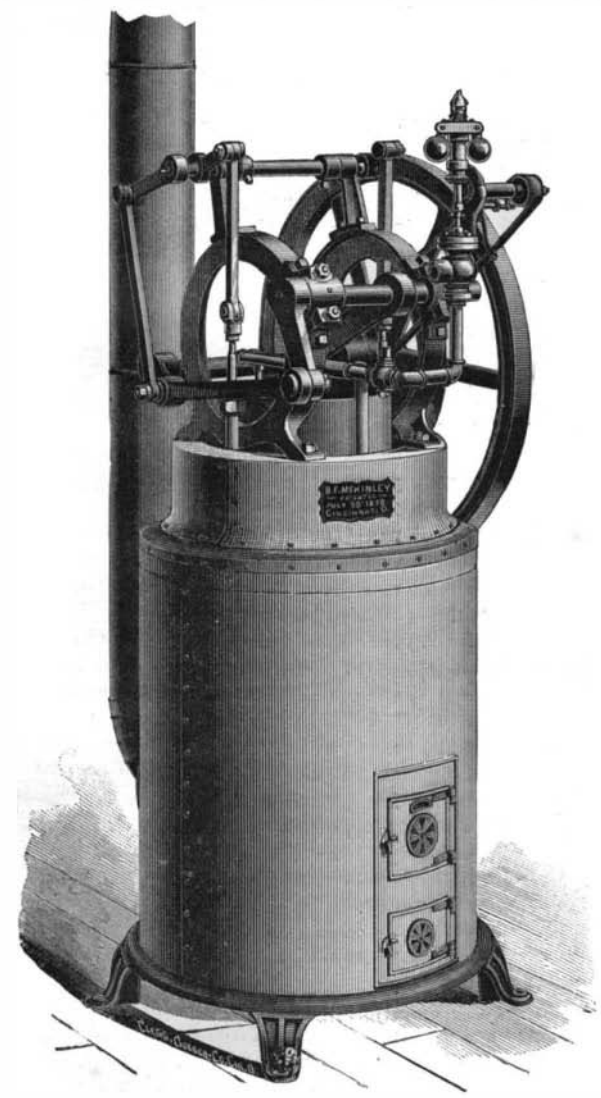


Fig. 1.—THE McKINLEY AIR ENGINE.

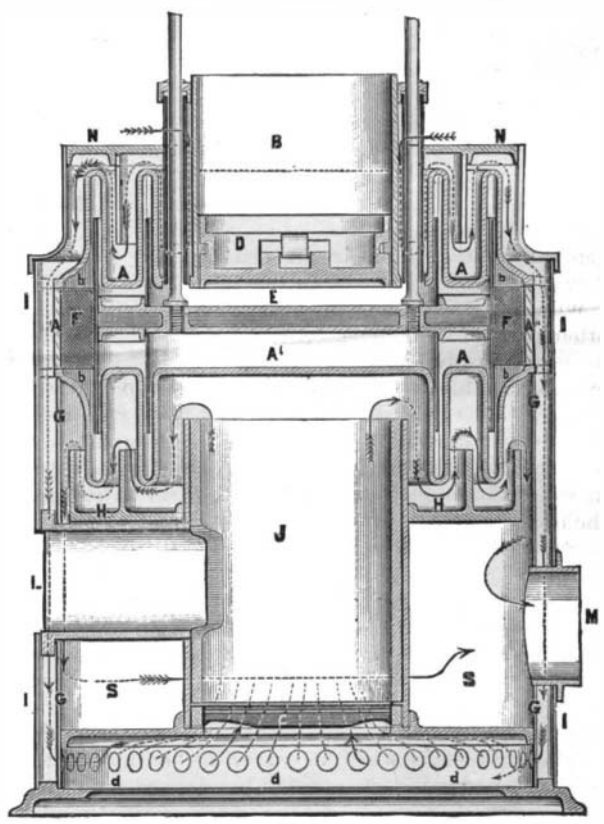


Fig. 2.—McKINLEY AIR ENGINE—VERTICAL SECTION.

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of the drum has holes, *d*, through which air enters the ash pan below the grate.

An outer case, I, forms an annular space entirely surrounding the regenerator and drum. The upper part of the case conforms in shape to the plate, A, and closes up with the outer edge of the base, N, which carries concentric flanges that descend into the outside corrugations of the plate, A. These flanges and the outside case form a continuous air space, by which a current of air entering near the top of the cylinder is made to flow over the surface of the cylinder, the upper surface of the regenerator, the outside surface of the furnace case, G, and enter the ash pan through holes, *d*, to feed the fire as before mentioned. This is an entirely original feature, and has a series of remarkable functions to perform. The first effect of this current of cold air is to come in contact with the cylinder, keeping it cool; from this it passes to the somewhat warmer plate, A, keeping its temperature down also. After this it passes over the furnace casing, still warmer from the escaping furnace gases, and keeps its temperature down also, and finally enters the ash pan laden with heat, thus stimulating the fire by heat thrown off from the cooler parts of the engine. This constitutes a regenerating feature that can be carried to an indefinite degree of refinement.

We will now explain the duties performed by the other parts of the engine. A fire being built, the plate, A′, becomes quite hot in the center, the heat being less intense toward its outer edge. The lower part of the diaphragm also becomes heated, as do the lower layers of wire cloth and the upper layers to a less extent. If now the diaphragm be caused to move up, the air above it, which is cool, will be made to pass over the inside of the upper plate, A, and down through the wire cloth, becoming heated more and more as it passes through the more highly heated layers; thence over the outer part of the plate, A′, which is still hotter, and over its inside surface, gradually increasing in temperature until the greater part of the air reaches the center of the plate next to the fire. By these means the air is gradually but rapidly heated, causing the pressure to rise and force up the piston.

When the stroke is completed, as the crank turns the center, the diaphragm is made to descend, and the heated air is made to pass back again, coming in contact with the surfaces, and, being hotter, it gives off heat to them. As its temperature is reduced, it comes in contact with still cooler surfaces, and is thus gradually but rapidly cooled, until the pressure falls below the atmospheric pressure, by which the working piston will be driven down again.

These successive movements of working piston and diaphragm are produced by attaching each to a crank movement that is at right angles or nearly so with the other, so that while one is passing the center and moving slowly, the other is moving rapidly, and *vice versa*. As these operations are repeated upon the same body of contained air in the engine, and no air is supposed to escape or be introduced, there is no necessity for induction or eduction valves, and the only valve used is a small one operated by the governor, that keeps the speed uniform, by allowing a small quantity of air to pass in order to keep the engine down to a given rate of speed. It will be seen that, as the air passes back and forth in the regenerator, it gives up heat to the surface and in turn receives it back from the surface again.

It is a somewhat singular peculiarity that the change of the direction of the movement of the diaphragm changes at the same time the functions of the entire engine surface (except a very small portion of the extremes of the hot and cold parts) from heating to cooling, and *vice versa*; that is, when the movement is such as to cause the air to be cooled, then almost the entire surface of both plates, diaphragm, and all the regenerating surface becomes cooling in its effect; that is, the air brought into contact with any given surface is hotter than the surface it is in contact with, and is cooled by the contact, and a reversal of the motion brings about an exactly contrary state; that is, the air in every part of the engine is cooler than the surface in contact, and is consequently heated by the contact. The whole action is regenerative, and the only heat not converted into power is what escapes up the chimney and what radiates from the engine, which by proper means may be reduced to a minimum exceedingly small; but, owing to the surrounding current of cool air, the engine throws off but little heat.

The concentrically corrugated plates can be constructed in this form of any desired size, without danger of buckling or breaking from unequal expansion by the heat, as they can expand radially and the curves of the corrugations will stop the expansion at each turn, while, on the other hand, the plate is greatly strengthened laterally.

There is no regulation of water level or pressure to look after, and no possible danger of accident to the attendant.

The engine is entirely self-contained, and needs nothing but a stove pipe connection to a flue to make it ready for fire and work. The cost of running is that of 40 pounds of soft coal per day for a one horse engine.

The manufacturers of this engine—the McKinley Engine Co., of 17 Broadway, Cincinnati, O.—claim that its strong points are safety, cheap first cost, cheap running expense, no increased insurance rates, and ready adaptability to any kind of work.

THE LEMURS IN THE BERLIN ZOOLOGICAL GARDEN.

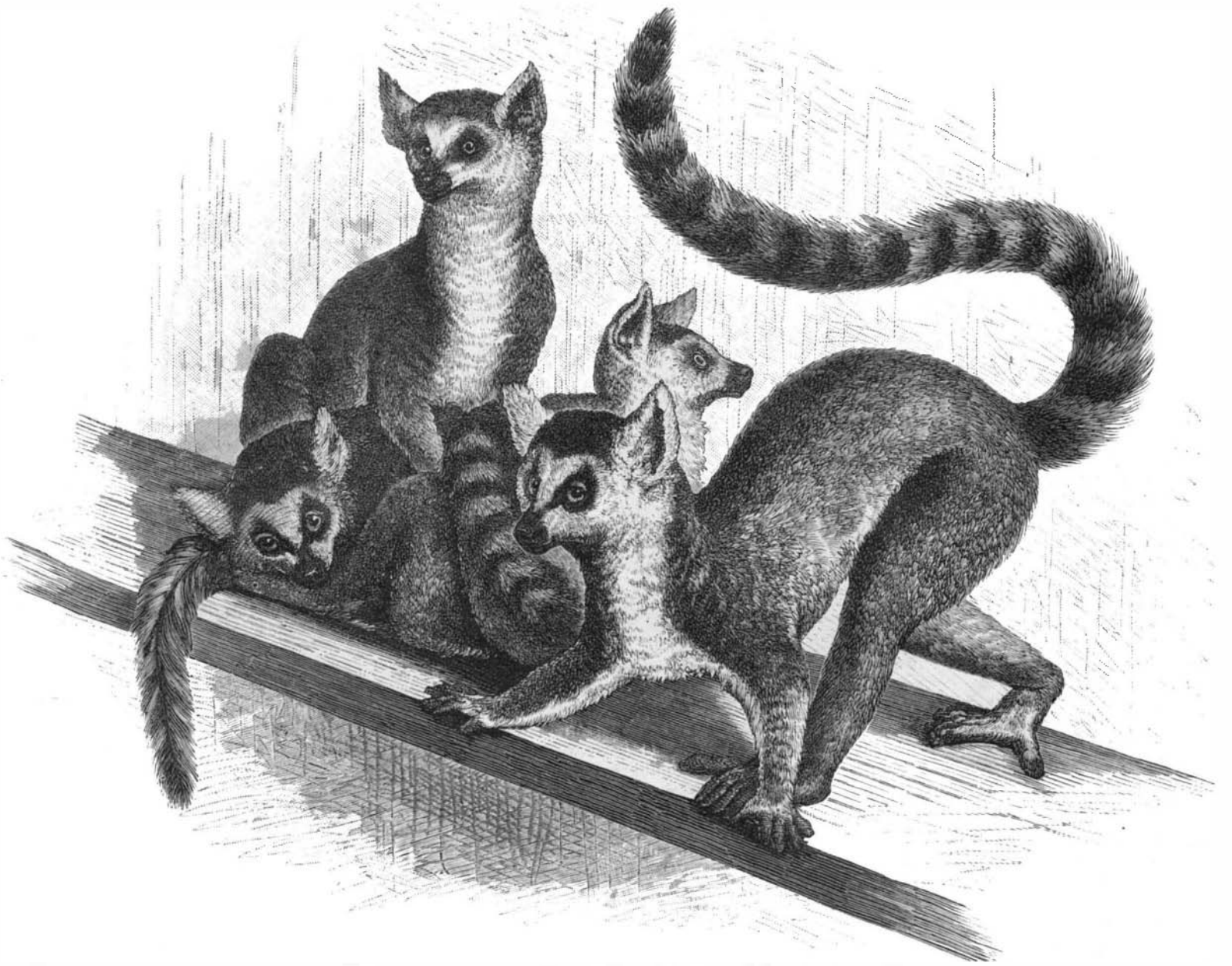
The Romans used to call the souls of the departed "Lemures," but they respected the good ones as household gods, or "Lares," while they feared the bad ones as restless, malicious ghosts and hobgoblins that wandered about in the night.

Science designates the lemur as the first family of half-monkeys, or that group of animals that can be considered as a connecting link between quadrumanous animals and gnawers.

The lemurs represented in this drawing from life are supple and bright creatures, and in their manners they remind one somewhat of monkeys, martens, and squirrels, but in certain positions they are very much like a kangaroo. The similarity is based upon the strongly developed extremities of the hind legs, which measure much more in size than the fore legs.

The *Lemur catta* has a length of from 85 to 90 cm., of which 35 to 40 is the body, and the rest is the tail.

The color of the fine wooly fur on the back is a gray-



THE LEMURS IN THE BERLIN ZOOLOGICAL GARDEN.

ish brown, with a tinge of red here and there, while the face, ears, and front part of neck are almost white; the only coal black coloring is seen around the eyes, on the nose, and on the forehead.

The black and white curved tail is quite graceful in its shape, and it is by no means a useless appendage, for in springing and jumping it serves as a rudder and balancing pole, while it serves as a stool in sitting.

When the animals huddle together at night, they twist their tails around each other, forming a sort of net about those who are sleeping.

The hands are nicely formed; the inside is deep black, while the outside corresponds to the color of the body; the fingers are exceedingly dexterous, for they pick up the smallest insect or piece of straw with great ease; they turn fruit over on all sides with the greatest rapidity, and eat it gracefully, always dropping out the unsavory portions.

Sociableness is a life necessity of our lemurs. Left alone, they become cross and soon die, while company makes different creatures of them. Then they are always merry, and chase each other around in the cage, springing among each other like monkeys, with their roguish tricks.

Most of the varieties of lemurs live in the woods of Madagascar that are the fullest of insects and fruits; they are also seen on neighboring islands, and go around nights after prey, screeching like our house cats when they mew very loud.

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