valve is coupled to a lever mounted on a rocking shaft fixed in adjustable phosphor bronze bearings. The eccentric rods for driving the Corliss wrist plates are hung on two two-armed rocking levers mounted on a 4 in. cast iron stud pin, which is bolted to the bed plate.

The air pump already in the engine house was used again. A cast iron liner was put in, 15½ in. in diameter. This pump is not shown in the engravings, but is of the vertical type, and is worked from links connected to the crosshead. The stroke is 18 in.

THE VENOMOUS SERPENTS OR TOXICOPHIDIA OF THE UNITED STATES.

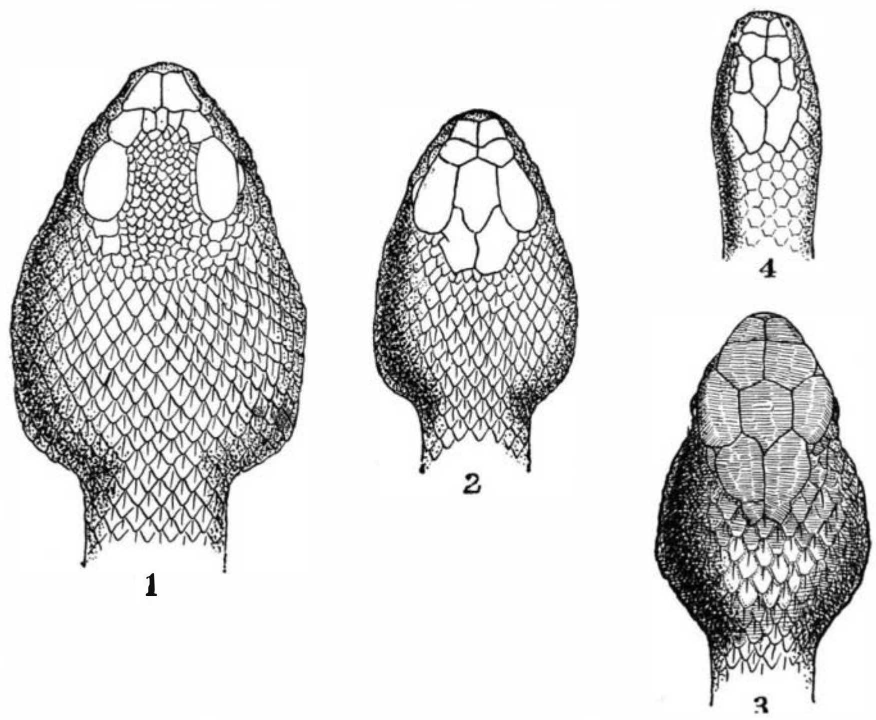
The rattlesnakes, family *Crotalidæ:* In genus *Crotalus*, the true rattlesnakes, the head above is covered with small scales. (See Fig. 1.) The species are: 1. Eastern or mountain rattlesnake, *Crotalus horridus.* It is found from Maine to Arkansas and Texas. It varies greatly in color, being found dark brown, nearly black, to pale sulphur yellow with ashy gray bands. 2. The diamond or Southern swamp rattlesnake, *Crotalus adamanteus.* It inhabits North Carolina to Florida. There are several varieties of this repulsive serpent, which from time to time have been described as new species; variety *atrox* is found from Texas to California; variety *scutulatus* in Arizona. 3. Western rattlesnake, *Crotalus confluentus*, habitat Nebraska to Oregon, south to Texas and New Mexico. The red rattlesnake, *C. pyrrhus*, of Arizona, seems to be a local variety. 4. The bull-dog rattlesnake, *Crotalus molossus*, of which the U. S. Museum, at Washington, contains only three specimens, one each from Arizona, Texas, and Mexico, is nearly related to the harsh rattlesnake, *C. durissus*, of Mexico and South America, and may be a variety of the latter. 5. The horned rattlesnake, *Crotalus cerastes*, found from Colorado to California and south to Mexico. 6. The tiger rattlesnake, *Crotalus tigris*, found in New Mexico and Arizona. The St. Lucas rattlesnake, *C. enyo*, bears a close relationship to *molossus* and *durissus*, and it is doubtful if it may be called a distinct species. Four specimens from Lower California are in the United States Museum. 7. The lucifer rattlesnake, *Crotalus lucifer*, bears a near resemblance to the diamond rattlesnake variety *atrox.* It is possible that the Oregon rattlesnake, *C. Oregonus*, described by Dr. Holbrook, is the young of this species. His faded type specimen in the collection of Academy of Natural Sciences, Philadelphia, measures about a foot in length, and the tail has but one button, which proves it to be quite immature. *C. lucifer* has been found in Oregon, California, and Arizona. Mitchell's rattlesnake, *C. Mitchellii*, is founded on one individual from Lower California. It is a doubtful species, resembling *lucifer* and *atrox.* 8. Kennicott's asp or rattlesnake, *Aploaspis lepida*, from the Rio Grande, Texas, has been described from two alcoholic specimens of heads only, and requires further study.

The second group of rattlesnakes belongs to the genus *Crotalophorus* of Gray, 1825. Linnæus in 1735 first gave the name *Caudisona* to all the known rattlesnakes; but subsequently rejected it, and in 1749 adopted *Crotalo phorus.* In 1754, and subsequently, he placed all the rattlesnakes in the genus *Crotalus.* Laurenti in 1768 adopted the genus *Caudisona* for the rattlesnakes. Gray in 1825 placed the rattlers with large plates on the head in the genus *Crotalophorus;* one year later, 1826, Fitzinger proposed *Caudisona* for the same group; therefore, Gray's genus *Crotalophorus* (a rattle bearer) should be retained. This family of rattlesnakes have the upper surface of the head covered with nine large plates, as seen in many non-venomous serpents. (See Fig. 2.) 9. Massasauga or prairie rattlesnake, *Crotalophorus tergeminus.* In 1854, Prof. Baird collected several specimens in a white cedar swamp at Byron, Genesee Co., N. Y. "Nessmuk," in *Forest and Stream*, says he observed it in a tamarack swamp, fourteen miles south of Brockport, N. Y. From New York its range extends westward to Utah and Montana, and from Ontario, Canada, south to Georgia. Edwards' rattlesnake, *C. Edwardsii*, although described as a native of Texas and Mexico, has lately been found in company with the massasauga in Bruce Co., Ontario. It seems to be only a variety between the prairie rattler and the following. 10. Southern ground rattlesnake, *Crotalophorus miliarius*, is found from North Carolina to New Mexico, and southward. *C. consors* is an accidental variety from Texas.

To *Ancistrodon* belong the pit vipers without the rattle—the copperhead and moccasins. (See Fig. 3.)

11. The copperhead, *Ancistrodon contortrix*, has been found from Vermont to Florida, and westward to Kansas. 12. The water moccasin, *A. piscivorus*, is said to be found from North Carolina to the Gulf, and westward to Texas and Arkansas. Two years ago an ornithologist captured what he declared to be a true moccasin in a swamp in southern New Jersey. He sold the specimen to a dealer in objects of natural history. When I called to examine it, I found it had been bought by some unknown person, and all trace of it was lost. Mr. G. was a member of the Philadelphia Academy of Natural Sciences, and had ample opportunity to identify his specimen. I can find no records of it occurring north of the State of North Carolina. The mountain moccasin, variety *atrofuscus*, is found in the mountains of North Carolina and Tennessee. The Texan moccasin, variety *pugnax*, occurs in Texas only.

In the harlequin snakes, *Elaps*, the neck is not contracted as in the foregoing genera, but in most cases is continuous with the head and body. (See Fig. 4.) The upper jaw on each side is furnished with a small erect grooved fang. They are small snakes, not generally much over two feet in length, and are beautifully annulated with carmine red, black, and yellow rings. Although belonging to the same family as the dreaded cobra of India, they are generally considered harmless, and it is said they never attempt to bite, even though handled. Audubon says that formerly it was the fashion for Indian girls of Florida to decorate their hair with these brilliant little serpents; and in many places they are known as "bead snakes."



1. Eastern rattlesnake. 2. Massasauga. 3. Water moccasin. 4. Harlequin snake.

POISONOUS SERPENTS OF THE UNITED STATES.

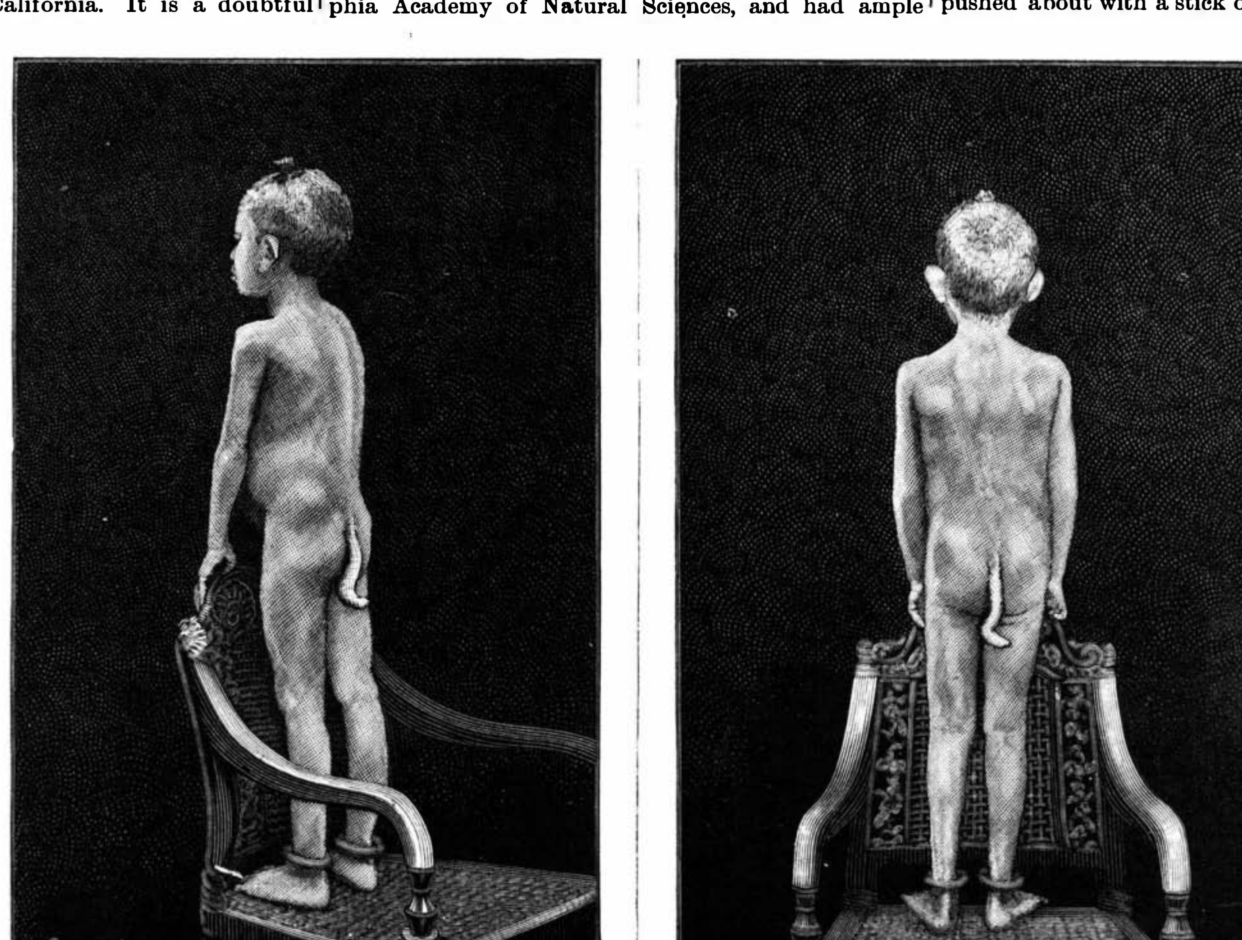
13. The common harlequin snake, *Elaps fulvius*, is found from South Carolina to Florida and Texas. Variety *tener*, of Baird and Girard, occurs in Texas, Mexico, and Florida. 14. Kennicott's harlequin snake, *Elaps euryxanthus*, inhabits Arizona and Mexico. *E. distans* has been found in Mexico and Florida; it appears to be merely a variety of *fulvius*, and not a distinct species.

The above list includes all the well-founded species of venomous serpents found in the United States; and it is not probable that many more names will be added in the future, as all the States and Territories have been well ransacked with the hope of finding "new species."

In nearly every section of country the natives will point out snakes which they "know for certain are awful poisonous," but which are, in reality, as harmless as a duckling. Take the hog-nosed snake or "blowing viper," *Heterodon platyrhinus*, for example; in one part of the country the rustic will declare to you that "that wiper am fearful wenomous," while in another section you will be informed that it is "a hog snake and ain't poisonous." By the way, this snake varies greatly in color, being found uniform black to pale yellowish brown with brown blotches. It can always be distinguished by its turned-up, hog-like snout and the manner in which it can flatten or spread itself and blow when approached. By some it is called "the spreading adder."

It is often a very repulsive and formidable-looking snake, and the additional fact that the posterior teeth in the upper jaw are long and fang-like has caused even educated persons to consider it venomous. Sometimes it has a curious habit of feigning death when pushed about with a stick or your foot—a habit which I have not observed in any other snake. At such times it throws itself over, assumes a *rigor mortis*, dislocates the lower jaw, becomes motionless, and to all outward appearances seeming as though the last spark of life had vanished. The unknowing person would imagine that a very tender spot had been touched which caused instant death. But when it sees the intruder at a safe distance—a snake always sleeps and dies with its eyes open—it quickly glides away to a place of safety. I know one instance where one of them permitted itself to be completely buried in sand without showing the least sign of life, but after a few minutes, when it supposed the unwelcome visitor had left, slowly pushed its head out of the sand, and not seeing the hidden yet observing enemy, slowly crawled out and began moving off.

The common garter or ribbon snake is rightly considered harmless, and yet the following clipping from a South-



A MOÏ BOY WITH TAIL NINE INCHES LONG.—(Engraved from a photograph.)

[FOR DESCRIPTION SEE PAGE 296.]

ern paper may be perfectly true: "A negro child on the plantation of Dr. B. R. Rieves, of this county, came to its death one day recently under peculiar circumstances. It seems that a cat had caught a garter snake and carried it into the house, where the child was sitting alone on the floor. The child in admiration for the snake took it up in its hands and was bitten by the reptile on the arm, and from the effects of the bite the child died."—*Dawson Journal.* This instance, however, does not prove that the garter snake possesses poison fangs and glands. Numerous cases are on record where the scratch of a pin, the puncture of a splinter, nail, or tack have caused death to man, yet we certainly do not consider a chip of wood or a tack articles of venom and death. I have seen many bites or scratches made by the teeth of garter and water snakes, and have been bitten myself, yet the scratches were less severe than the wounds we sometimes receive from thorns in plucking June roses.

C. FEW SEISS.

CAUDAL APPENDAGE IN MAN.*

Naturalists have up to the present time given little attention to the study of tailed men. Such an organ has simply aroused the curiosity of any one who has seen a specimen, quite as a bearded woman arouses interest in a dime museum. The works on this subject are very incomplete, a few lines here and there scarcely throwing any light on the subject. There is one monograph † on this subject. There are few documents on the subject, the monstrosity is seldom found, and few of the well known cases could bear a close scrutiny.

It is not our intention to translate or give an abstract of this German production, but we have the good fortune to be able to reproduce an engraving from two very good photographs taken from life, and we shall accompany them with a few descriptive words.

A number of travelers in South Africa have testified to the existence of men of the Nyams-Nyams tribe who had tails. This may or may not be true. If such is the case, Mr. Quatrefages does not consider that the evidence to that end is very trustworthy, and rather comes to the conclusion that it has not been absolutely proved, although he believes the fact not improbable. Mr. Ecker, on the contrary, after examining this subject thinks that the testimony of explorers is credible.

Although there may not be a race of human monkeys, it must be admitted that there are some cases of individuals having a caudal appendage. When I say "some" cases, it should be understood that Pliny and Ptolemy, and after them Marco Polo, Strup Maillet, and others, speak of this anomaly, and their citations would comprise in all not 15 or 20 cases, but from 150 to 200. The well authenticated cases, however, are very few in number.

Bartels enumerates and describes twenty-one cases, which he classifies as: 1. Tail connected with body. 2. Tail with free movement. 3. Cutaneous prolongation. The first includes the triangular base bone unusually developed, and which extends to the anus and partially covers it. The second includes those tails that form a sort of projection at the back, and which separate from the body at the sacrum. The third will not be reviewed, as it does not seem necessary, as it could take either of the other forms mentioned and still be simply a cutaneous prolongation.

The specimens already observed enable us to give a general description, which will be done, however, with due caution. The tail is conical or spherical in shape, rarely cylindrical. The end nearly always curls slightly and sometimes is twisted like that of a pig. It is seldom more than 3 or 4 inches in length. It is sometimes covered, and sometimes it is quite smooth. In the former case the hair grows in places and resembles somewhat the tail of a cow. Bartels cites and has shown a case of this kind, while Quatrefages, who lived before his time, had considered this condition as a mere legend.

Whether these tails are soft or rigid, they possess in general no movement of their own. This physical peculiarity is usually accompanied with some other defect, with *atresia ani* in particular, and almost always with general constitutional weakness. Such are the general characteristics of this class of monstrosities. Can the cause of this be discovered? *Adhuc sub judice lis est.* Bartels considers that it is due to imperfect development, induced perhaps by inheritance from an ancestral type, while Quatrefages had not believed in this, but considered that it was caused by some abnormal development in the embryo. It is not for us to decide which theory is to be accepted. It is a curious circumstance, however, that this peculiarity is found principally among the male species. I do not think that the females of the lower orders are less favored in this respect than the males. It is also curious that the white races appear not to be privileged in this respect. If we admit that they are a superior race to the others, then perhaps atavism would explain it. In none of the cases that have been examined, however, could vertebræ be found in the tail; while the specimen that was dissected by Virchow simply consisted of fat and muscles. Atavism would explain alone the existence of an hereditary monstrosity.

The question of heredity was, at an early day, discussed by Mr. De Quatrefages. He came to the conclusion that such an organ, whatever its origin might be, could be transmitted from father to son. Such a conclusion is affirmed in the cases of other monstrosities in which this is found to be the case. The subject of the engraving, however, which we have not as yet described, is a very remarkable case. He is a young Moi, twelve years of age, who was taken to Saigon some time ago, where he was examined and photographed. Although so young, his tail was already nearly a foot in length. With the exception of its great length, this specimen resembled in almost every other respect those that had been examined by Bartels. From the information we have been able to procure, it appears that the organ is soft and smooth and has no bony frame. Bartels cites only four cases of this kind, while its cylindrical shape appears to be very rare. We stated above that, as a rule, this peculiarity was accompanied with other malformations, and such is found to be the case in the present instance. By examining the photograph it will be observed that a small mound or bunch is found upon each buttock. The shoulder blades seem to project abnormally, but it should be borne in mind that the subject is very thin.

The tail seems ordinary and possesses none of the peculiarities described by Mr. De Quatrefages. He describes tails two or three inches in length, while Bartels describes them as long as five inches, but this young Moi's tail is about ten inches in length. Therefore, up to the present time this is the best specimen on record. This matter ought not to be passed over carelessly, but it merits a thorough and complete investigation and study which should be no longer neglected.

* Etienne Rabaud in *La Naturaliste.*

† Max Bartels, Ueber Menschenschwanze, Archiv fur Anthropologie, 1880, p. 1 a 41, 1 pl.

Laws of Heat.

Heat is transmitted in three ways—by *conduction*, as when the end of a short rod of iron is placed in a fire and the opposite end becomes warmed—this is conducted heat; by *convection* (means of currents), such as the warming of a mass of water in a boiler, furnace, or saucepan; and by *radiation*, as that diffused from a piece of hot metal or an open fire. Radiant heat is transmitted like sound or light, in straight lines in every direction, and its intensity diminishes inversely as the square of the distance from its center or point of radiation. Suppose the distance from the center of radiation to be 1, 2, 3, and 4 yards, the surface covered by heat rays will increase 1, 4, 9, and 16 square feet; the intensity of heat will diminish 1, $\frac{1}{4}$, $\frac{1}{9}$, and $\frac{1}{16}$, and so on in like proportions until the heat becomes absorbed, or its source of supply stopped.

Whenever a difference in temperature exists either in solids or liquids that come in contact with or in close proximity to each other, there is a tendency for the temperature to become equalized; if water at 100° be poured into a vessel containing an equal quantity of water at 50°, the tendency will be for the whole to assume a temperature of 75°; and suppose the temperature of the surrounding air be 30°, the cooling process will continue until the water and the surrounding air become nearly equal, the temperature of the air being increased in proportion as that of the water is decreased.

The heat generated by the fire under a boiler is transmitted to the water inside the boiler, when the difference in the specific gravities, or, in other words, the cold water in the pipes, being heavier than that in the boiler, sinks and forces the lighter hot water upward. This heat is radiated from the pipes, which are good conductors of heat, to the air in the room, and raises it to the required temperature. That which absorbs heat rapidly parts with it rapidly, and is called a good conductor, and that which is slow to receive heat parts with it slowly, and is termed a bad conductor.

The following tables of conductivity, and of the radiating properties of various materials, may be of service:

CONDUCTING POWER OF VARIOUS SUBSTANCES.—DESPRITZ.		RADIATING POWER OF VARIOUS SUBSTANCES.—LESLIE.	
Material.	Conductivity.	Material.	Radiating Power.
Gold	100	Lampblack	100
Silver	97	Water	100
Copper	89	Writing paper	98
Brass	75	Glass	90
Cast iron	56	Tissue paper	88
Wrought iron	37	Ice	85
Zinc	36	Rough lead	45
Tin	30	Mercury	20
Lead	18	Polished lead	19
Marble	2·4	Polished iron	15
Fire clay	1·1	Gold, silver	12
Water	0·9	Copper, tin	12

From the above tables it will be seen that water, being an excellent radiator and of great specific heat, and cast iron a good conductor, these qualities, together with the small cost of the materials, combine to render them efficient, economic, and convenient for the transmission and distribution of artificial heat.

Heat is a word freely used, yet difficult to define. With a temperature of 65° to 70° we frequently hear it remarked, "How hot this room is! It is insufferable." Water at the same temperature would be described as cold; a temperature of 90° in the shade we call "intensely hot." We should speak of water at this temperature as scarcely warm; a smith would rarely consider his iron hot if less than 800° (red heat), and would call it a good heat at 2,700° (welding). It would appear paradoxical to speak of heat and cold as synonymous terms, yet what we frequently call cold is only another term for a low degree of heat. The word "heat" is commonly used in two senses: (1) to express the sensation of warmth; (2) the state of things in bodies which causes that sensation. The expression herein must be taken in the latter sense. By adopting certain standards we are enabled to define, compare, and calculate so as to arrive at definite results, hence the adoption of a standard unit of heat, unit of power, unit of work, etc.

The standard unit of heat is the amount necessary to raise the temperature of 1 lb. of water at 32° Fahr. 1°, *i. e.*, from 32° to 33°.

Specific heat is the amount of heat necessary to raise the temperature of a solid or liquid body a certain number of degrees; water is adopted as the unit or standard of comparison. The heat necessary to raise 1 lb. of water 1° will raise 1 lb. of mercury about 30° and 1 lb. of lead about 32°.

Table of the Specific Heat of Equal Weights of Various Substances.

	Specific Heat.		Specific Heat.
SOLID BODIES.		LIQUIDS.	
Wood (fir and pine)	0·650	Water	1·000
" (oak)	0·570	Alcohol	0·598
Ice	0·504	Acid (pyroligneous)	0·590
Coal	0·280	Ether	0·520
Charcoal (animal)	0·260	Acid (acetic)	0·509
" (vegetable)	0·241	Oil (olive)	0·309
Iron (cast)	0·241	Mercury	0·033
Coke	0·201		
Limestone	0·200		
Glass	0·195	GASES.	
Steel (hard)	0·117	Hydrogen	3·409
" (soft)	0·116	Vapor of alcohol	0·547
Iron (wrought)	0·111	Steam	0·480
Zinc	0·095	Carbonic oxide	0·245
Copper (annealed)	0·094	Nitrogen	0·243
" (cold hammered)	0·093	Oxygen	0·217
Tin	0·056	Atmospheric air	0·237
Lead	0·031	Carbonic acid	0·202

—*Ironmonger.*

Acrophobia.

BY WINSLOW ANDERSON, M.D.

Among the many curious psychical experiments that are now attracting the attention of scientific minds, the one to which the term "acrophobia" has been applied has several points of interest. In referring to the term and phenomena, *Science* for January, 1889, defines it as an exaggerated condition of fear.

Dr. Verga has recently described the phenomena in his own case:

Though by nature not at all timid, all his courage leaves him when above ground. He complains of palpitations in mounting a step-ladder, for instance; finds it extremely unpleasant to ride on the top of a coach or even to look out of a first story window. This idiosyncrasy forbids him the use of an elevator, and the mere thought of those who have cast themselves down from high places causes tingling all over his person. His acrophobia even goes so far that the thought of the earth spinning through space is enough to cause discomfort.

Persons on a bridge high above the water, or on a cliff, or high up in a tower, are frequently overtaken by not only exaggerated fear, but by *abnormal* fear, producing at times dizziness and even faintness. Another class of individuals are seized with an intense and, at times, an uncontrollable desire to jump down from any height which they may have reached.

A greater or less degree of this fear seems quite common and perfectly compatible with normal mentality. —*Pacific Med. Jour.*

A Scientific Hotel Keeper.

Mr. E. S. Chapin, who died in Springfield, Mass., a few days ago, in his seventy-fourth year, not only made for his hotel, the Massasoit House, an almost national reputation, but was much interested in scientific subjects, and for forty years a reader of the SCIENTIFIC AMERICAN. In 1864 he published a pamphlet entitled "Gravity and Heat," and three years later, with the assistance of his daughter, Mrs. Haile, expanded his theory into a book of 120 pages, called "The Correlation and Conservation of Gravitation and Heat, and some of the Effects of these Forces on the Solar System." In 1887 he published "Gravitation the Determining Force." Williams College gave him an honorary degree of A.M. for his investigations.