

rats the kidneys of one partner are capable of functioning for the other partner for months at a time. We cannot here elaborate this difficult chapter of our experiments, but will merely mention that they involve interesting discoveries with regard to the formation of oedemas, the cause of the hypertrophy of the heart and the problem of the internal secretion of the kidneys.

Sauerbruch and Heyde have also tried to find out whether it was possible to find an explanation of the beginning of birth pangs by studying the process of parturition in the case of two animals thus united. In the course of these investigations they made the surprising observation that shortly before the beginning of the pregnant animal's throes, the normal animal became extremely ill, and, indeed, perished in convulsions while the pregnant animal remained well. The investigators came to the conclusion that at the end of the period of pregnancy certain substances, probably of a specific nature, make their appearance, which are non-poisonous to animals in an advanced state of pregnancy, but are extremely toxic to normal animals, occasioning a violent death. They believe too, that these specific substances are capable of occasioning abortion at the beginning of the period of pregnancy.

Under the same head, finally, are to be classed the experiments made upon frogs by Harm with respect to the production of secondary sex characteristics. Harm based his investigations upon the hypothesis that the genital glands may secrete substances which are of importance with respect to the development of definite sex characters. He also studied the problems as to whether the influence of the testicle upon the phenomena of rut depends upon an internal secretion. In these experiments he united a normal animal with one which

had been castrated. He thus demonstrated that certain phenomena of sex which are lacking in ordinary castrated animals, such, for example, as the yellow color of the fatty bodies and the clasping reflex were retained in the parabiotic castrate. On the other hand the atrophy of the glands, as also the tubercles of the epidermis, the so-called "thumb callouses," were not prevented.

While the experiments described above have concerned physiological problems rather than pathological ones, at the same time they have thrown light upon the cause of death from uremia, from severe burns, and from contusions. These experiments alone have been able to give a definite answer as to whether temporary pathological symptoms are to be referred to a reflex or to a toxic action. The proof of the latter is shown by the illness of the second partner which had not been artificially injured. These results were particularly important for the understanding of the causes of death from burns (Heyde and Vogt) as also death from intestinal stoppage (Sauerbruch and Heyde) which were formerly attributed to various causes, reflex action especially being responsible for the first symptoms of disturbance.

We may also mention briefly the work done in this manner with regard to the origin and transference of poisons of an external nature, the transferability of the tuberculin reaction or of anaphylactic poisoning and the formation of anti-bodies (Friedburger).

I trust I have succeeded so far as it was possible within such limited space in proving that the series of experiments made possible by parabiosis form an excellent means for the study of weighty problems—a means capable of leading to other important conclusions.

Turtles, Terrapins and Tortoises

Reptiles Whose Flesh and Eggs are Prized as Table Delicacies

By May Tevis

Photographs from the American Museum of Natural History

A GOOD many people doubtless will be rather startled to hear that turtles and their relatives, the terrapins and the tortoises are really reptiles. Most persons regard snakes with both fear and abhorrence, partly because of the deadly venom so many of their tribe possess, partly because of their sly, surreptitious methods of attack, and partly no doubt, because of subconscious associations connected with the original indiscretion of Mother Eve. Turtles, on the contrary, are generally regarded not merely with tolerance but even with esteem and affection, and this not merely because of their succulent appeal to the palate but likewise through subconscious associations somewhat more obscure in character. Whatever the reason may be, the turtle family has for centuries been held in high regard in many parts of the world. Perhaps this is partly because of their very solid and dependable structure. Is it not in the Upanishads that the world was represented as resting on the broad and steady back of a great turtle—surely a more dependable basis of support than even the mighty shoulders of Atlas? Then, too, these creatures enjoy a tremendous reputation for steady determination of purpose and unflagging energy in carrying it out, as witness the ancient fable of the hare and the tortoise. In short, they are looked upon as symbols of the eminently desirable virtues of patience, prudence, and perseverance. The writer has in fact seen these qualities amusingly represented in baby loggerheads just out of the shell, scrambling up through the warm Florida sands which form their incubator, and heading straight for the ocean in spite of various attempts to divert them or bar their way with obstacles. And who that loves his Uncle Remus can fail to have a kindly feeling for old Brer Terrapin?

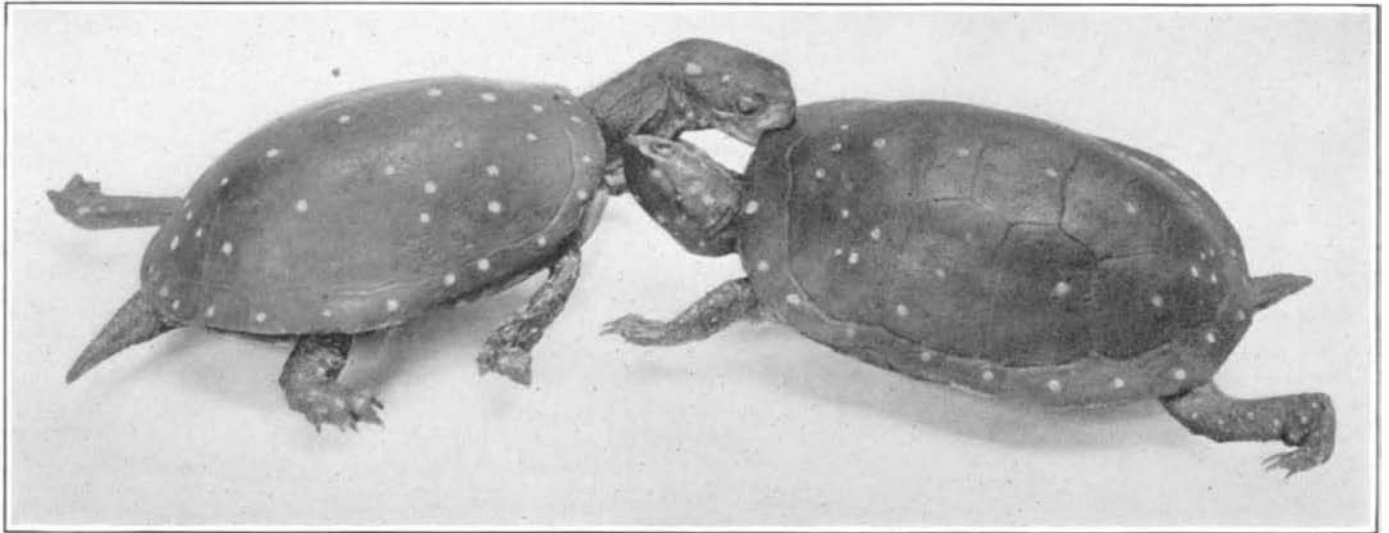
Then, too, the majority of people consider the idea of

eating the flesh of reptiles as being repellent and even disgusting, whereas the flesh of many members of the turtle family is a highly prized delicacy. Green turtle soup is famous all over the world and terrapin are fairly worth their weight in gold, selling even before the war at the rate of \$75 a dozen for specimens 8 inches long (according to Mr. Dittmar, though the writer has found small ones recently at 75c.), which makes it amusing to recall that they were once so plentiful in the waters of the Delaware that the slaves upon the nearby Maryland plantations petitioned for relief from a too constant diet of venison and terrapin.

However, turtles, terrapins and tortoises are true reptiles according to scientific definition, since they are cold-blooded vertebrates which breathe by lungs throughout their whole existence and not by gills during a part of the time as do the likewise cold-blooded and vertebrate animals, frogs, toads and other Batrachians. Unlike Batrachians they undergo no change of form, coming from the egg in the same form which they retain throughout their lives. Furthermore, the skull of these animals is joined to the backbone by a single rounded knob or condyle, which is characteristic of reptiles as well as of birds, whereas in Batrachians as well as in mammals there are two of these rounded knobs or condyles. Again in the great majority of reptiles the skin is covered with scales or shields, while in most Batrachians it is naked.

CLASSIFICATION.

In the preceding paragraphs I have used the word turtle somewhat loosely to include their congeners, the terrapins and the tortoises, and the word turtle is, in fact, generally so used in this country. Strictly speaking, however, it is better to confine the word turtle to those members of the Chelonia



WAX CAST OF A PAIR OF FIGHTING SPOTTED TURTLES

(Greek, *Chelonium* = a shield) which live exclusively in water and possess paddle shaped limbs; the purely terrestrial members of the *Chelonia* having club shaped limbs, are properly called tortoises, while those which live both on land and in water and possess an intermediate form of structure are terrapins.

The body of these animals is protected by a bony shell, usually covered with horny shields, into which the head, neck, limbs, and tail may be retracted. This shell is composed of numerous bones, the principal being expansions of the vertebrae and ribs, forming the carapace, or dorsal buckler, the neck and tail being the only movable portions of the spinal column, and clavicles and abdominal bones forming the plastron or ventral buckler. The carapace and plastron are usually connected by a lateral part known as the bridge. Both the bony plates and the horny shields on the shell afford excellent characters for the purpose of classification.

In some tortoises and terrapins perfect hinges of elastic ligament are formed across the plastron, as in the so-called Box Tortoise, and either the anterior or the posterior lobes, or both, as the case may be, are movable and close up the shell. In the genus *Cinixys* a similar hinge is situated across the carapace, the hinder part of which is movable.

Regeneration of lost parts does not take place, although, as Gadow has shown, the injuries to the shell are made good by new growth of bony and horny tissue, after the dead portion has been cast off.

A tail is always present, but differs much both in length and structure, according to genera and species, this organ being sometimes covered with horny or bony tubercles, while in many the tip is provided with a sharp, nail-like spur. The toothless jaws are covered with cutting horny sheaths which may be serrated and constitute pseudo teeth. The neck, which varies much in length, may be either completely or only partly withdrawn into the shell, in some forms simply sideways (*Pleurodira*), or by a sigmoid curve in a vertical plane (*Cryptodira*). The eye is rather small and protected by an upper and lower lid, and a transparent membrane (the nictitating membrane), which moves horizontally; the pupil is always round. The sight and senses of taste and touch are well developed, that of hearing, however, is very imperfect, especially among aquatic forms, some of which are devoid of an exposed tympanum or ear-drum.

All tortoises, terrapins, and turtles lay eggs which may be round, oval or elliptical, and are generally hard-shelled; marine turtles, however, produce eggs, the shell of which is leathery instead of hard; they are always buried in the ground and hatched by the heat of the sun. Hibernation takes place in the temperate zone, the period varying in length according to the climate. Aquatic species generally hibernate

at the bottom of the ponds or rivers they live in, or in the mud on the banks, while the land forms secrete themselves in the earth and sand, a few constructing regular burrows which may extend to a depth of several feet.

The food varies according to the structure and the mode of life. Land forms are vegetarians, those frequenting the water are either carnivorous or herbivorous, a few only living on a mixed diet.

Tortoises are remarkably long-lived, the giant forms of the Aldabra and Galapagos Islands attaining an age unparalleled by any other animal.

The order is not a very large one, the number of species of *Chelonian* amounting to only just over 200.

LEATHERBACK TURTLE.

The *Dermochelys coriacea*, of the family *Sphargidae*, is the only representative of the suborder. It is the largest of living chelonians, and differs from all other turtles, terrapins, and tortoises in that its vertebrae and ribs are entirely free, and not fused with the carapace. The body is protected by a shield of small mosaic-like bony plates, covered with a very thick layer of leathery skin, which, except for the presence of a number of longitudinal ridges, is in adult specimens perfectly smooth; in the young it appears rather tuberculate. The limbs are paddle-shaped flippers without claws, giving the animal great swimming powers, and enabling it to venture far out to sea. In color it is dark brown, often more or less distinctly spotted with yellow or looking as if splashed with whitewash.

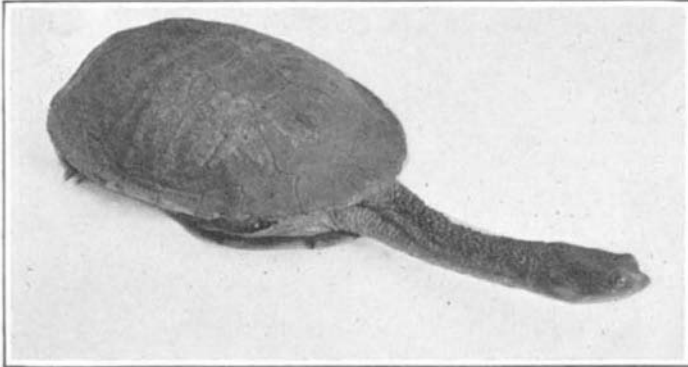
This creature has been considered to represent, so far as its vertebral column is concerned, the primitive type out of which the ordinary tortoise has been evolved says Boulenger, it being believed that the ossifications underlying the skin have gradually become fused with the bones of the skeleton to form the shell of tortoises and turtles proper. Others believe the *Sphargidae* to represent an ultra-specialized type evolved out of the turtles.

The Leatherback Turtle has a world-wide distribution, and is, in fact, a pelagic animal, straying to very distant localities, occasionally visiting the coast of Great Britain. In spite of its wide range it is by no means common. Numbers have been seen, however, off the coast of Tenasserim, and at the entrance to the Klang Straits, where they gather in order to deposit their eggs, each female depositing some three or four hundred.

The strength and pugnacity of this turtle are indicated by the following account by G. W. Gourley, of the capture of a specimen at Santa Barbara in the year 1905.

"The turtle was first seen swimming on the surface about two miles off shore. I went after it, accompanied by a boy,

in an eighteen-foot sailing boat. On approaching the turtle I dropped the tiller and got forward with the gaff hook, swung over the side, and got the hook fast in the leathery part of the neck. He immediately sounded, and ran out the full length of the line—about two hundred feet—towing the boat about half a mile farther out to sea. He then came to the surface and we pulled up close to him again. When he caught sight of the boat he turned and came towards us



AUSTRALIAN SNAKE-NECKED TURTLE

and threw his flippers over the gunwale of the boat, nearly capsizing her. I climbed up on the upper side, and shoved him off with an oar, the end of which he grabbed and bit off like a piece of cheese. His movements were very swift; using his fore-flipper he could turn almost instantly from one side to the other, and his head would project about eighteen inches from the body. I succeeded at last in throwing a noose over his head, and later, by attracting his attention in the opposite direction, got ropes round both flippers, finally having five lines on him, and started to tow him towards the shore. We were from 11:30 A. M. until 4 P. M. in finally landing him. When about half-way to shore he suddenly turned, and made a break out to sea, towing the boat stern first, with all sail drawing full, for several hundred yards, with little effort. He emitted at intervals a noise somewhat resembling the grunt of a wild boar."

The largest specimen on record is over eight feet in length and weighs just over 1,500 pounds.

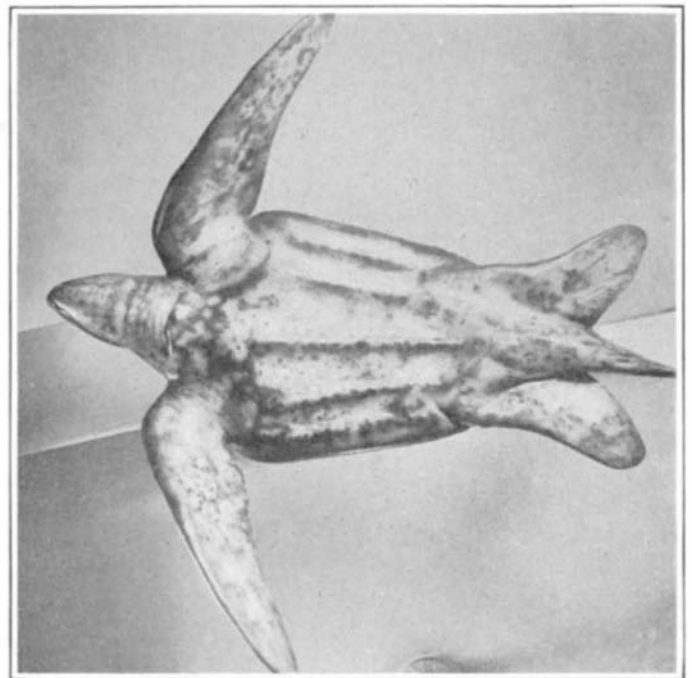
Snapping turtles.—Snapping turtles, sometimes called alligator turtles, have enormous heads, strongly hooked jaws, a long tail, a chin provided with fleshy appendages, and a very small cross-shaped plastron. One variety, *Macrochelys*, sometimes attains a length of nearly six feet. This turtle while sometimes found in the southern states is most abundant in the Mississippi and the streams which flow into it. It has one very striking peculiarity, namely, a number of white fleshy appendages of the mucous membrane situated just in front of the tongue, which, the mouth of the creature being kept open, when in the water, are moved in such a manner as to simulate living worms, with the evident object of attacking the fish it lives on.

All these turtles are notorious on account of their savage dispositions. When annoyed they rise on their hind legs and turn almost complete somersaults in their efforts to bite. According to Holbrook they live at the bottom of stagnant pools or rivers of sluggish motion, occasionally coming to the surface with the rip of their snouts elevated, the other parts concealed, and in this manner float about aimlessly, descending to the bottom again when disturbed. They are much esteemed as an article of food, and large quantities, at least in North America, are brought to market. They are common in sea-food shops in New York City. They do exceedingly well in captivity, two "Snappers" in the collection of the Zoological Society in London, received nearly fourteen years ago, are almost as ferocious as on arrival, says Mr. Boulenger, the director, and will still occasionally seize upon walking-sticks and such articles as may be offered them "for the pur-

pose of inducing them to show off their uncontrollable tempers." These specimens are fed exclusively on meat. In their native land they feed principally on fish and small waterfowl.

In the family *Cinosternidae*, popularly known as mud terrapin, the anterior and posterior lobes of the plastron are movable and connected with the central part by hinges, so that their oval-shaped shell can be partly or completely closed. The mobility of the plastron varies considerably to species and with age, for, as in the case of all terrapins with hinged plastrons, the mobility is not so marked in the young. The species most frequently seen in captivity are the Pennsylvanian mud terrapin, *C. Pennsylvanicum*; the stink-pot mud terrapin or Musk Turtle, *C. Odoratum*; and the blood-stained mud terrapin, *C. Cruentatum*. The two former are distributed throughout the Eastern State of North America, while the latter is confined to Central America.

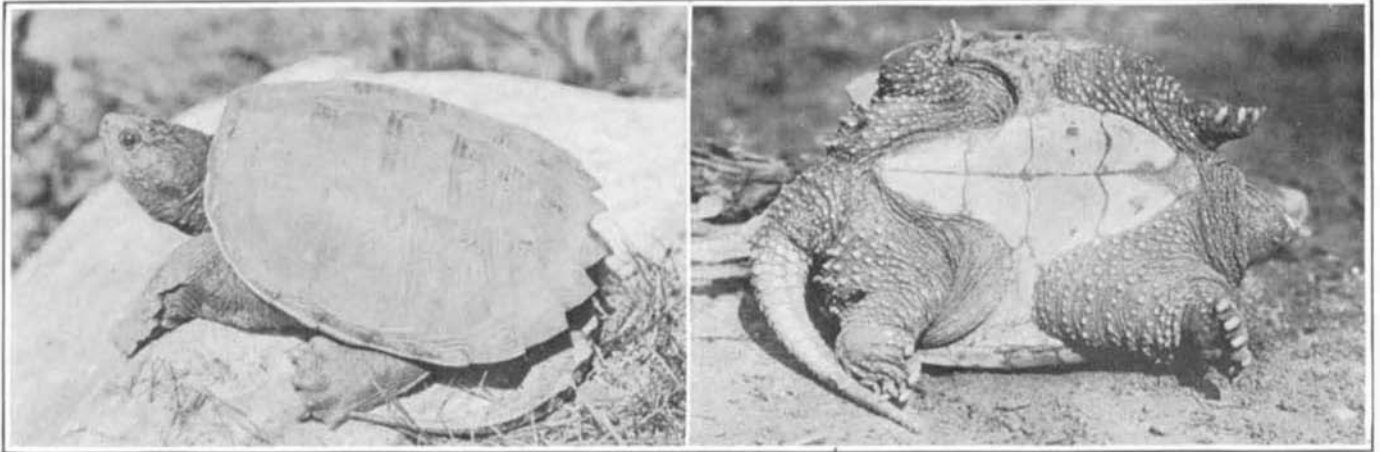
In *C. Pennsylvanicum* and *C. Cruentatum*, the plastral lobes are freely movable; the plastron, however, in the former species, is small, and consequently does not close up completely against the rim of the carapace, as in the case of the latter. The end of the tail is provided with a horny, nail-like appendage in both sexes in *C. Pennsylvanicum*, it is present only in the female in *C. Cruentatum*, and is absent in both sexes in *C. Odoratum*. In the latter species the plastron is considerably narrower and smaller than in the two preceding, and the lobes are only feebly movable. This terrapin derives its name from the fact that on being alarmed it emits from certain glands a remarkably pungent and most disagreeable odor of musk.



VENTRAL VIEW OF A LEATHER BACK TURTLE

The members of this family, none of which exceed a shell length of six inches, are found in muddy ponds or ditches, feeding on small fish and tadpoles. They are said to be very treacherous creatures; when handled they immediately withdraw into their shells, firmly closing them; they do not remain inside for long, however, for after a few seconds they dart out with unexpected rapidity, their mouths wide open, ready to inflict a severe bite with their cutting jaws. The back of the legs of the male in some of the species bears two patches of horny tubercles, and by rubbing these against one another stridulating sounds are produced very similar to those made by grasshoppers.

The widely distributed family *Testudinidae*, which embraces some 130 species, includes a number of strictly aquatic gen-



THE SNAPPING TURTLE NOTED FOR ITS SAVAGE DISPOSITION. THE VENTRAL VIEW SHOWS THE SMALL CROSS-SHAPED PLASTRON

era, as well as all the land tortoises, the passage from one form to the other being so gradual as to preclude any sharp definition. With the exception of Australia and Papussia, its representatives are distributed throughout the greater part of the world.

Batagur and *Hardella* are two closely related aquatic genera, represented each by a single species; the former, inhabiting Bengal, Burma, Siam, and the Malay Peninsula, is to be distinguished from the latter, which is confined to northern India, by the fact that its front limbs have only four claws, instead of the usual five. The limbs are very broadly webbed, somewhat approaching the paddle-shape. The tail is short.

The Baska Turtle, *Batagur baska*, abounds in the Ganges and its tributaries, and is occasionally caught out at sea in fishing nets. Although purely a vegetable feeder in its native waters, specimens in the London Zoo all develop a taste, we are told, for the bread, biscuits, and buns thrown into their tank by visitors. The eggs of this species, the collecting of which is a royal prerogative in Siam, resemble hens' eggs in size and shape.

Hardella thurgi, which likewise feeds solely on aquatic plants, is, according to Anderson, brought to Calcutta in large numbers during the cold months and sold to a low caste of Hindoos, who keep them alive in tanks, selling and eating them themselves. He gives the following account of the extraordinary manner in which they are captured: "A number of men, all but naked, collect together, each man being provided with a large bundle of green marsh grass neatly tied up in the form of a cylinder, measuring about two feet long. These men enter the water, throwing the bundles before them, which act as floats, and on which each man rests his chest as he gets beyond his depth. Then, one after another, they push away these floats, dive to the bottom of the river, and reappear generally with an example of *Hardella* obtained in the mud."

Chrysemys is a large genus distributed throughout North and Central America. The carapace is feebly convex, the plastron is immovable. Although eminently aquatic, frequenting rivers and ponds, and ditches in the case of *C. picta*, the painted terrapin, these terrapins often leave the water, and are most active on land. The soft parts as well as the shells are in most species most beautifully marked. In *C. ornata*, for instance, the head and neck are streaked with orange, while each costal and marginal shield is provided with a large yellow or orange ocellar spot. These markings are brighter and much better defined in the young than in the adult, where, in a good many cases, they disappear almost entirely. In *C. scripta* the sides of the head are ornamented with bright yellow, or yellow and pink bands. Mr. Hugh Smith has given an interesting account of the breeding habits of this species. The egg-laying season, it appears, is in June and July, and the eggs are laid in some cultivated tract, usually a cornfield

adjoining water, the nests being made some distance away from the water, sometimes more than a hundred feet. The nest, which is shaped like a bottle, is made usually in a sandy clay, above high-water mark, the hole being dug out by the female with her fore-legs. The size of the nest depends on the size of the animal, an average nest being four inches deep and four inches wide. The eggs, up to thirty-five in number, are laid at one time, and when the laying is completed, earth is scraped into and over the hole and packed lightly. The packing is accomplished by the terrapin's raising herself as high as possible on her hind legs, and then dropping heavily. As soon as the nest is covered over the terrapin withdraws to the water. If a terrapin is disturbed while making a nest or laying, she will abandon the nest. The young hatch in the autumn, but remain in the nest, where they hibernate until the following spring. On emerging they are about the size of a fifty-cent piece. This terrapin formerly supported a profitable fishing industry, but of late years has become rather scarce, those caught being accidentally taken in fishing nets.

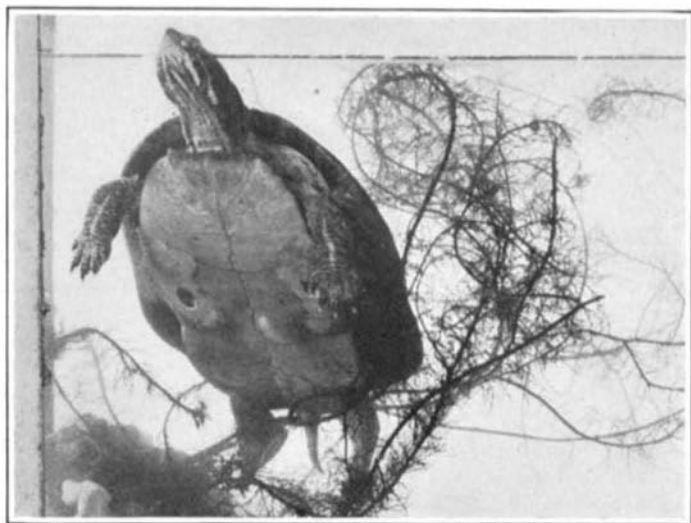
The European pond tortoise, *Emys orbicularis*, is distributed throughout the greater part of southern Europe, Algeria, Tunisia, and southwest Asia. In Central Europe it extends locally as far north as Central France, Holland, Prussian, and Poland. The coloration of the shell is subject to much variation; it is usually dark brown or black with numerous yellow radiating lines, or spots; the plastron is yellow and brown, occasionally entirely blackish brown. The head is black, with lighter dots, which are usually yellow, and in some males of a pale brown. The shell, which is oval in the adult, round in the young, is smooth, with a few well-marked ridges on each shield. The tail is as long as the shell in the quite young, two-thirds that length in adult males, and about one-half in the females.

The tortoise generally hibernates in the mud at the bottom of the pond or river towards the end of October. The lethargy, especially of those hibernating in shallow waters, is not very profound, and a little sunshine, even in mid-winter, is sufficient to awaken them from their slumbers. They resume their activity towards the middle of March, pairing in April, and laying up to a dozen oblong eggs in May or June. Adult specimens do well in captivity; they feed both on land and in the water, usually upon meat or fish, but will sometimes eat lettuce. The quite young are, however, exceedingly delicate, and generally succumb to pneumonia after a few months of captivity. The flesh of this species is said to be moderately good eating, and was formerly appreciated as a delicacy for "fish days" in the Roman Catholic parts of Germany.

Blanding's terrapin, *Emys blandingi*, is a North American species, closely resembling the European pond terrapin. The carapace, which is slightly more convex than in the latter species, is jet black, spotted with bright yellow. The plastron

is yellow and black. The head is brown above, yellow beneath. Like its European ally it is easily domesticated. It takes to land frequently in search of a change of diet, feeding on insects and berries.

In *Clemmys* the plastron is united to the carapace by bone and not by ligament as in *Emys*, from which it does not otherwise differ. The genus is represented in Europe, Africa, southwestern Asia, China, Japan, and North America. Two species are found in Europe, the Iberian terrapin, *Cl. leprosa*, which inhabits the Spanish Peninsula, Morocco, Algeria, and



PAINTED TURTLE IN AN AQUARIUM

Tunisia, and the Caspian terrapin *Cl. caspica*, restricted to southeastern Europe and Asia, from the borders of the Caspian Sea to the Persian Gulf.

In *Cl. leprosa* the carapace is dark olive; the plastron yellow. The head is olive, the sides being streaked with yellow, while an orange spot is situated between the orbit and the ear. A number of yellow bands extend along each side of the neck. The shell seldom exceeds six inches in length. Its specific name is derived from the fact that the creature is subject to a gangrenous disease, when living in not sufficiently aerated waters, which gives the shell a leprous appearance.

Cl. caspica is more handsome, the carapace being elegantly marked with black-edged yellow, wavy markings. This and the preceding species are far more aquatic in their habits than *Emys orbicularis*, and, unlike the latter terrapin, never feed out of water. Freshly captured specimens of the Caspian terrapin emit, when handled, a disagreeable odor, which is due, as in *Cinosternum*, to the secretion of a pair of inguinal glands. When kept for some time in confinement, however, they lose this objectionable habit. Although reaching a length of about five inches, imported specimens rarely measure more than two, and, like most young terrapins, seldom thrive for any considerable time under captive conditions.

In *Cistudo*, the representatives of which are the true Box Turtles, the plastron is connected with the carapace simply by ligaments, and is divided into two movable lobes, enabling the creature, after withdrawing its head, neck, limbs, and tail into the shell, to close it hermetically like a box. The digits are almost entirely free, being provided at most, with only a very short web.

With the genus *Cinixys* begins the series of entirely terrestrial types, the true tortoises, which are provided with club-shaped feet and webless digits, and in which the plastron is always united to the carapace by a broad bridge.

In this genus a remarkable modification of the shell takes place, the posterior portion of the dorsal buckler being hinged and movable.

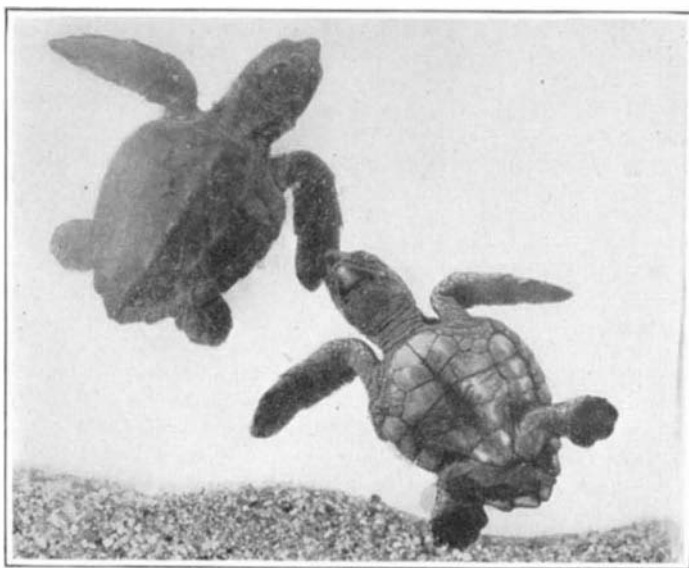
The Gopher Tortoise, *T. polyphemus*, of Florida, is remarkable inasmuch as it lives in burrows, which it only leaves on

very hot days. The burrows are excavated in the sandy soil by means of its front limbs, which are armed with abnormally long claws, with the help of the plastron, which is provided with a small spade-like projection. According to H. J. Hubbard the galleries descend at an angle of 35 degrees, and reach a vertical depth of about nine feet from the surface of the ground, measuring often as much as eighteen feet in length. The temperature at the lower end does not vary much throughout the year, not falling below 70 degrees F. in winter nor rising above 80 degrees in the summer. Once the tortoise has established itself in one of these burrows, it cannot be made to vacate or excavate a new home, but settles down for long periods, some of the burrows being known to have been inhabited by the same individual for as much as twenty-five years. The galleries, if abandoned, immediately become filled up with the shifting sand; they afford a refuge for various other animals, including opossums, raccoons, and owls. The Gopher Tortoise does not survive many months of captivity, making no attempt to burrow.

The Elephantine Tortoise, *T. elephantina*, is now nearing extinction in its native home, Aldabra, but of late years it has been introduced in the Seychelles, where it is now fortunately thriving under Government protection. The shell of large specimens measures five feet in length.

The South Albermarle, *T. vincina*, grows to an even larger size, its shell reaching over five and a half feet in length, such specimens weighing at least five hundred pounds. It may be distinguished from *T. elephantina* by the absence of the nuchal shield.

Some interesting notes have recently been published by the Governor of the Seychelles regarding the conservation of land tortoises in the island. The largest specimen of the herd measures four feet nine inches over the surface of the carapace, and is probably the largest living specimen at the pres-



A PAIR OF LOGGERHEAD TURTLES DISTINGUISHED FOR THEIR LARGE HEADS

ent day. "Gordon," as the creature is called, shows likes and dislikes, and is very combative, having bitten many visitors who presumed on his apparent lethargy. The breeding season in the Seychelles extends from January to April, when the females lay their eggs in holes dug out by their hind limbs, and then covered over. The eggs, which are white, round, and the size of a tennis ball, vary in number from nine to twenty-five. The young hatch out in from 120 to 130 days, and work their way out of the ground; half the eggs are usually infertile, but in some years of great drought very few young appear, being apparently unable to reach the surface. Their rate of growth is exceedingly fast, since they measure, when four years old, nearly two feet in length. When twenty-five they are said to attain full growth.

These tortoises in the London Zoological Garden hibernate from the end of October to the beginning of March. They are fed chiefly on cabbage, of which they consume, during the hot weather, almost a bushel a week each. "One large Elephantine Tortoise is peculiarly untortoiselike in his taste, being extremely fond of the bread and buns which he receives from the visitors, whom, if provided with these dainties, he will follow round his enclosure, often attracting their attention by butting against the railing of his paddock."

The Green Turtle, *Chelone mydas*, enjoys world-wide fame, for it is from the flesh of this creature that the famous "turtle soup" is obtained. The heart-shaped shell is smooth, polished, and slightly notched and serrated behind. The head is large, somewhat compressed at the sides. The jaws are provided with very much serrated cutting edges at the sides, the lower beeing hooked in front. The shell attains a length of about four feet, such specimens weighing about four hundred pounds. Although fairly abundant in all the tropical seas, the great bulk of those received in this country are obtained from the West Indies.

"The eggs are deposited on the sandy shores of uninhabited islands. Before embarking on her parental duties, the female makes a thorough inspection of the beach where she has the intention of laying. Satisfied that the situation is appropriate, she digs a hole nearly three feet deep, with her flippers, and therein deposits some two hundred eggs. These holes are then covered over with sand and levelled down by means of the flippers, in such a manner that it is only with the greatest difficulty that their place of concealment can be discovered. The whole operation of digging, laying, and filling up lasts about a couple of hours, when the turtle once more returns to the sea, leaving the eggs to be hatched by the heat of the sun." After a few weeks the young turtles break through their egg-shells, lift up the sand, and, without the slightest hesitation, make straight for the sea. Although man is perhaps their chief enemy, enormous quantities of young turtles are devoured by large fish, and only a very small percentage reach maturity.

The food of the Green Turtle consists almost entirely of fish and marine plants.

The Hawksbill Turtle, *Chelone imbricata*, also a powerful swimmer, inhabiting all the tropical and subtropical seas, only coming to shore at the breeding season, derives its English name from its prolonged hooked snout. The carapace, the shields of which are more or less imbricate, is marbled yellow and dark brown. It is a somewhat smaller species than the Green Turtle, the shell of adult specimens rarely measuring more than three feet in length.

Although not edible, this animal is highly esteemed on account of its horny shields affording the substance known as "tortoise-shell." According to Sir Edward Tennant, the cruel method is employed in Ceylon of suspending the living turtle over fires, until the heat detaches the plates from the bones of the carapace, after which the creature is put back in the water, it being erroneously believed to return again with a regenerated shell. It appears that if the latter be removed after death the color becomes cloudy and milky, and therefore useless from a commercial point of view.

An interesting account of the fishery resources of the Philippine Islands, which contains some interesting information on this turtle, has been given recently by Mr. Alvin Seale. During the year 1909, there were exported from the Philippines 2,040 kilograms of tortoise-shell. While a small number of turtles are caught with hook, net, spear, or trap, by far the greater number are captured when they come to shore in order to deposit their eggs, the animals being killed without being given a chance to lay, a short-sighted policy, which, unless the turtles are protected during the breeding season, which is from May to August, will eventually result in the destruction of the fisheries.

In the Philippine Islands, it is satisfactory to learn that the method of removing the tortoise-shell from the animal's

back, described by Tennant, is not resorted to, the shell in most of the islands being removed after the turtle has been killed, by immersing the carapace in boiling water until the shields loosen; another method is to bury the body in the sand for about a week, when the shields become detached. The quantity of tortoise-shell obtained from a single adult specimen varies in weight from five to ten pounds.

The Loggerhead Turtle, *Thalassochelys caretta*, is characterized by an enormous head. The carapace, which is very strongly arched, is uniform dark brown or black. The lower jaw is slightly hooked. Its range is even wider than that of either the Green or the Hawksbill Turtle, it being found much farther north, and being in fact not uncommon in the Mediterranean and neighboring parts of the Atlantic. It is of little value from a commercial point of view, its flesh, although not absolutely inedible, being far inferior to that of the Green Turtle.

Although in fresh water aquariums all these marine forms refuse to feed, and die of starvation in a very short time, they will live for many years under captive conditions if provided with sea-water, even in quite small tanks.

As we have said, the flesh of the loggerhead turtle is not very edible. However, the eggs laid by these animals are not only edible but very delicious. The writer has often gathered them on the coast of Florida, fresh from the nests. They are perfectly spherical, creamy white in color, and the "shell" instead of being brittle like bird's shell, resembles tough parchment in look and feel. The eggs are never eaten simply boiled so far as I know; the reason given being that the albumen does not solidify. This fact, however, I cannot vouch for personally, but I have eaten dozens of these eggs in the form of griddle cakes, puddings, etc. They are entirely free from any fishy or unpleasant taste or odor and are very nutritious. They are not only popular as an article of food among the natives of Florida, but they are also keenly enjoyed by various wild animals, including bears, opossums and skunks. So keen is the competition for these delicacies in fact, that one must make a very early start to obtain the prize.

When ready to deposit her precious burden the female turtle swims ashore at high tide and crawls straight up the sandy beach for a distance of several yards, where the nest will presumably be safe from the waves. She then excavates a hole, usually about a foot in diameter and perhaps 18 inches deep. In this a large number of eggs is deposited, usually ranging from 120 to 150 eggs. As will be seen such a nest is a find indeed, comprising several pounds of valuable food; consequently people living near the coast often make up "turtle egging parties" during the spring and summer months when the tide is right, in the hope of coming upon one or two turtle "crawls." The crawl consists of the parallel marks left by the creature's flippers as she toils her way across the sand. After depositing the eggs she fills the hole neatly, and then apparently whirls round and round. Consequently, at the end of each crawl, there is a sort of roughly circular whorl in the sand. The pocket of eggs, however, is by no means exactly in the center of this whorl, so that it requires considerable skill to locate it when digging up the whole area. Experienced hunters judge its location by the greater softness of the sand. I well remember, some years ago, walking up the Ormond Beach before that part of the world was as fashionable and as much frequented as at present—for two or three miles and finding several crawls, but in each case the nest was completely empty, the reason being very evident from the fresh bear tracks which led the way. Finally we came in sight of the bear himself and turned back, though he was undoubtedly in a very amiable frame of mind after just swallowing hundreds of the titbits we ourselves coveted.

Since the mother turtle never returns to look after her offspring, once having prepared for their proper launching into the world, many of them are devoured at a tender age, even when they have escaped being eaten in the form of eggs. There undoubtedly should be some sort of legislation to protect these

creatures, and it would be well to require the finders of the eggs to rebury a certain percentage of them in a fresh place where there are no tell-tale signs to reveal their presence. I have done this myself and been rewarded by the entertaining spectacle described above of the baby turtles scrambling out of their little nests and setting solemnly off for their first dip in the chilly waters of the ocean.

HOW SPRING FLOWERS CAN BLOOM UNHARMED IN SPITE OF FROSTS.

IN studying the phenomenon of the chilliness of the ground during the night as a result of spring frosts, observers have usually confined themselves to recording the temperature observed immediately above the vegetation, woods, grass, herbs, etc., which usually covers the ground, but a Scotch investigator, Mr. T. B. Franklin, has recently attacked the problem in a much more thoroughgoing manner, basing his studies upon the assumption—which he has proved to be correct—that there is frequently a very great difference between the temperature of the ground itself and that of the air above it. This difference is chiefly due to the nature of the protective layer above the earth itself.

The cooling of the ground on a clear night is due to radiation, but the effects produced by this are at first counterbalanced by the conduction of heat, which brings toward the surface of the ground the warmth of the deeper strata. Thus when the earth begins to freeze the latent heat liberated by the freezing of the moisture must be radiated before a new fall in the temperature of the ground can occur. In other words, it is only the surplus of the radiation after the balancing of these two factors which is effective in lowering the temperature of the ground. Accordingly when the surface of the ground is dry and the conductivity is reduced, or when the temperature of the deep lying strata is already low, the ground is cooled much more rapidly by radiation.

It is obvious, therefore, that the temperature of the surface of the ground depends upon three factors:

1. The comparative humidity of the air.
2. The degree of dryness of the superficial layers.
3. The temperature of the subadjacent layers.

Mr. Franklin undertook to determine the comparative importance of these different factors. In order to calculate the power of conduction he measured the temperature at the surface at a depth of 10 cm. Between these two points the temperature usually is almost uniform so long as the surface does not freeze.

The results obtained admirably proved the correctness of the theory, but it was found that on clear, calm nights, when the stars of the fifth magnitude are visible the radiation of the ground depends upon the relative humidity, other factors such as condensation and evaporation, exerting but little effect upon ground temperature. The temperature of the surface tends to fall rapidly below the temperature at a depth of 10cm., by a number of degrees such that the conduction starting at this depth exactly balances the radiation. After this balance has been attained, the surface temperature cannot fall more rapidly than that of the stratum at a depth of 10cm., and consequently when there is a sufficiently high temperature of the subsoil frost is improbable. The difference of temperature between the surface and the depth of 10 cm., which would constitute an equilibrium between conduction and radiation is probably about 5.5°C.

3. In winter, at which time the ground is almost invariably humid, it possesses a uniform maximum conductivity, but it may rise to 11 degrees cent., after a dry period in the spring, or at the beginning of summer. These data seem to indicate that it will be possible in practice to predict a frost at night according to observations made in the afternoon with regard to the three factors mentioned above.

When the ground is covered with any substance which is a poor conductor of heat, radiation from the surface is con-

siderably diminished on clear nights. Mr. Franklin made a series of observations concerning the minimum temperature of the surface of the ground when entirely bare and when covered with layers of different substances. These layers were each 12.5 mm. in thickness and consisted of well-crumbed loose earth, of cinders, of manure, of dead leaves, and finally of a natural growth of grass and moss. The maximum thermic efficiency of these five protective layers was as follows:

1. Crumbly earth, 1.7°C.
2. Ashes, 3.3°C.
3. Manure, 3.6°C.
4. Dead leaves, 4°C.
5. Natural grass and moss, 5.5°C.

During the winter of 1918-19, when these experiments were made it was found that the ground covered with either grass or moss never froze.

By covering the ground with a layer of ashes and placing a screen on top, Mr. Franklin succeeded in maintaining the temperature at 5.5°C. above that of the naked ground, thus equaling but not exceeding the protective effect of the natural covering of grass or moss.

On the slopes of ditches, or in the shelter of hedges and woods protected against the wind and against the effects of radiation by a layer of dead leaves, of grass, or of moss, it will be readily seen how the roots of spring flowers can thus pass through winter without being touched by frost. Even in December, when there is a period of warm rain to give the necessary heat to the ground, these plants will begin to send up their leaves and may be seen blooming at times, just when the winter is most severe. Thus Mr. Franklin saw a primrose which had been so stimulated by the mild weather of December, 1918, that it had made its way through the mossy turf above it and bloomed February 10, 1919. The leaves and flowers in the air, had at this time a temperature of 9.5°C. below zero, while its roots safely buried in the warm earth were 0.5°C. above zero. Thus there was a difference of not less than 10°C. between the roots and the flowers.

VOLUNTARY DETERMINATION OF SEX BY MEANS OF CHEMICALS.

DURING the last five years certain experiments with respect to the determination of sex have been conducted in the Pharmacological Institute of the University of Frankfurt. The results obtained were eminently successful and were recently described by Dr. L. Adler, at a session of the Frankfurt Senckenberg Society. The investigator, Richard Hertwig, and his students are able to produce males from frogs, common brown frogs (*Rana fusca*), during the period of development by the application of heat of from 25 to 28 degrees cent. Under these conditions certain transformations take place. The same success was obtained by the use of eggs which have attained a state of hyper-maturity before being fertilized. Dr. Adler also discovered that the male frogs produced from such eggs exhibit transformations of the thyroid gland in a very high degree, and these largely correspond to the alterations observed in human beings occasioned by Basedow's disease. Another investigator, Gudernatsch, succeeded in obtaining 100 per cent of male frogs by feeding tadpoles with the substance of the thyroid gland. In fact, among 400 tadpoles thus fed there was not a single female.

Under the influence of heat a retrogression or degeneration of the thyroid gland occurs and by reason of this some of the effective substance contained by this gland is liberated and thereupon occasions the transformation of female organs into male organs. The chemical agent concerned in this reaction is iodide of albumen. Very curiously the males thus artificially produced all had uncommonly small weak legs.

Some experiments have been made with animals higher in the scale, but so far as the writer knows without much success. It must be remembered, too, that there is more or less danger connected with the use of the thyroid treatment.