THE GARTER SNAKE.

The ribbon snakes, or "garters," as they are generally called, are the most common serpents of our country. Notwithstanding their frequency, their life history is but little known. The larger and most numerous species is the *Eutænia sirtalis*, first described by Linne. It varies greatly in color and markings, not only in different sections, but even in the same localities. Naturalists from time to time have made about 26 distinct species out of this one *sirtalis*, and it is extremely perplexing, and enough to make the young scientist weary, to study these many long, dry and useless descriptions, only to find in the end that they describe one common species of snake known to science since 1758. Out of these 26 so-called new species, we can find about seven varieties only of the well known *E. sirtalis* of Linne. The common garter snake can be identified by the following description, which I make as plain and with as few technical terms as possible: Form rather robust when full grown. Ground color above olive brown or gray to greenish or brownish black. One vertebral and two lateral yellowish white or pale greenish yellow lines. These three lines are often very indistinct, and sometimes entirely wanting. The vertebral strip generally remains visible anteriorly. Between the dorsal and lateral stripe on each side are two rows of alternating black or dark brown spots, quadrate, and sometimes conspicuous on a light ground, at other times lost in the ground color. Beneath generally pale bluish olive, chin and throat white, sometimes yellow or green tinged. A black spot margined with white (sometimes double or two) on each side of and at the base of each abdominal plate, the skin between the dorsal scales often appearing as small white lines or dashes. Head distinct from the body, flat on the crown, and of a uniform olive brown color. Often a pair of small linear whitish spots on the center of the head. Anteorbitals one (rarely two). Upper lip plates 7 or 8. The scales of the back are all ridged in the center, (carinated), in 18 to 21 rows, narrow above, broad below. Abdominal plates 145 to 155 (to over 180 in some varieties). Plates on the under side of tail 50 to 90, all divided. Length when full grown, from two to nearly three feet.

In the Middle States the garter snake awakens from its winter sleep and comes forth in the early spring. I have met with it as early as March 24, while the snow was yet upon the ground in many places. The males and females immediately seek each other, and may often be found in warm sunny spots, joined in copulation. At this season especially they emit a rank and disagreeable odor, particularly noticeable when captured, and I feel convinced that the sexes follow and find each other entirely by scent. The garter is ovoviviparous, that is, the thin transparent egg case is broken at the moment of oviposition, and the young come into the world formed and colored like the adult, while the hog-nosed snake (*Heterodon*), checkered snake and king snake (*Ophibolus*), and the black snake (*Bascanium*), lay eggs covered with a tough, whitish, somewhat flexible shell, which takes many days to hatch under warm sand or decaying vegetation. The young are generally born in the month of August. The earliest date I have recorded is July 23, and the latest August 25. The number produced at a birth varies from 13 to 80, and their length is about 7½ inches, not one or two inches, as some have supposed. The rattlesnake and copperhead produce only from 5 to 12 at a birth.

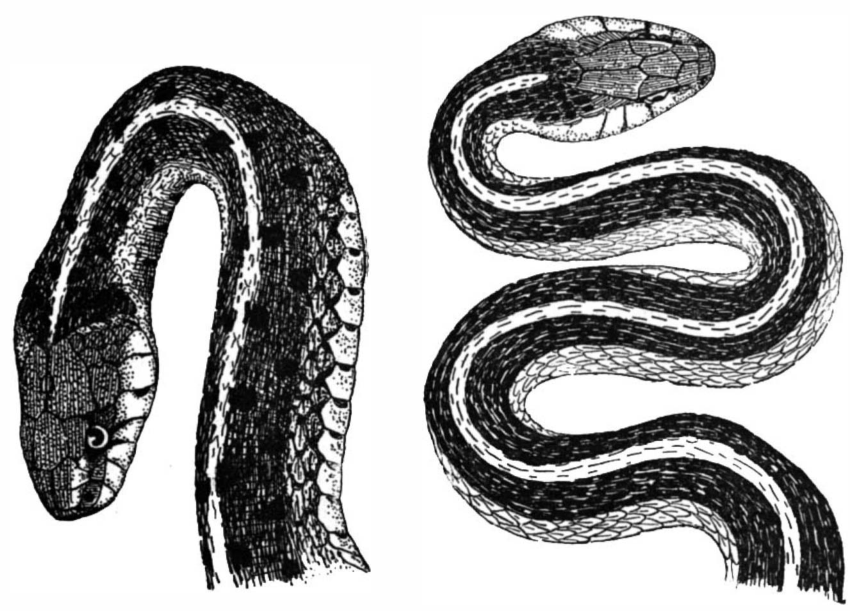
A few summers ago I had a large female *sirtalis*, which had been caught the previous spring, in a vivarium, by herself. I was greatly astonished one morning to find that the vivarium contained 28 snakes instead of one, the happy mother having during the night given birth to 27 baby snakes. They were quite a lively little party, crawling about and over their mother with unmistakable infantile glee. Notwithstanding their playful activity, they were continually yawning during the morning, perhaps not fully recovered from their prenatal sleep. The first thing thought of was how and what to feed this interesting family. I knew that a toad or frog, once or twice a week, was food sufficient for the mother, but the snakelets did not appear able to master a large grasshopper, much less a toad. Having been informed that young snakes fed upon insects, I at once went on a collecting trip and secured a number of crickets, grasshoppers, beetles, flies, moths, and caterpillars for them, but not one even attempted to catch or swallow one of the insects. At last I concluded to try earthworms (*Lumbricus*). The first worm I brought to them was recognized by several of the snakes when yet about three feet away from the glass front of their cage, and the worm had scarcely dropped from the forceps in my hand, before five of the baby snakes seized upon it, and such fighting, twisting, rolling, and pulling I never before witnessed! The worm was torn apart, and four snakes began greedily to swallow the two pieces. One of the snakes not only swallowed his end of the worm, but also the head of his brother who was at work at the opposite end, and when the snake discovered that while eating he was being eaten, the writhing and squirming was indescribable, until the unfortunate snake disengaged his head and neck from the teeth of his brother.

After this I had no trouble in feeding, having discovered what may be called the milk for baby garter snakes. I am of the opinion that many species of our land snakes, when immature, feed upon earthworms. Dr. Holbrook, in his work, "North American Herpetology," says that the little brown snake, *Storeria De Kayi*, feeds upon insects, but I could never get them to eat insects of any kind. Earthworms were their only food. The mature garter snakes feed mainly upon toads and frogs. I have never known them to be insectivorous. In captivity I have seen them swallow salamanders and small fishes, but I doubt very much if they ever pursue and capture the latter in the water.

I once found a *sirtalis* that had captured a frog too large for his mouth. He had swallowed one hind leg of the frog, but could proceed no further. The frog had evidently been dead for several hours, still the snake held on, and expressed anger when I feigned to take the frog away.

The garter snake is perfectly harmless, and of a timid disposition, yet it will sometimes bite when caught in the hand. The bite, however, amounts to nothing more than a few slight scratches. Out of the many living individuals of this species I have had only one of them, a male, possessing an ugly disposition. When teased he would flatten himself like a black *Heterodon*, showing white between the scales, and strike and bite viciously at an offending object again and again, until he would fall over in a paroxysm of rage. At last he died after one of these fits.

C. FEW SEISS.



THE GARTER SNAKE.

Protection for the Originators of New Plants.

Different plans for patenting plants have been often advocated, but the essential objection to them all was well stated by Professor Bailey, as follows: "It is exceedingly doubtful if a patent could be secured for varieties which spring up from a chance seedling, and most of our varieties come in this way. But if the patent were granted, there are innumerable cases in which no jury of experts could agree concerning the distinctness of varieties." Few cautious persons would be willing to swear to the identity of a given strawberry or rose, and it would be difficult to prove in any given instance that the flower or fruit in question was not a new one closely resembling an older variety.

Mr. A. L. Bancroft, of California, suggested a horticultural register wherein separate plants, like roses, chrysanthemums, ferns, apples, grapes, could be kept and numbered, on a system similar to that adopted in the various herd books where choice live stock is registered, but we then pointed out that a herd book was devised for a purpose quite distinct from those which it is proposed to secure by a system of plant registration. Individual animals are registered so that they may be identified, that their pedigree may be established, and that purity of blood may be maintained in a given breed or strain of live stock. In the case of plants, where the registration of one individual must stand for an entire class and where the parentage is often unknown and always of secondary importance, it is difficult to see how such a list would prevent a duplication of names for the same plant or the selling of different plants under the same name. Mr. Bancroft's scheme has been carefully elaborated since then, and a plan of registration has been adopted by the California State Horticultural Society. We have no space here to go into the details of the plan, which have been very carefully elaborated, but as it was discussed it seemed to the nurserymen in their convention that it was quite too cumbersome to be practical and effective.

There is, however, considerable protection already given to the originator of a new fruit in the copyright law. Mr. Hoyt, of New Canaan, Connecticut, stated that he had taken out such a right on his label of the Green Mountain grape, and had been instructed by eminent legal authority that no man could use this title on a label to a grapevine and sell it without his consent. It is true that if any one should buy a plant of Mr. Hoyt he could propagate it as largely as he chose for his own use, or could sell the vines under another name, but there would be little temptation to a grower to sell a really valuable variety under a name which would conceal its identity. The name is the very thing the plant pirate most wants, and he very often sells nothing else but the name of a good variety, attaching it to an entirely different plant from the one it really belongs to. This registered trade mark has proved of value too in preventing the sale of spurious plants under the label so registered, so that copyrighting assists in preventing the sale by unauthorized persons both of genuine plants and their counterfeits.

It is hard to see how much greater protection than this can be secured by a horticultural register. The plan of registering new plants has, however, many merits in other directions. It would be of interest to have an accurate description of any new plant filed in some public office, with its portrait and parentage so far as known. We should like to compare a plant and berry of Hovey's seedling strawberry as grown to-day with a preserved specimen of the original plant and its berry, or accurate portraits and descriptions of them, to see if any variation from the type had taken place. In questions of identity the register might give some assistance, but the inherent difficulties of accurate varietal description would remain. An organized effort to secure registration would be of value, too, in enlisting the co-operation of all horticulturists to secure to originators their rights, for, although no system yet devised can add much to the protection now given by the trade mark laws, this protection would be much more effective if it had an active and united public sentiment behind it.

Of course this protection to the introducers of new plants would make such plants more expensive for a time, just as patented machinery and copyrighted literature is more expensive. But although this increased price might be considered a burden upon horticulture, the advantages gained would be positive and important. Chief among these would be the encouragement offered to careful experiments in hybridizing. When growers can feel sure that they will reap some reward from discoveries in this field, we may entertain a reasonable hope that the breeding of plants may be reduced to something like a system or a science.—*Garden and Forest.*

Indianapolis Meeting of the American Association for the Advancement of Science.

By the invitation of the Governor of Indiana, and other State officers, the mayor and common council and aldermen, and the board of trade of Indianapolis, together with the Indiana Academy of Science, and several educational institutions, the American Association for the Advancement of Science will hold its thirty-ninth annual meeting in the State House of Indiana, from August 19 to 28, together with several allied societies for the promotion of agriculture, botany, entomology and geology. Originally the society was known as the Association of American Geologists and Naturalists, which held its first meeting fifty years ago in Philadelphia. Its scope was enlarged and name changed in 1848, and a constitution adopted admitting other departments of science. In that year the membership was 461. In 1871, when the twentieth meeting was held in Indianapolis, there were 668, and now more than 2,000 are enrolled, of whom fully a thousand are expected to attend this year's meeting. The A.A.A.S. is divided into eight sections, each of which will meet by itself to discuss matters pertaining to its own department of science. General sessions of the entire association are also held at times set by the council. It is expected that nine general addresses, and about 200 special papers will be read. President Mendenhall will give his annual address on Tuesday, August 19, and resign the chair to his successor, Professor Goodale, of Harvard University. Arrangements have been made for excursions on Saturday, August 23, and also at the close of the meeting. For information as to special railroad rates and entertainment, etc., application should be made to Alfred F. Potts, Esq., Indianapolis, Ind. Every effort will be made by the local committee to secure the comfort of visitors, and to promote the success of this great assembly of distinguished men of science.

The Annealing of Copper.

BY G. WYCKOFF CUMMINS, NEW YORK.

Copper is at present almost universally annealed in muffles, in which it is raised to the desired temperature and subsequently allowed to cool either in the air or in water. It may be stated for the benefit of those not versed in the practical work of annealing that a muffle is nothing more or less than a reverberatory furnace. It is necessary to watch the copper carefully, so that when it has reached the right temperature it may be drawn from the muffle and allowed to cool. This is extremely important, for it is found that if the copper is heated to too high a temperature, or is left in the muffle at the ordinary temperature of annealing for too long a time, it is "burnt" as the workmen say. Copper that has been "burnt" is yellow, coarsely granular, and exceedingly brittle—so much so that in some samples in my possession it cannot be bent once at a right angle without breaking. It is even more brittle at a red heat than when cold.

In the case of coarse wire it is found that only the surface is "burnt," while the interior is damaged to a far less extent. This causes the exterior to split loose from the interior when bent or when rolled, thus giving the appearance of a brittle copper tube with a copper wire snugly fitted into it. Cracks a half inch in depth have been observed on the surface of an ingot on its first pass through the rolls, all due to this exterior "burning." It is quite apparent that copper that has been thus overheated in the muffle is entirely unfit for rolling, either for rods or sheet copper or for wire drawing. It is found that the purer forms of copper are far less liable to be harmed by overheating than samples containing even a small amount of impurities. Even the ordinary heating in a muffle will often suffice to "burn" in this manner the surface of some specimens of copper, and thus render them entirely unfit for further working. The explanation of this will be made later. Copper that has been thus ruined is of use only to be refined again.

As may be inferred from the above, only the highest grades of refined copper are at present used for drawing or for rolling. This is not because the lower grades, when refined, cannot stand sufficiently high tests, but because the present methods of working are not adequate to prevent these grades of copper from experiencing the deterioration due to overheating. This is unfortunate for the manufacturer since, I understand, he has to pay cash in advance for the highest grades of refined copper.

In order better to appreciate the explanation of the various phenomena of copper annealing, let us see what refined copper is. The process of refining copper consists in an oxidizing action followed by a reducing action which, since it is performed by the aid of gases generated by stirring the melted copper with a pole, is called poling. The object of the oxidation is to oxidize and either volatilize or turn to slag all the impurities contained in the copper. This procedure is materially aided by the fact that the suboxide of copper is freely soluble in metallic copper and thus penetrates to all parts of the copper, and, parting with its oxygen, oxidizes the impurities. The object of the reducing part of the refining process is to change the excess of the suboxide of copper to metallic copper. Copper containing even less than one per cent of the suboxide of copper shows decreased malleability and ductility and is both cold short and red short. If the copper to be refined contains any impurities, such as arsenic or antimony, it is well not to remove too much of the oxygen in the refining process. If this is done, "overpoled" copper is produced. In this condition it is brittle, granular, of a shiny yellow color, and more red short than cold short. When the refining has been properly done and neither too much nor too little oxygen is present, the copper is in the condition of "tough pitch" and is in a fit state to be worked.

"Copper is said to be tough pitch when it requires frequent bendings to break it, and when, after it is broken, the color is pale red, the fracture has a silky luster, and is fibrous like a tuft of silk." On hammering a piece to a thin plate it should show no cracks at the edge. At tough pitch, copper offers the highest degree of malleability and ductility of which a given specimen is capable. This is the condition in which refined copper occurs in the market, and if it could be worked without changing this tough pitch, any specimen of copper that could be brought to this condition would be suitable for rolling or drawing. We have seen that tough pitch is changed if we either add oxygen to or take oxygen from refined copper.

By far the more important of these is the removal of oxygen, especially from those specimens that contain more than a mere trace of impurities. This is shown by the absolutely worthless condition of overpoled copper. The addition of carbon also plays a very important part in the production of overpoled copper.

That the addition of oxygen to refined copper is not so damaging is shown by the fact that at present nearly all the copper that is worked is considerably oxidized at some stage of the process, and not especially to its detriment.

Let us see how the above facts are related to the process of annealing copper. I have already referred to what is known as "burnt copper." This you may already have recognized as nothing more nor less than copper in the overpoled condition. This is brought about by the action of reducing gases in the muffle. By this means the small amount of oxygen necessary to give the copper its tough pitch is removed. You must remember that this oxygen is combined with impurities in the copper, and thus renders them inert. For example, as explained by Dr. Peters, the oxide of arsenic or antimony is incapable of combining more than mechanically with the copper, but when its oxygen is removed, the arsenic or antimony is left free to combine with the copper. This forms a very brittle alloy, and one that corresponds almost exactly in its properties to overpoled copper. To be sure, overpoled copper is supposed to contain carbon, but that this is not the essential ruining principle in case of annealing is shown by the fact that pure copper does not undergo this change under conditions that ruin impure copper, and also by the fact that the same state may be produced by annealing in pure hydrogen and thus removing the oxygen that renders the arsenic or antimony inert. No attempt is made to deny the well known fact that carbon does combine with copper to the extent of 0·2 per cent and cause it to become exceedingly brittle. It is simply claimed that this is probably not what occurs in the production of so-called burnt copper during annealing. The amount of impurities capable of rendering copper easily "burnt" is exceedingly small. This may be better appreciated when it is considered that from 0·01 to 0·2 per cent expresses the amount of oxygen necessary to render the impurities inert. The removal of this very small amount of oxygen, which is often so small as to be almost within the limits of the errors of analysis, will suffice to render copper overpoled and ruin it for any use.

Perhaps the most interesting part of this article, to practical men at least, will be the description of a method of avoiding the numerous accidents that may occur in the annealing of copper, due to a change of pitch. As already pointed out, the quality of refined copper is lowered if oxygen be either added to or taken from it. It is quite apparent, therefore, that a really good method of annealing copper will prevent any change in the state of oxidation. To accomplish this it is necessary to prevent access to the heated copper both of atmospheric air, which would oxidize it, and of the reducing gases used in heating the muffle, which would take oxygen away from it. Obviously the only way of accomplishing this is to inclose the copper when heated and till cool in an atmosphere that can neither oxidize nor deoxidize copper. I find that by so doing copper may be heated to the melting point and allowed to cool again without suffering at all as regards its pitch. There are comparatively few gases that can be used for this purpose, but, fortunately, one which is exceedingly cheap and universally prevalent fulfills all requirements, viz., steam. In order to apply then in practice the principles already enunciated, it is necessary only to anneal copper in the ordinary annealing pots such as are used for iron; care being taken to inclose the copper while heating and while cooling in an atmosphere of steam. This will effectually exclude air and prevent the ingress of gases used in heating the annealer. Twenty-four hours may be used in the process, as in the annealing of iron wire, with no detriment to the wire. This may seem incredible to those manufacturers who have tried to anneal copper wire after the manner of annealing iron wire. By this method perfectly bright annealed wire may be produced. Such a process of annealing copper offers many advantages. It allows one to use a grade of copper that has hitherto been worked only at a great disadvantage, owing to the ease with which it gets out of pitch. It allows one to use annealers such as are ordinarily used for annealing iron, and thus cheapens the annealing considerably as compared with the present universal use of muffles. There is no chance of producing the overpoled condition from the action of reducing gases used in heating the muffles. There is no chance of producing the underpoled condition due to the absorption of suboxide of copper. None of the metal is lost as scale, and the saving that is thus effected amounts to a considerable percentage of the total value of the copper. The expense and time of cleaning are wholly saved. Incidentally bright annealed copper is produced by a process which is applicable to copper of any shape, size, or condition, a product that has hitherto been obtained only by processes (mostly secret) which are too cumbersome and too expensive for extensive use and, as is the case with at least one process with which the author is acquainted, with the danger of producing the overpoled condition, often in only a small section of the wire, but thus ruining the whole piece.

If it is desired, the copper may be annealed in an apparatus so arranged that the copper when heated may be dropped into a body of water without access of air, and thus make a far smaller annealing plant suffice. It may be mentioned that copper seems to be made neither softer nor harder by being cooled suddenly in this manner than if cooled slowly, though some of the alloys of copper are rendered somewhat softer by a sudden cooling; in fact, there is not the slightest evidence anywhere to justify the quite prevalent belief that an art of hardening copper was known to the ancients. The hardest tools of the ancients were made of bronze, not copper.

By application of the same principles it is possible to prevent both deoxidation and oxidation in the heating of copper ingots for the rolls, and thus, by keeping copper at tough pitch all along, any copper that can be given tough pitch can be used for rolling as sheet copper or for wire.

I think it also practicable to produce bright copper rods direct from the rolls.

Compound Interest Table.

CONSTRUCTED BY FREDERIC R. HONEY, PH.B., YALE UNIVERSITY.

	Double.	Triple.	Quintuple.	Septuple.
Rate per cent.	69·3197	109·8692	160·9554	194·6051
From 1 to 10	·3431	·5438	·7967	·9632
" 11 " 20	·3382	·5360	·7853	·9494
" 21 " 30	·3336	·5286	·7745	·9364
" 31 " 40	·3292	·5217	·7643	·9241
" 41 " 50	·3251	·5153	·7548	·9126
" 51 " 60	·3213	·5092	·7460	·9020
" 61 " 70	·3177	·5036	·7377	·8920
" 71 " 80	·3144	·4983	·7300	·8826
" 81 " 90	·3112	·4933	·7227	·8737
" 91 " 100	·3083	·4886	·7158	·8654

By means of the accompanying table, it is easy to ascertain the number of years in which *any* sum of money put out at compound interest may be doubled, tripled, quintupled, or septupled. The method of using the table is illustrated by the following examples.

Ex. I.—*To find the number of years in which any sum of money put out at* 15 *per cent will be tripled.* Look down the vertical column under *rate per cent* for 15; it lies between 11 and 20; carry the eye along this horizontal column until it reaches the vertical one under the word *triple*, and the figure ·5360 is found; multiply ·5360 by 15 (the rate per cent). The product is 8·04; add this figure to that at the head of the column, viz.: 109·8692; divide the sum, viz., 117·9092, by 15; the quotient 7·86 is the number of years required.

Ex. II.—*To find the number of years in which any sum of money put out at* 25 *per cent will be quintupled.* Look down the vertical column under *rate per cent* for 25; it lies between 21 and 30; carry the eye along this horizontal column until it reaches the vertical one under the word *quintuple*, and the figure ·7745 is found; multiply ·7745 by 25 (the rate per cent); the product is 19·3625; add this figure to that at the head of the column, viz., 160·9554; divide the sum, viz., 180·3179, by 25; the quotient 7·213 is the number of years required.

By the same table it is easy to determine the number of years in which a sum of money may be quadrupled, by doubling the number of years in which it will be doubled; sextupled, by adding the number of years in which it will be tripled to the number in which it will be doubled; octupled, by tripling the number of years in which it will be doubled, etc.

The above statements suppose interest to be payable *annually*. If payments be made *half yearly*, the calculation must be made for half the rate per cent, and the answer will come out in the number of half years, *i. e.*, the answer must be divided by 2 in order to ascertain the number of years. Also if payments be made *quarterly*, the calculation must be made for one-quarter the rate per cent, and the answer divided by 4 in order to obtain the correct result.

The Manufacture of Celluloid.

The manner in which celluloid is made in France is as follows: A huge roll of paper is unwound slowly, and while unwinding is saturated with a mixture of five parts of sulphuric and two parts of nitric acid, which is carefully sprayed upon the paper. The effect of this bath is to change the cellulose in the paper into pyroxyline. The next process is the expelling of the excess of acid in the paper by pressure and its washing with plenty of water. It is then reduced to a pulp and bleached, after which it is strained, and then mixed with from 20 to 40 per cent of its weight in water. Then follows another mixing and grinding, after which the pulp is spread in thin sheets, which are put under enormous hydraulic pressure and squeezed until it is as dry as tinder. These sheets are then put between heated rollers and come out in quite elastic strips, which are worked up into the various forms in which celluloid is made.

The Iridium Light.

Upon a suitable plate or support, such as wax, the form of the desired filament is penciled with plumbago; this is placed in an electrical iridium bath. When a film of sufficient thickness is deposited upon the stenciled design, the filament is peeled off from the beeswax and the plumbago brushed off the back. Iron wires are used as conductors. The filament is incandesced in the atmosphere, as it is practically non-combustible, or, for security against breakage, it may be incandesced in any suitable gas or in a vacuum.