

90 pounds from the normal. Upon opening the gate the pressure would fall 90 pounds below the normal, then rise to 80 pounds above normal, dropping again to 75 pounds below normal, the fluctuation continuing for about half a minute, or until the normal pressure was reached. An attempt was then made to control the gates by hydraulic rams, the power being taken from the pipe line. The rams opened and closed the gates so expeditiously that a fluctuation in pressure of 170 pounds each way from the normal was recorded. To check the speed the exhaust outlets of the rams were reduced in size to $\frac{3}{8}$ of an inch—an arrangement which increased the time of opening or closing to half a minute, and reduced the variation of pressure to 30 pounds. The hydraulic gates were eventually discarded in favor of a set of gates which are operated by means of a hand wheel.

These have proved very successful, and there has been no further trouble from water shock.

By reference to Figs. 3 and 5 it will be seen that the receiver is carried upon I beams which extend across the wheel pit. There are three single jet Pelton wheels for driving the generators, two for driving the exciters, and two smaller wheels which operate the governor mechanism. The main Pelton wheels are 57 inches in outside diameter and each wheel has 27 buckets. On the same shaft with the wheel is a three ton fly wheel, 5 feet in diameter, and as the speed of revolution is 600 per minute, the disruption of the fly wheel by centrifugal force is provided against by shrinking on a 2 inch steel band around its periphery. The enormous force of the water is shown by its behavior in the wheel pit. When the water was first turned on, instead of falling from the buckets into the tailrace, it followed the wheels to the plank covering of the pit, along which it rushed, finally leaping out horizontally a distance of 60 feet. Where it struck the bottom of the pit, it tore up the concrete and attacked the underlying rock. A cushion pipe 14 inches diameter and 14 feet long was placed in line with the jet, but it merely reversed the direction of the water, which was spurted out upon the roof of the power house. The floor was then covered with $\frac{3}{8}$ inch steel plates, but the sand and fine gravel in the water cut through the plate. Finally, a $1\frac{1}{2}$ inch cast iron plate was placed at the point of impact, the idea being to replace it as soon as the water had worn it away.

The power house, which is a handsome structure of granite 36 feet in width by 70 feet long, contains three 340 K. W. multipolar General Electric 3-phase generators, which deliver current at 700 volts to a low potential switchboard, from which it is carried to six 125 K. W. transformers, which deliver 3-phase current at 11,000 volts through a high potential switchboard to the line. There are also two $12\frac{1}{2}$ K. W. multipolar exciters, each of which can take care of the whole plant. The transformers are of what is known as the air blast type. They are placed upon an inclosed platform, through which air is forced, issuing through holes in the floor and thence to ventilating ducts in the cores of the transformers themselves. The power house and the substation at Fresno are protected by lightning arresters and choke coils.

The pole line from the power house to the city is built of square sawed redwood poles 12 by 12 inches at the butt and 6 by 6 inches at the top, the length varying from 35 to 40 feet. The 11,000 volt circuit is made up of two 3-phase 3 wire sets of No. 3 B. & S. soft drawn copper. The insulators are arranged on two arms, there being four on the top arm, two on each side of the pole and two on the bottom arm, each of which is placed centrally beneath the two on the upper pole. It will be seen that the insulators thus form a triangle on each side of the pole, each triangle carrying one complete circuit. The insulators are of the well known "triple

petticoat" type. They are of helmet shape, with a groove at the top and wings on each side, and the transmission wire is carried by the groove, which is tied to the wings by soft copper wire. The course of the line for ten miles is through a rolling country which is situated below the snow line and is easily accessible. From the foothills the line runs through the wheat fields and

bubbles it expands with an explosive force. So loud are the reverberations through the hills that the farmers who live six miles from the power house can tell the hour at which the water is being turned on. The total length of the work is forty-five miles. The length of the ditch, as before stated, is seven miles, and its capacity sixty cubic feet per second. The reser-

voir above the pipe line has a capacity of four million cubic feet, and covers an area of eight acres. Altogether there is a constant supply of water in sight sufficient to provide fully fifty thousand horse power to the city.

The plant has been in active operation since June 12, 1896, and is giving the very best of satisfaction. It is now supplying current for 165 arc lights, over 5,000 incandescent lamps, and 460 horse power in motors.

The original conception and the plans of this very successful work are due to Mr.

John S. Eastwood, civil engineer of Fresno, to whom we are indebted for the photographs and data used in the preparation of the present article.

COLLECTORS OF SNAKES.

BY L. P. GRATACAP.

Human curiosity is excited by few subjects in the animal world more keenly than by snakes. The ancient associations of these singular creatures, the peculiar innate instinct of dread and repulsion aroused by them, and the deadly power possessed by a few genera among them contribute to make them perennial objects of interest. The popular feelings of alarm and fascination in their presence were vividly shown at the winter reception of the Microscopical Society at the American Museum of Natural History, where Mr. R. L. Dittmars, of this city, exhibited microscopical preparations of the fangs of rattlesnakes, and by way of a captandem two glass covered boxes containing respectively a water moccasin and young and a copperhead and young. The breathless interest of the spectators, their incessant storm of inquiry, and the congested crowd that poured in and around the basilisk eyed reptiles were eloquent testimony to the peculiar attraction exerted by them upon the average visitor. The exhibition made by Mr. Dittmars was a very faint suggestion of the remarkable display which the favored guest of his hospitality may enjoy at his own home. In a room of moderate dimensions this collector has arranged his ophidian pets in lines of boxes with glass covers placed around the walls. A remarkable and rather startling effect is produced, one not altogether reassuring when the expectant visitor enters this singular domestic den of reptiles, and observes the excitement of the rattlesnakes, unpleasantly accentuated by the keen sibilant hum of their tail buttons.

Here a Florida diamond back rattler, a Goliath in strength and of monstrous size, rolls himself in ominous coils, and with depressed nostrils and erect rattle seems the impersonation of stifled fury, his sinister expression giving a frightful ferocity from the glittering eyes and the singularly expressive sculpture and markings of his broad head. The delicate and featherlike scales over his body impart to it a softness and velvet beauty which accentuates the fiendlike bitterness of his aspect. There a number of Texan rattlers are twisted into a graceful group, bristling with alert heads and sonorous with the peculiar sharp whirr of their vibrating tails. Another case shows a torpid mass of water moccasins. Their careless attention, as the visitor approaches, seems more reassuring, but though less nervously irritable, their bite is almost as venomous as that of the rattler, and their rage and gloating rapacity, when they seize their prey, more terrifying.

The banded rattlesnake (*Crotalus horridus*) of this latitude is represented by a number of smaller specimens, gathered almost picturesquely, about their water tub or stretched indolently over a few stones, while

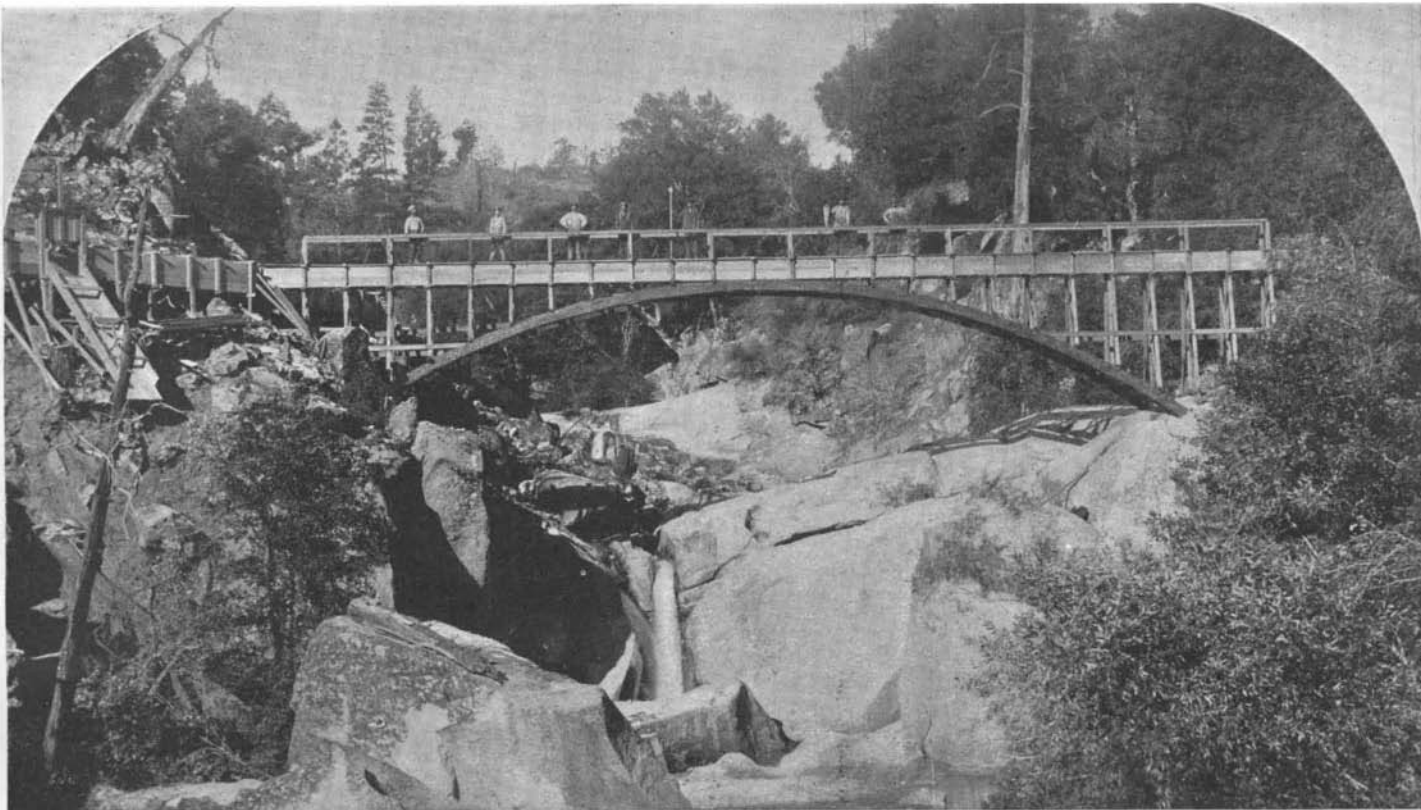
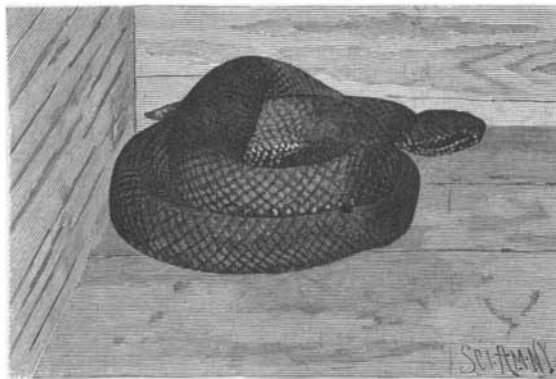


Fig. 10.—WOODEN ARCH FLUME ACROSS THE NORTH FORK OF THE SAN JOAQUIN RIVER.

THE LONG DISTANCE ELECTRIC POWER TRANSMISSION PLANT AT FRESNO, CALIFORNIA.

vineyards which are characteristic of this part of the valley.

At the substation at Fresno the line enters through choking coils, lightning arresters, and the high tension switchboard, which stands some eight feet above the floor. The choke coils are made up of 150 feet of insulated wire which is coiled into a ring and thoroughly taped. The self-induction of these rings obliges the lightning to take the required path. The current after leaving the switchboard is carried to step-down transformers, whose construction is similar to the step-up transformers at the power house. There are nine of these arranged in three sets. Three 125 K. W. transformers deliver current at 115 volts to the commercial incandescent circuits. Another set of three 75 K. W. transformers delivers current at 1,000 volts for operating the power circuits, and the third set of three 40 K. W. transformers delivers a 3,000 volt current for the suburban and outlying districts. A five horse



WATER MOCCASIN.

power induction motor drives a blower which furnishes the air blast for cooling the transformers.

The San Joaquin Electric Company has established a price of \$64 per horse power per year for its electric power. The current for lighting purposes is furnished at fifteen cents per K. W. hour, measured by meter, with discounts of from five to twenty-five per cent, or it is furnished at a fixed rate of from thirty cents per sixteen candle power lamp per month to ten cents per lamp for bedrooms, bathrooms, etc.

A visitor to the power house will be startled by the loud detonations which accompany the starting of the water wheels. The noise is described as being similar to a heavy bombardment by artillery, and to an inexperienced ear it would sound as though the whole plant were in danger of violent disruption. The explanation of these concussions is that the air which is collected in the receiver and the pipes is subject to the enormous pressure of 609 pounds to the square inch, and on its escaping from the nozzle in the form of

their diminutive rattles seem scarcely responsive to the provocation of a gesture or a blow. A large copper-head snake (*Agkistrodon contortrix*), curiously observant, but motionless, is extended in another case, his faintly rubescent tint and impassive attitude increasing his resemblance to a metallic cast.

Less threatening are the numerous groups and individuals of the non-poisonous species, whose long familiarity with handling have rendered them tame and gentle. They are taken out by Mr. Dittmars and, entwined around him, form living festoons of slowly undulating bands marked by party-colored stains, blotches, squares or lines, emitting with lightninglike rapidity their delicate forked tongues.

The beautiful red corn snake of more southern latitudes, the long black chicken snake, the pest of hen-roosts in the South, the agile and belligerent black snake of our swamps and woods, the exquisitely colored green snake found more to the north, the highly colored hog-nose snake with its inflated neck and mimicry of menace and attack, the many species of garter snake, from those of the Mojave Desert to the lithe and variegated ribbon snakes of our fields and hillsides; the singular milk snake, over whose variations in markings Dr. Cope has exhausted his searching analyses; the vivid pine snake, the fox and water snakes, compose a garland of novelty and interest.

Mr. Boulenger, who has recently completed the catalogue of snakes in the British Museum, a work of extraordinary pains, recognizes 1,639 species, which he divides among nine families. First in this systematic arrangement come the wormlike Typhlopidae living in burrows under the earth, and numerous in the tropics. Allied in habits are the Glauconiidae, and then the huge pythons and boas, with an intermediate section of the Ilysiidae with only five species, two East Indian genera and one South American. The Uropeltidae follow, the whole of whose forty-two species are confined to Ceylon and India, where they are found in the tea and coffee fields. Mr. Boulenger limits the sixth family to one genus and species, *Xenopeltis unicolor*, of India and Malay. The seventh family is the Colubridae, the most extensive of all, comprising the more common of our snakes. This enormous family has been separated into three parallel series, the first with solid teeth, the second with the hinder teeth on the jaw (maxillary) grooved, and the third with the forward maxillaries grooved. The first comprise (*Aglypha*) harmless snakes, the second (*Opisthoglypha*) suspicious, more or less poisonous species, the last (*Proteroglypha*) venomous groups. The typical poisonous snakes are placed in the Viperidae, the ninth family. Here rest the copperhead, rattlesnake, cobra, fer de lance, etc. The eighth family, Amblycephalidae, have non-extendible jaws and feed on insects. The erectile teeth belong to the true vipers, and it is interesting to observe the fang or tooth of the rattlesnake, disclosed from its membranous sheath, and forced by pressure upon some solid object, exude the deadly liquid so mysteriously fatal.

Mr. Dittmars has been engaged with Dr. Langman, of this city, in procuring, from a vigorous and large collection of snakes, belonging to the latter, samples of the venom of water moccasins, rattlesnakes and copperheads. This is furnished to the laboratory at Heidelberg for analysis in continuation or confirmation of the studies of Weir Mitchell and Calnette.

However strong the sense of abhorrence may be awakened in some in the presence of these reptiles, it would, upon familiarity, rapidly disappear, and it would in most cases be succeeded by a real affection for the many graceful and harmless species.

Mr. Dittmars is not alone in his attachment to this neglected section of the zoological series. Prof. G. R. O'Reilly, Mr. Charles H. Higby, Mr. Gustav Von Moser, and Dr. G. Langman, all of this city, also keep collections, and become deeply attached to their ophidian pets, or, in the case of the vipers, find them full of interest.

THE habit of dressing too warmly within doors in the winter season is earnestly deprecated by physicians. The temperature of modern houses and offices is usually about 70 deg., which is summer heat. Yet both sexes select thick flannels and heavy dresses and coats for house wear and then go out into an atmosphere many degrees colder, with little additional protection, especially for the feet. This is a fruitful source of colds.

Breathe Properly.

Do you know what an "active chest" is? Probably not, answers a writer in the New York Tribune; but your chest ought to be active—that is, lifted up—two-thirds of the time you are awake. Stand up and take a long breath, as long as you can; now you lift your chest; keep your chest up while you go on breathing by movement of the abdomen and the muscles at the side of your waist. A very slight movement is all that is necessary for normal breathing; but now you have let your chest fall! You are so tired you can't hold it up! That shows a very bad, unnatural state of things; the normal human being, whenever he is not relaxed, walks with his chest up; and when he talks with vigor or interest, it is with his chest up; and you can't hold yours up three minutes without fatigue—you can't do it, at all, for five! Do you know that the preservation or achievement of a round, slender waist will be your reward if you will strengthen your muscles and learn to keep your chest up? It will certainly, except as you become hopelessly fat, and even then good breathing will do much to preserve some good outlines in your figure. Proper breathing and the habit of keeping the chest up will keep all the internal organs in their proper place and keep them from spreading the waist in any way that is unsightly,



QUEEN WILHELMINA OF HOLLAND.

and shows not Greek health, but deficient vitality. The first thing is to get so you can hold the chest up. Walk across the floor three times, holding up your chest (just as you do when you try to fasten a tight skirtband), at the same time breathing deeply from the abdomen. After the three times you are exhausted; rest and try it again; to-morrow you can perhaps do it four; don't tire yourself, but keep at it till you have strengthened the muscles that hold your chest up just as you would strengthen the muscles of your arms, with use. Always practice out-of-doors or with your windows up; there are many good breathing exercises and but few can very well be conveyed in print, but the main thing is very simple; breathe with your chest up, and keep on doing so till you do it naturally, all the time that you are not relaxed in rest.

One good exercise that can be taught is to simply stand and take as long a breath as you can, chest well up, and then hold it as long as you can. This exercise used for a few minutes every day is most beneficial, and physicians recommend it for strengthening and expanding the lungs.

Professor Tyndall said that, as a broad general rule, any air out of doors was better than any air indoors. Breathing exercises are most effective outside the house and generally they are not conspicuous even on a city sidewalk.

THE QUEEN OF HOLLAND.

Of the two child monarchs who have been ruling in Europe of late years—the King of Spain and the Queen of Holland—it is of the young queen that the world at large has heard the most. And indeed it is with her that the world has the more sympathy, for she is the last of the House of Orange, a house made famous three hundred years ago through the bold and determined military achievements of its greatest member, William the Silent—the "Father William" of the Dutch people.

It is a rather striking coincidence that now, after three centuries have elapsed, the thrones of Holland and Spain should both be held by children, and that these children should be, too, the lineal descendants of those most bitter enemies, Philip II and William the Silent; the former the would be destroyer of Dutch civil and religious liberty, the latter the founder and maintainer of it. Though he died a martyr to the cause—for the assassin's knife directed by Philip ended his splendid career—William's life and example so inspired the Hollanders that they were able to keep up the fight until, over twenty years later (in 1609), Spain gave up the contest and the United Provinces of the Netherlands were freed from the yoke of ecclesiastical and civil despotism, against which they had fought for thirty-seven years. This struggle was one of the most heroic and hard fought struggles for liberty the world has ever seen. A nation with less persistency than the Dutch could never have won it.

During the centuries since the separation of the United Provinces from Spain, that particular part of the Low Countries known as Holland has passed through many vicissitudes of government. In the first half of the present century the Republic of the Netherlands went to pieces, and the separate kingdoms of Holland and Belgium were formed out of it; so that at the present time Holland is a limited monarchy having two law making houses much like those of the English Parliament.

Wilhelmina Helena Pauline Maria, the young Queen, was born on the 31st of August, 1880; consequently, she will attain her majority and be pronounced ruling sovereign a year from the last day of August next.

King William III, the father of the Queen, spent the best part of his life in wild dissipation, and developed a character altogether unsavory. In 1839 he married Princess Sophia, of Saxony. He was then Prince of Orange, but after a half score of years had passed he became King, and the fortune left him turned his head. He plunged into all sorts of dissipation, and finally alienated himself from his queen, whom he falsely accused of plotting with the Emperor Napoleon to depose him, and set her up as Queen Regent. So bitter became his hatred of his first Queen that, even when she was on her death bed, he refused to see her. Of the two sons whom he had by this marriage, the elder, the Prince of Orange, ruined his health and died after a few years of reckless life in Paris; the second son, Prince Alexander, who was of a gloomy and un-

sound mind, soon followed his brother to the grave; and left now without an heir, the fast aging King began to look about for another wife, that he might not die childless. He finally determined on the Duchess of Albany, a daughter of the Prince of Waldeck-Pyrmont, for his second queen, but she, unfortunately, did not fancy the decrepit old King for a husband. She was a young woman of twenty-two, and could hardly be blamed. It is said that when Queen Emma heard her sister refuse the King's offer of marriage she said to her, "Helen, I should never refuse to become a queen." The King happened to overhear the remark and was so pleased with the younger sister Emma—a girl of but nineteen—that he addressed his offer of marriage to her, and she, true to her word, did not refuse. So it came about that this lively young maid returned with King William to The Hague and became his beloved queen, nursing him tenderly through the long, painful years that remained to him of life. Helived to see his little daughter reach the age of ten years; and a few years before his death, at a council of the States-General, he obtained the setting aside of the Salic law, which forbade a female heir to succeed to the throne. So, upon her father's death, Wilhelmina became Queen, and her mother, whom she resembles in many respects, was appointed Queen Regent.

The little Queen was of a most delicate constitution during her early years, and grave doubts were at one