UNSCIENTIFIC AND SCIENTIFIC DIVINING RODS.

BY GEO. M. HOPKINS.

Notwithstanding the tendency of scientific knowledge and general enlightenment to dissipate superstition, the proportion of believers in certain kinds of demonstrations attributed to the supernatural is beyond belief; yet when we find, on investigating the subject, that many coincidences have occurred which seem to establish the claims of the advocates of such

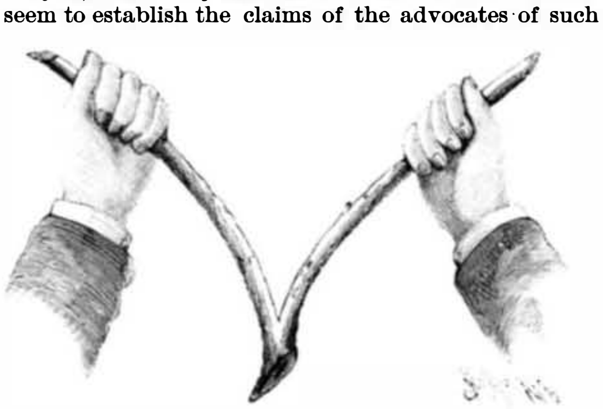


Fig. 1.—FORKED TWIG DIVINING ROD.

beliefs, it is no wonder that some of these notions gain credence, especially in view of the fact that the majority of unsuccessful experiments are never made known.

The divining rod—so called—is a very ancient device, but the belief in its efficiency is as strong to-day as it ever was, yet there is no scientific reason why it should be of any use whatever for any of the purposes to which it is applied. The ancient divining rod (Fig. 1) consisted of a forked twig of hazel, apple, or any fruit-bearing tree. It was held in the hands with the branches both lying normally in the same horizontal plane, with the crotch pointed either toward or away from the body of the operator. It was carried in this position over the ground, and whenever the forked twig bent downwardly it indicated proximity to water, minerals, or metals. The same performance is gone through with in these times, and we often hear of remarkable successes attained by modern operators. These successes are due partly to the good judgment of the operator, but mostly to sheer luck or chance. The dipping of the rod is not due to the action of the water or minerals, but to the voluntary or involuntary movement of the muscles of the hands and arms. If we assume that the operator is honest, we must admit the movements to be involuntary. In using the rod the hands are held in a strained, unnatural position, which renders it very difficult to hold the twig for any great length of time in the prescribed position without causing the muscles to twitch and thus compel the branch to dip.

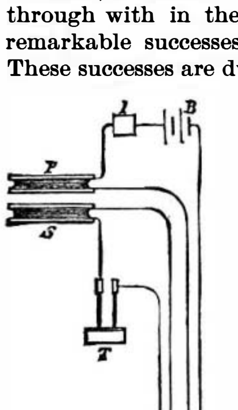


Fig. 6.—INDUCTION BALANCE.

The mineral rod illustrated in Fig. 2 is formed of a tube preferably, though not necessarily, of bamboo, with compartments at its ends. In one compartment is placed a piece of loadstone, and the other is partly filled with quicksilver. Both ends are corked and the instrument is held as shown in the cut. When the loadstone end dips it is supposed to indicate iron, but when the quicksilver dips it is taken as an indication of precious metals.

Although it does not seem advisable to multiply the accounts of these unscientific and worthless instruments, still, to convey an idea of the variety of devices of this class in existence, one more example is illustrated. The instrument consists of a small bottle suspended by a string and covered with thin cloth tied around the neck of the bottle. A specimen of the metal or mineral sought for is placed in the bottle. The string by which the bottle is suspended is held by the hands as steadily as possible. The bottle first revolves in one direction and then in the other. When it stops it begins to oscillate like a pendulum. The line of vibration is supposed to point to the object sought. The operator carries the device in the direction indicated until vibration ceases; the point where this occurs is the spot where the mineral or other substance looked for is to be found. If several different substances are looked for, a sample of each must be put in the bottle.

It is needless to say that all these devices and methods are devoid of any scientific principle, and if they ever give indications that lead to a find, it is either accident or coincidence. In the case of the last instrument described, the string naturally untwists when the downward pull of the weight comes upon it, and the acquired momentum of the revolving bottle causes it to continue to revolve after the string is untwisted, and twists the string in the opposite direction. The torsion thus produced revolves the bottle in the opposite direction, and so on until equilibrium is established. This will take some time; perhaps a half hour or more. At the expiration of this time the hands of the operator are so tired as to be incapable of holding the string steadily, and as a result the oscillations follow.

As to the scientific divining rods—if such a term can be applied to scientific instruments—the simplest of these is the miner's compass, shown in Fig. 4, and familiar to most readers of this article. It is simply a magnetic compass needle arranged to swing in a vertical plane. Its pivots being jeweled, it swings freely and points to any body of iron or magnetic ore contained in the earth. It is operative for a considerable distance, and has been used for years for locating iron mines; but it is of no use whatever for other than magnetic metals or ores.

In Fig. 5 is shown an instrument devised by the writer, in which a coreless induction coil of peculiar construction is used in connection with the telephone for indicating the presence of metals. The induction coil consists of a primary coil, preferably of rectangular form, made of coarse wire, No. 18, and connected with a rapid automatic circuit breaker and battery. The secondary coil is made of fine wire, No. 36, and is arranged exactly at right angles to the

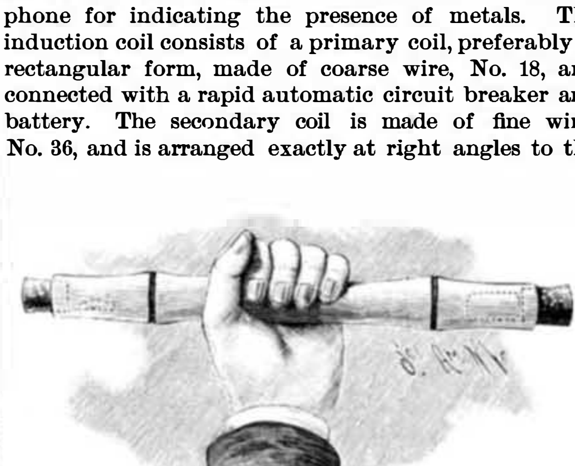


Fig. 2.—ROD FOR IRON AND PRECIOUS METALS.

coarse wire coil. A telephone is connected with the secondary coil. If the primary circuit is continuously and rapidly interrupted while the coil is not in the vicinity of any metal or magnetic material, no sound will be heard in the telephone, as all the inductive influences are equal and opposite; but when the coil is held in proximity to a body of metal or magnetic ore, this equilibrium is disturbed and the sound is heard in the telephone.

The distance through which this instrument is operative depends upon the diameters of the coils and the strength of the current used in the primary coil. The larger the coil and the larger the current, the greater will be the penetration of the inductive effect. As the induction is effective for only a few inches in an ordinary coil of 6 or 8 inches in length, the instrument is useful for minerals lying near the surface. It may be used to advantage on the sea bottom, along cliffs, in wells and borings, and upon ground abounding in metals lying near the surface, by simply causing it to pass over or near such surfaces. When it is to be used under water, it must of course be inclosed in a waterproof casing of non-metallic material.

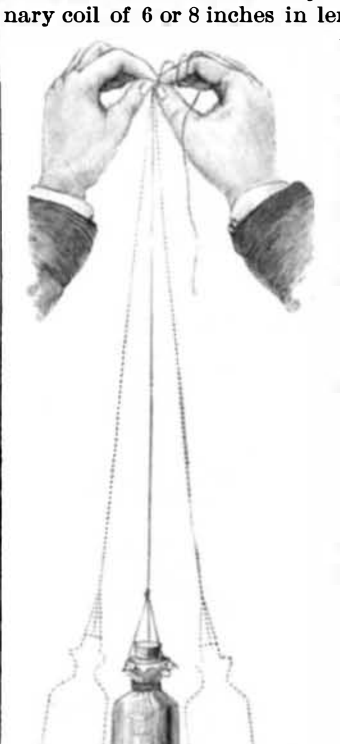


Fig. 3.—GOLD FINDER.

This instrument, which is an induction coil pure and simple, should not be confounded with the induction balance described below.

The induction balance invented by Professor D. E. Hughes has had a number of useful applications, one of which is the electric submarine detecter of Captain McEvoy. Professor Hughes demonstrated the extraordinary sensitiveness of the apparatus to the presence of small pieces of metal when brought near to one or other pair of coils.

The arrangement of the balance will be understood from Fig. 6, where P S and P^1 S^1 are the four coils of the balance, arranged in pairs separated from each other and connected by insulated wires. The coils, P and P^1, are joined together through a battery, B, and a key or interrupter, I, thus constituting the "primary" circuit of the balance. The coils, S S^1, are connected through a telephone, T, and constitute the "secondary" circuit of the balance. The interrupter, I, may be either manipulated by hand or automatically, so as to give a continuous action. Whenever the primary circuit is closed by its means, a current traverses the primary coils, P P^1, and induces a corresponding current in the secondary coils, S S^1. This current is of course audible in the telephone, T, but by reversing one of the secondary coils, say S^1, the current induced by the primary coil, P^1, in the coil, S^1, is made to oppose the current induced by the other primary coil, P, in the other secondary coil, S, so that it is possible to cause these two induced currents to annul one another and produce silence in the telephone.

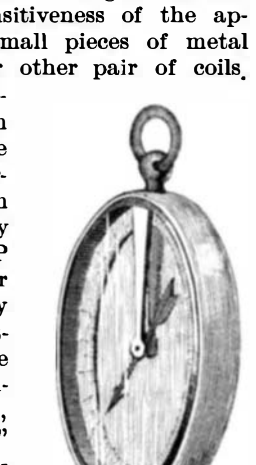


Fig. 4.—MINER'S COMPASS.

This is done by making the two primary coils and also the two secondary coils alike in all respects, and placing the secondary, S, at the same distance from P that S^1 is from P^1. The final adjustment to produce silence in the telephone can be made by altering the distance between a secondary coil and its primary, say the distance of S from P, or it can be made by means of a small piece of metal adjusted near one pair of coils, as was originally shown by Professor Hughes. To employ this arrangement for detecting metal masses it is only necessary to obtain a sufficiently good balance in this way, and explore the field where the metal is supposed to lie by moving about the pair of coils, S^1 P^1. Then, if

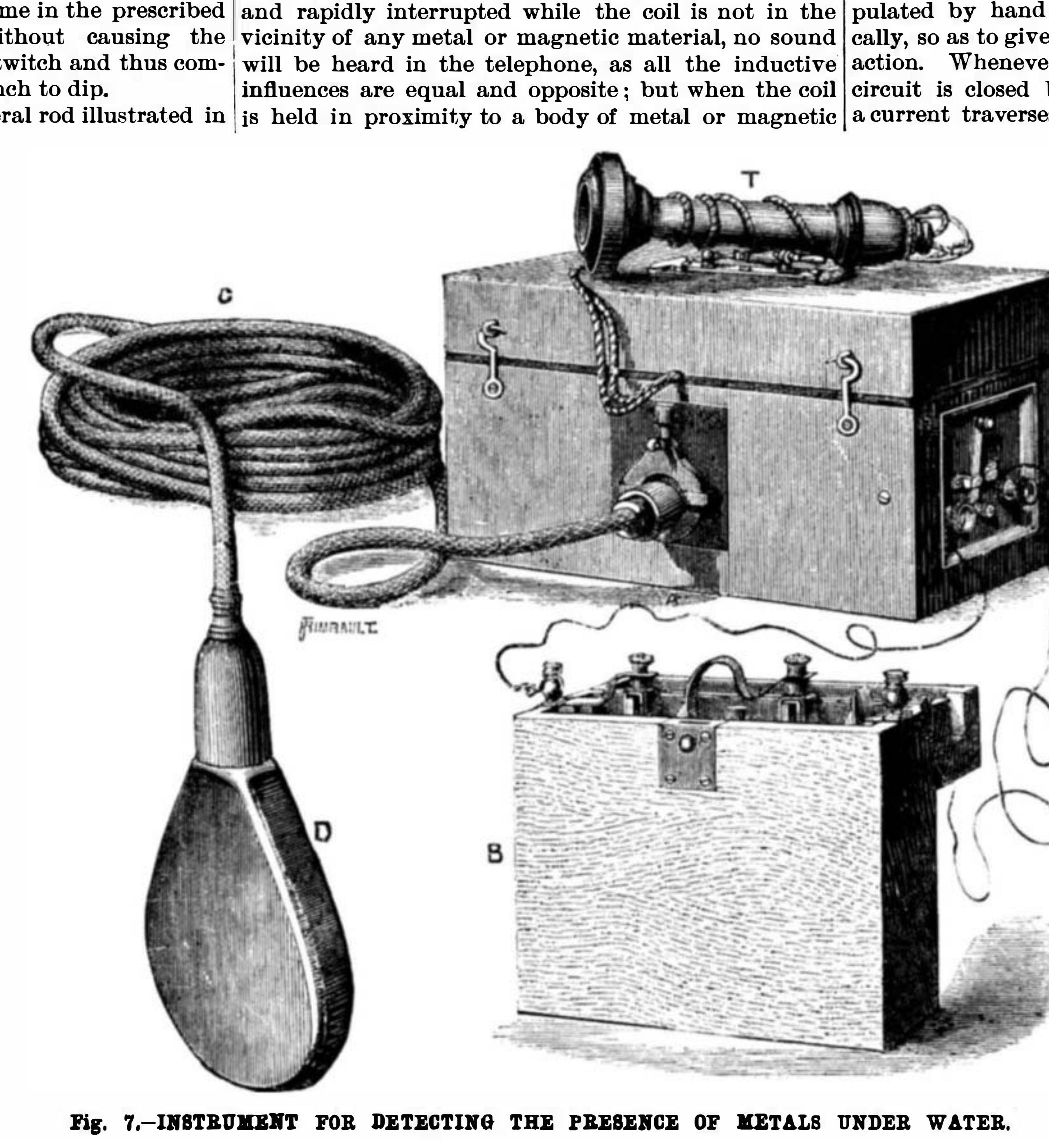


Fig. 7.—INSTRUMENT FOR DETECTING THE PRESENCE OF METALS UNDER WATER.

these coils come near a piece of metal, the inductive disturbance which its presence creates will upset the existing balance, and the telephone, before silent or nearly so, will give out distinctly audible sounds, owing to the predominance of the induced currents in the secondary, S^1, over those in the secondary, S.

The idea of applying the balance to the detection of metals has been worked out by Captain McEvoy, who has reduced it to a thoroughly practical form. This

Fig. 5.—ELECTRICAL ORE FINDER.

actual apparatus is illustrated in Fig. 7, where A is a portable case containing the adjustable coils, P S, and the interrupter, I; B is a voltaic battery of two cells, which may be replaced by a small magneto-electric machine giving alternating currents; T is the telephone in the secondary circuit; C is an insulated cable conveying the wires connecting up the two pairs of coils; and D is the detecting or exploring case containing the two secondary coils, S^1 P^1. The coils, P S, inside the box, A, are separated by a layer of soft India rubber, and an ivory screw passes through both coils and the rubber washer between. An ebonite head to the screw is adjusted by hand so as to press the coils together or let them further apart by regulating the pressure between them and the India rubber. The simple device adjusts the balance of induction and reduces the telephone to silence.

The interrupter is a special device which consists of a small iron reed or tongue kept in vibration by a small double-poled electro-magnet, thereby interrupting the current a certain number of times per second, so as to give out a definite note which is easily recognizable in the telephone.

A switch, E, at the box turns the current from the battery on and off the interrupter at a moment's notice. The telephone is the ordinary speaking receiver of Bell.

The cable, C, is insulated with India rubber having its pores filled up with ozokerit or black earth wax forced in under pressure and when in a hot fluid state. It is further protected with an outer braided sheathing, and is fitted to the box, A, by an ingenious socket, which in an instant establishes connection between the corresponding primaries and secondaries, and locks them together. The detecting cage, D, is made of wood soaked with paraffin wax. It is watertight, and contains two exploring coils, S P, Fig. 6. When it is lowered into the water by the cable, C, and moved about, or dragged over the bottom, the instant it comes against a piece of metal, such as a torpedo case, a chain, or a submarine cable, it disturbs the balance, and the note, heard in the telephone very faintly until now, becomes unmistakably loud and clear. It is, indeed, somewhat surprising to find so marked an effect.

If there is any objection to this instrument, it is that a body of metal lying in the plane of the coil will not affect it.

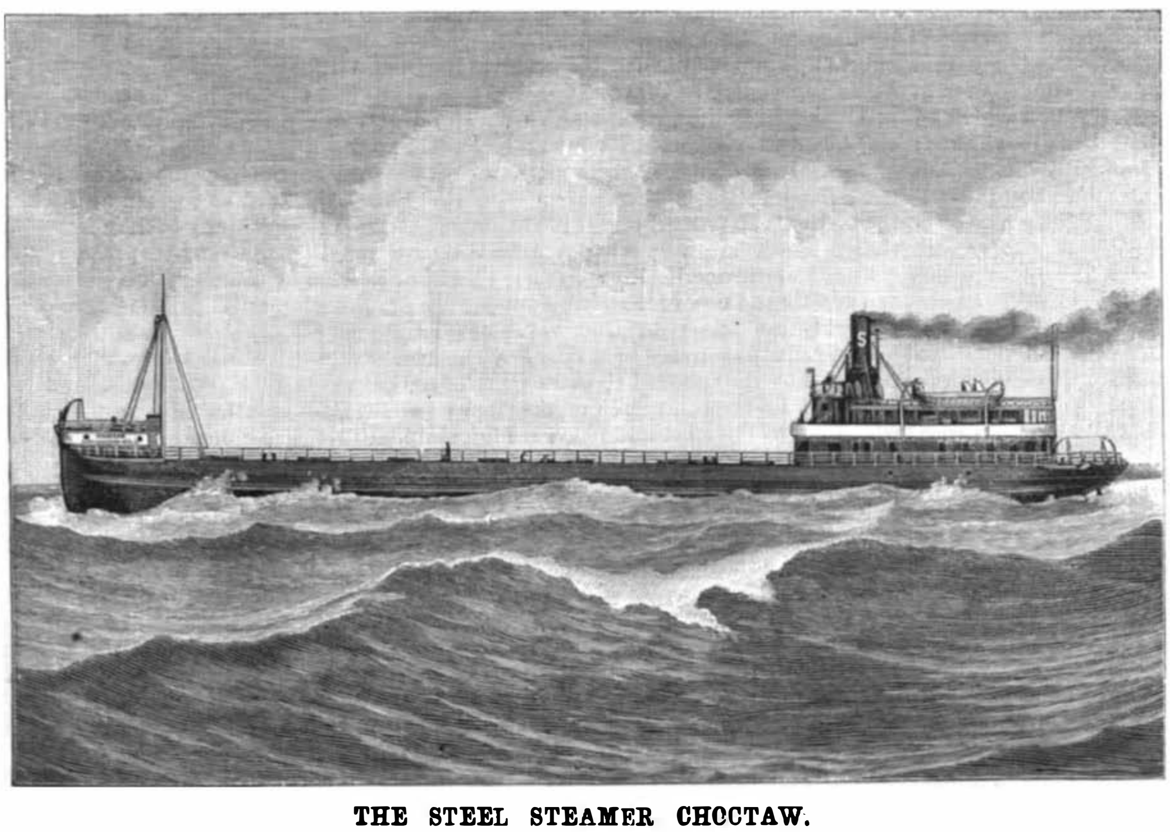
Pertinacious John Nash.

When a pupil in Sir Robert Taylor's office, John Nash had an early opportunity of bringing himself into notice. Sir Robert, on one occasion, putting before his clerks some plans to which certain alterations were needed in an unusually short space of time, was annoyed at being told that it was impossible to do what he required. This being overheard by young Nash, he ventured to ask if he might undertake the task which had been declined by his superiors. Sir Robert, struck by the earnest manner of the boy, granted his request. Nash immediately went to his room, procured paper and candles, and, sitting up all night, labored incessantly at the drawings, and by the time appointed appeared before Sir Robert with the plans completed. As another illustration of Nash's perseverance in after life, and his determination never to be overcome by seeming difficulties, it is told that on one occasion, having to go to some out-of-the-way place in Wales, he disdained the accustomed road, which was circuitous, and resolved to seek a more direct path to his object. Setting out on foot, he encountered many hedges, ditches, and fences, most of which he passed, but not without difficulty. At last meeting with a locked gate, awkwardly framed and inconvenient to mount, he was seen to retrace his steps several hundred yards, make a sudden run and attempt to vault over the gate. Failing in this, again and again he put forth his strength, and nearly accomplished his aim; at last stripping himself of his coat and waistcoat, by a longer run and a desperate spring he succeeded in clearing the barrier. He was then seen to climb deliberately over the gate, retrace his course, put on his clothes, and proceed quietly on his way.—*The Architect.*

THE STEEL STEAMER CHOCTAW.

The builders of vessels for the freight business on the great northern lakes are sharply competing with each other in the building of the most economical and efficient craft for the enormous transportation service now being done, and which is growing with marvelous rapidity. The ability of a vessel to carry an extra 100 or more tons of cargo, the efficiency of its engines in comparison with its coal consumption, its average rate of speed and freedom from liability to any sort of accident likely to interfere with the daily performance of its full work, are all carefully considered in the making of contracts for the new freight steamers now being built for the lake trade. This is necessary because there is so much competition in the carrying business that the smallest differences in the efficiency of the vessels often mark the line between a profitable or a losing business for the owner of a vessel, and on this account the builders are constantly making improvements in the steamers they are now turning out for this work.

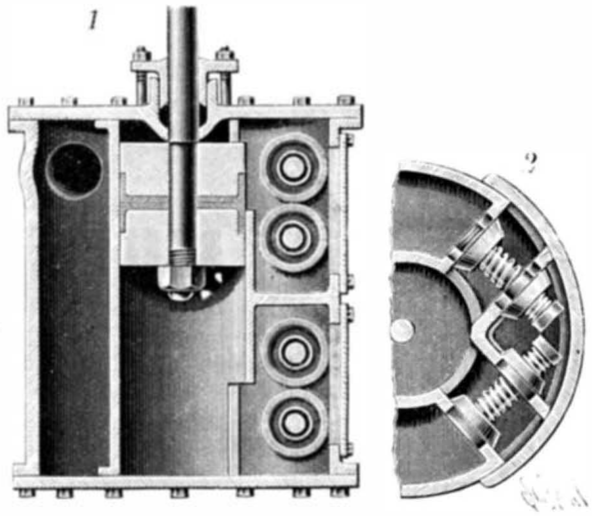
The accompanying illustration of the new steel steamer Choctaw, built by the Cleveland Shipbuilding Co. for the Lake Superior Iron Co., represents one of the latest models of this class of vessels. She is 266 feet long on the water line, 38 feet beam, and her moulded depth is 22 feet 4 inches. She will carry 2,683 net tons of fuel and cargo on a draught of 15 feet, her speed, light, being 13 miles an hour, and 12 miles an hour when loaded. Her engines are triple expansion, with cylinders 17, 29, and 47 inches, respectively, and a stroke, common, of 36 inches. She has two boilers, each 11 feet in diameter and 12 feet long.



THE STEEL STEAMER CHOCTAW.

AN IMPROVED FIRE ENGINE PUMP.

The illustration represents a double-acting fire engine pump in which the valves and interior mechanism are arranged to be more conveniently accessible than they have been with previous forms of construction, thus facilitating the repairing or replacing of the valves whenever necessary, and lessening the expense of keeping the engine in order. The improvement has been patented by Mr. T. S. La France, of 508 Spaulding St., Elmira, N. Y. Fig. 1 is a vertical section, and Fig. 2 a horizontal section, showing a portion of the section and delivery valves, on the line of the side inlets for receiving water from either side of the engine. Both the pump barrel and casing are closed at top and bottom, neither end requiring to be opened, nor the back of the casing, the barrel, or its plunger needing to be removed, in order to get at the valves. All the valves, both inlet and outlet, are in the front portion of the casing, as shown in Fig. 2, and running vertically from top to bottom in this front portion are partitions, joined midway of their height by a horizontal dividing partition, forming upper and lower inlet valve chambers, while between these two sets of inlet chambers are upper and lower outlet valve chambers. The plunger is made with upper and lower solid heads, holding reverse cup-shaped leather or flexible packings between them. In the front of the pump casing are openings of sufficient size to take in or expose all of the valves, these openings being covered by removable separate lids, whereby access may be readily had to either or both the upper and lower sets of inlet and outlet valves. By this arrangement of the valves and valve chambers the pump barrel and its outer casing may be cast in a single piece if desired.



LA FRANCE'S FIRE ENGINE PUMP.

Costa Rica.

Although Costa Rica is only about half the size of New York State, its list of birds numbers 730 species. It is a country of forests and of all sorts of climates, from the torrid sea coast to that found at an elevation of 11,500 feet, the top of the volcano Irazu, where ice forms.

The trees are not deciduous, although their leaves fall in part during the dry season, which extends from October to May. At the end of the rainy season, many North American migrants appear, and as the dry season advances they retreat to the coast region, and are not seen again till another year. Bird life is more abundant during the wet season, for the reason that fruit and insects abound at that period. The breeding season nearly corresponds with that of the United States.

Near San Jose, at an elevation of 5,000 feet, are what are called "the prairies," about five miles square. They become flooded to the depth of about an inch from September to February, and on them are found a number of species of water fowl and waders.—*George K. Cherrie.*