

MOUGIN'S "FORT OF THE FUTURE."

In the domain of the art of war a new fact has recently become known, which is of a nature to carry with it consequences of great importance—a new fact, we say, but not an unlooked-for one. A problem which was long regarded as insoluble has finally been solved. Artillery, the progress of which is continuous, has found a method of firing, without danger of premature explosion, hollow projectiles charged with breaking explosive substances. It must be admitted that this discovery is of a nature to modify the art of war profoundly. A revolution is announced, which, considered from the standpoint of the extent of the results, may be compared to that which occurred on the occasion of the invention of gunpowder. The firing of a melinite or gun-cotton shell is capable of producing singularly powerful effects, the verification of which has already upset the principles of the art of constructing permanent fortifications.

Instructed by the first experiments to which he has recently been led, the military engineer is unable to disguise the fact that, without the concomitance of great expense, it is no longer possible for him to construct walls capable of resisting the power of these new methods of attack. At the same time, he has found himself constrained and forced to suppress within his works those military structures hitherto called bomb-proof, because they consisted of a series of connected vaults, generally of 19 feet span, and 3 feet thickness at the key, and covered with a mass of earth from 9 to 13 feet in depth. Such structures, by the force of things, have become singularly vulnerable and easily destructible even. The military engineer can therefore no longer derive any material advantage from the masonry that has hitherto been the principal element of his structures; but, can he still count upon the properties of masses of earth properly arranged? No; earthworks cannot withstand the fire of projectiles filled with a breaking charge. Under the action of the bursting of the shell, the earth shoots up into the air, disperses in powder, and finally disappears. And, more than this, acting after the manner of a tamping, the mass of earth converts the projectiles that have entered it into dry torpedoes, and hence it is more injurious than useful. As the engineer can bring into play neither earth nor masonry, what resource remains to him? It has been many times observed that progress makes its way in a quasi-circular path. The human mind, in pursuing the end that is assigned to it, merely describes cycles always passing through the same points. An idea is suggested to it, it grasps it, then repudiates, and then again returns to it, so that, in the course of ages, extreme civilization often nearly touches extreme barbarism. Fortification offers us a striking example of this mode of evolution in a circle.

In the times of the great historic alluviums, quaternary man, as we know, dwelt in caves. Some of these places of refuge could contain two or three hundred persons; but, although the interior was roomy, the entrance was narrow. In time of peace, this exit was closed by means of a curtain made of reindeer's skin, while in time of war a number of rocks, properly piled, performed the functions of a defensive door, and the joints formed embrasures through which the inclosed people shot out their projectiles. The quaternary cavern was therefore nothing else than a fortress.

Well, in our own day, in the last years of the nineteenth century, we are about to see the military engineer return to the idea of the defensive cavern. In the number of prehistoric fortifications, science admits those

strange structures that have been discovered in France, Germany, and Scotland, and that have received the name of vitrified forts. These inclosures, situated upon ancient formations, crystalline or otherwise, are formed of various materials, granite,

ble dimensions. The obstacle consisted of a wall which was no less than from 60 to 95 feet in thickness. The scarps of Nineveh, for example, and those of Babylon, were more than 85 feet. Why did ancient engineers adopt such dimensions, which now appear to us so huge? Because it was necessary to oppose a great resistance to the action of demolishing apparatus, especially to that of the battering ram.

Well, in our day, the military engineer who is embarrassed by the firing of shells containing a breaking charge would have to have recourse to such thicknesses. If he does not decide to do so, one of the reasons is that the marvels of modern industry permit him to substitute for masonry masses of metal having the same resistance with less thickness.

Then it has been found that beton and a metallic cuirass alone resist the action of shells containing a breaking charge—such as melinite or gun-cotton. Hence it follows that these two elements of construction should be able to suffice the engineer. That being the case, it is evident that the forts that it is necessary to construct cannot any more resemble those that now constitute the defenses of our frontiers than the latter resemble the strong castles of the middle ages.

The neo-modern fort, conformable to the type devised by Commander Mougin (*attache* to the General Direction of the Forges of St. Chamond), the construction of which upon a certain position selected near our frontier has been ordered by a ministerial decision of July 23, 1887, has a singularly original character.

Let one imagine to himself a bulging of the earth, recalling on a large scale one of those hillocks produced by the subterranean work of the mole. We have not here, however, a mass of earth, but rather a block of beton. This artificial rock, measuring fifty yards in length by from thirty to forty in width, rises from a dozen yards beneath the natural ground. Its maximum projection above the earth does not exceed three or four yards. Externally, then, it exhibits the aspect of an ellipsoidal calotte gently sloping to the earth and nearly invisible to the eye of an observer, provided that it has for a base the bottom of a depression in the ground (Fig. 1).

At the center of this rock rise, flush with the surface, three armor-clad turrets established *en coin*—one and two—each armed with two guns of large caliber; at the circumference, four small disappearing turrets, each armed with rapid-firing guns; and at three other properly selected points, armor-clad observatories. Of these latter, one permits of watching the ground of attack, and the two others are designed for projecting fascicles of electric light at night, and thus illuminating the dangerous points of the territory. Each of these turrets and observatories closes a cylindrical well having cuirassed sides, and debouching at the base in a system of subterranean apartments (Fig. 2). These latter are arranged in part as store-rooms for provisions and ammunition and in part as machinery rooms. The underground machinery department includes a powerful steam engine, with cistern and duplicate boiler, a battery of ventilators for renewing the air, accumulators with pumps, and hydraulic motors for raising, lowering, and revolving the turrets and elevating the ammunition, etc., and, finally, dynamos and electric accumulators for internal lighting and projecting light externally (Fig. 3).

How is this cave entered? Communication with the exterior is had through a tunnel, whose top is eight or ten yards beneath the natural level of the earth. This gallery, the length of which necessarily varies with local conditions, branches and

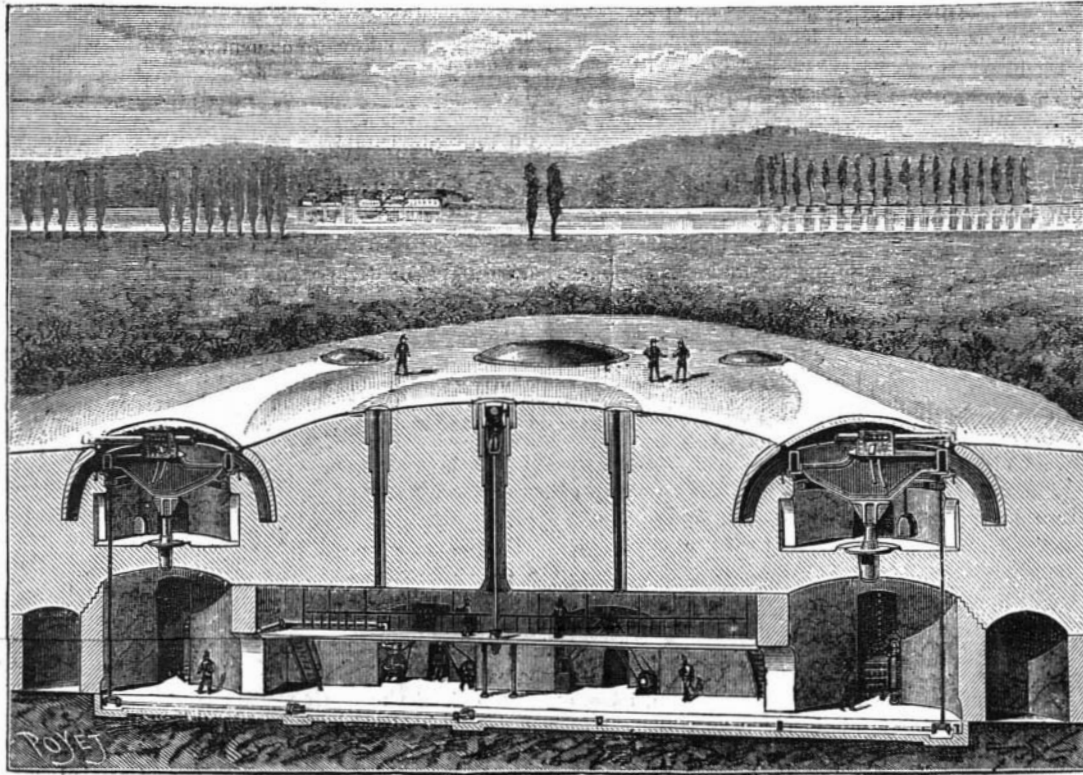


Fig. 2.—PLAN OF THE FRONT OF THE FORT.

gneiss, quartzite, basalt, etc., fused together by means of fire.

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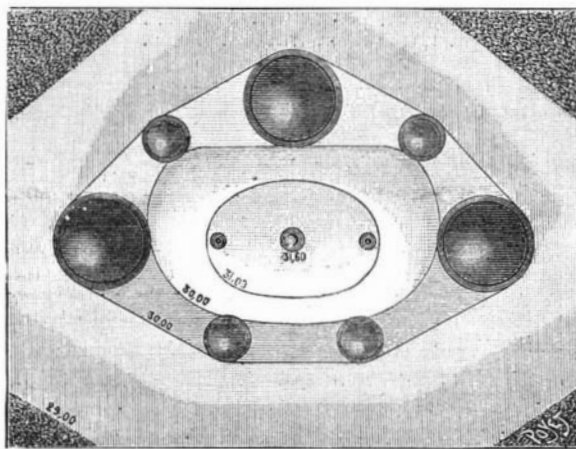


Fig. 1.—BIRD'S EYE VIEW OF THE PLAN OF THE SUBTERRANEAN FORT.

not the vitrified rockwork, which he knows not how to make, but beton, which is analogous to it.

In historic times, during the long period, styled antiquity, fortified inclosures had a profile of considera-

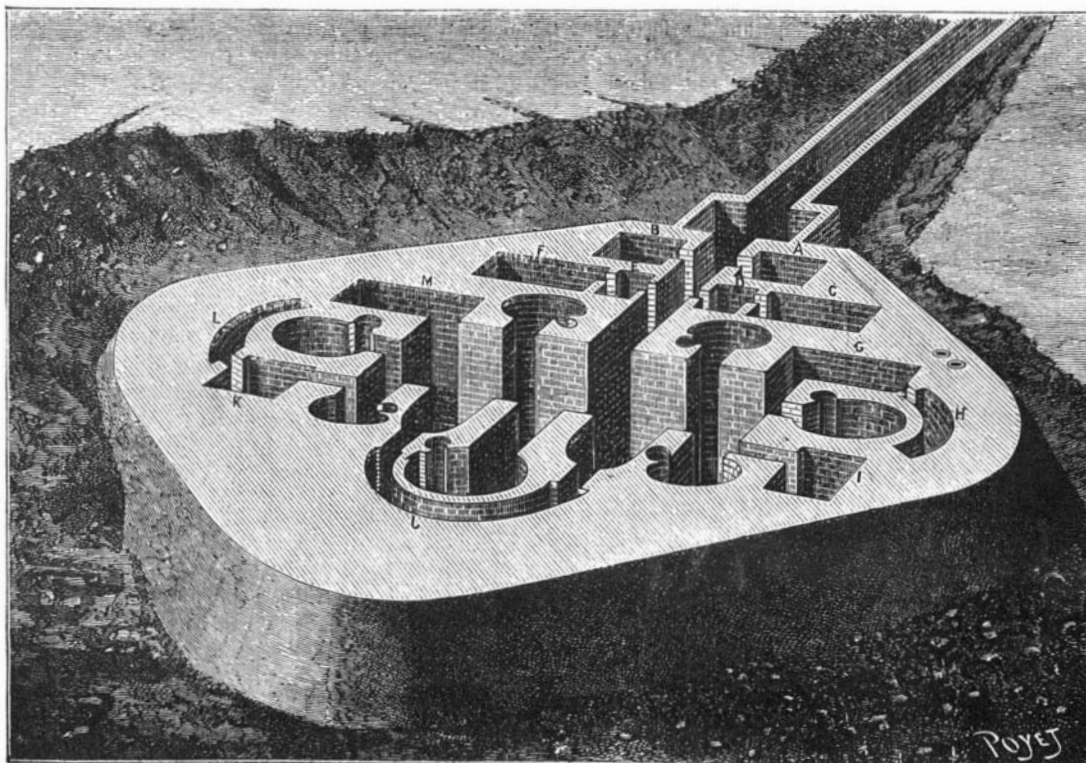


Fig. 3.—PLAN OF THE FOUNDATIONS.

- A. Infirmary. B. Quarters of lieutenant commander and surgeon. C. Projectile magazine. D. Room for charging projectiles.
- E. Cartridge factory. F. Powder magazine. G. Generators and kitchen. H. Coal room. I. Office of the commander and telegrapher. J. Room for spare stores. K. Office of accountant. L. Provision room. M. Accumulator.

runs, on the one hand, to the apartments above mentioned, and on the other to the bottom of a cuirassed well. A winding metallic stairway runs along the sides of this well, but is not attached thereto. This well, with sufficient opening to allow of the passage of duplicate *material*, forms an integral part of an iron plate framework, capped by a horizontal plate 8 inches in thickness. This plate, which normally closes the mouth of the well, is protected by the cross fire of the two disappearing turrets.

If it is desired to give access to the fort, it is only necessary to cause a hydraulic piston to act through a simple maneuver of a cock, and thus raise the internal framework, the staircase, and the plate 6½ feet. All forwarding of material and every relief of the garrison is signaled by telegraph or telephone. The doorkeeper does not maneuver the hydraulic elevator until he has heard the password and the disappearing turret on guard has recognized the comers. Moreover, there are arranged along the tunnel a number of obstructions analogous to those that the engineers of the middle ages used to multiply in the galleries giving access to their fortified castles. Finally, the entrance to the catacombs is itself provided with a door, defended by two mitrailleuses.

The garrison is reduced to thirty or forty mechanics and specialists having in charge the manipulation of all the machinery above noted. The situation of this *personnel* is not without analogy with that of the mechanics and stokers of armored ships, who also are only able to breathe through the artificial ventilation provided. These men, however, can be very frequently relieved.

Commander Mougin's fort, as just described, with its three large two-gun cuirassed turrets, its four small turrets with two rapid-firing guns, its three obstructions, and all its internal machinery, will not exceed in cost the net sum of \$500,000. This is relatively cheap.

Upon the whole, the conception of the fort of the future presented itself long ago to the mind of professionals in the form of a relatively invulnerable armored ship run aground on the position commanding the defile or railway to be defended. Commander Mougin has certainly done a useful service in showing how such a conception can be carried out.

His solution of the problem offers the advantage that, with equal live power, that is power in artillery, it permits of reducing, in the ratio of ten to one, the effective *personnel* necessary to perform the service. All our generals deplore the fact that, in the present system, the constitution of the regular garrisons absorbs, at the hour of mobilization, several hundred men, who might keep in the field, and the presence of whom on the field of battle would be of a nature to lead to decisive results. In this new system, the absence of a few mechanics and assistants, taken from the ranks, will not perceptibly reduce the territorial regiments that are called upon to furnish them.—*La Nature*.

The Gas Meter Specter.

F. H. Carruth, on the joys of what he terms suburban life, is not confined to any locality, but his well told experience with the gas man illustrates the belief many gas users cherish:

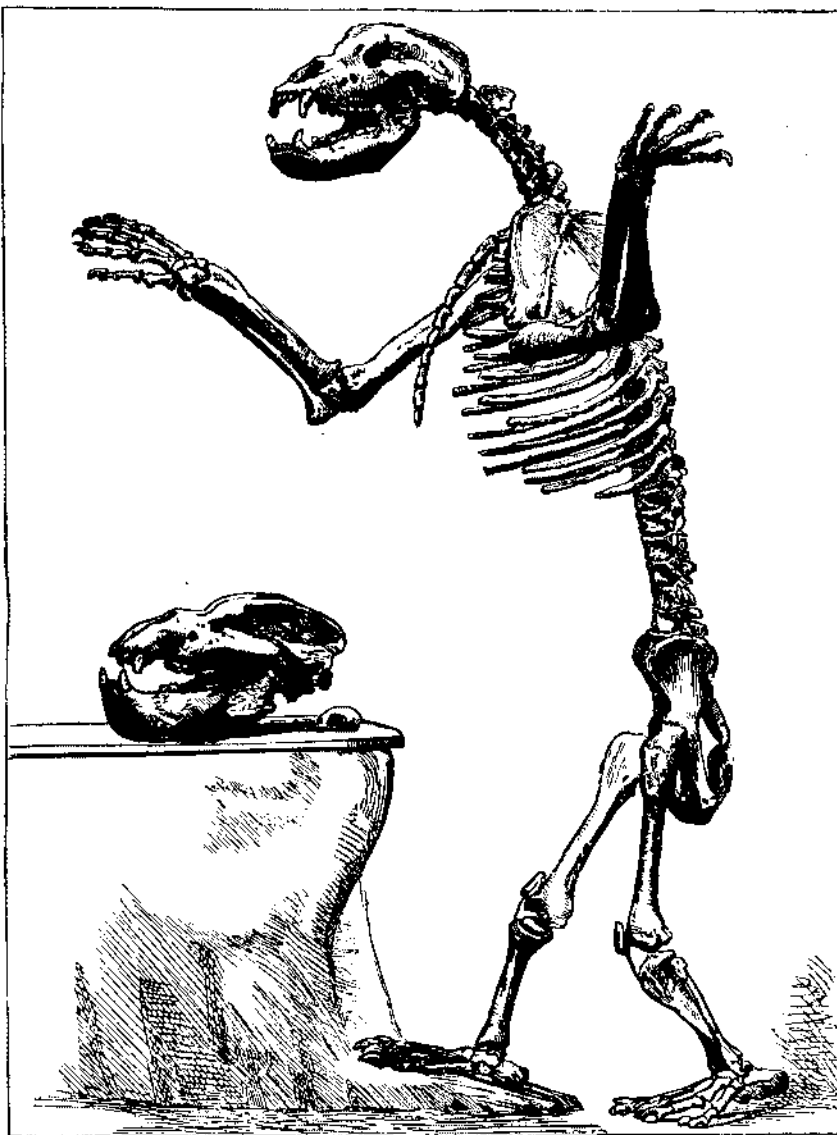
Every other day a man comes from the gas works, and after we let him in he goes down to the foot of the basement stairs and holds a secret conference with the meter. He opens a little door in it and takes a poker and stirs it up inside. Sometimes during the executive session we overhear him sort of growling away to himself, and complaining about the way the meter acts. He will explain to it that it isn't doing as well as Brown's, and that Robinson's is 'way ahead of it. Then he will punch it again with the poker, and we can hear the wheels buzzing around in it. He says meters are like other folks, liable to shirk and to 'tend to business. Then he will hit it another whack, and ask it pointedly if it wants to bankrupt the company. When he gets it running with a low, steady hum, he will shut the door and take down some figures in a blankbook, and as he comes up the stairs we will hear him saying: "Three and four and one are eleven and five is eighteen, and seven is twenty-nine, and six is forty-one, and four to carry is fifty." Then he will go around and look at our burners and dig away at them with a screwdriver and an old jackknife, and will try to sell us some new jet tips which look like old fashioned open top thimbles. He said one day that the superintendent told him that the company wasn't making nothing. I asked him how the stock was selling, and he said that he understood there wasn't any on the market just at present. He thought it had been withdrawn to be watered or something like

that. Probably they would be awful glad to get rid of it after that.

A PREHISTORIC BEAR.

Large quantities of the bones of various animals, such as the lion, hyena, bear, and prehistoric dog, have been found from time to time in caves in various parts of the world. It is probable that, as far as Europe is concerned, these caverns were more abundantly filled a few centuries ago than at present. In the prescientific era of medicine, a brisk traffic took place in these prehistoric bone deposits, as in the analogous case of Egyptian mummies. A physician of Gratz, Styria, writing in the year 1695, describes how he received many hundreds of bones and teeth, as well as four dragons' heads, and that, with these potent implements, he achieved numerous noteworthy cures. It has since been ascertained that these skulls and bones belonged to bears. The receptacle where they were found is still called "Dragons' Cave."

Our illustration represents the skeleton of a prehistoric bear (*Ursus spelæus*), as well as a second gigantic skull, which were found about four years ago in the Peggau Cave, near Gratz, Styria. The entrance to the cave is in a perpendicular rock face, some hundreds of yards in height, and the animal remains were covered with a



A PREHISTORIC BEAR.

stalactite deposit from five to ten inches thick, which had effectually preserved them from decay. Under the stalactite was a conglomerate several yards in thickness, composed of calcareous spar, quartz, and limestone. Several days were occupied in chiseling the bones out of this solid mass. A hole was made in the hinder part of the lower skull represented in our illustration, for the purpose of examining the interior. Its blunt and colossal shape differs considerably from the modern type, and indicates that this bear belonged to a very early period. The skull of an ordinary cat is given underneath in order to show the comparative size. The skull of the bear is wonderfully well preserved, the teeth are firm, and the bones bright yellow. To look at they might have been under the earth some dozen years, instead of at least twenty or twenty-five thousand. This skull is about twenty inches long and twelve inches high. The tusks are about four inches long. The skull of the skeleton is rather longer, but not quite so high. The entire skeleton is over nine feet high. The living animal was probably over ten feet.—*The Graphic*.

THE amount in the U. S. Treasury to the credit of the Patent Office fund is \$3,500,000, a sum ample, one would think, to enable the Patent Office to employ a sufficient force to keep the work of the office so well up that but little delay should occur in disposing of every application for a patent, but unfortunately some of the classes are very much in arrear with their work.

The Effects Produced by Earthquakes upon the Lower Animals.

In the last issue of the "Transactions of the Seismological Society of Japan," Professor Milne, the well-known student of volcanic phenomena, discusses the effects of earthquakes on animals. The records of most great earthquakes refer to the consternation of dogs, horses, cattle, and other domestic animals. Fish also are frequently affected. In the London earthquake of 1749, roach and other fish in a canal showed evident signs of confusion and fright; and sometimes after an earthquake fish rise to the surface dead and dying.

During the Tokio earthquake of 1880, cats inside a house ran about trying to escape, foxes barked, and horses tried to kick down the boards confining them to their stables. There can, therefore, be no doubt that animals know something unusual and terrifying is taking place. More interesting than these are the observations showing that animals are agitated just before an earthquake. Ponies have been known to prance about their stalls, pheasants to scream, and frogs to cease croaking suddenly a little time before a shock, as if aware of its coming. The Japanese say that moles show their agitation by burrowing. Geese, pigs, and dogs appear more sensitive in this respect than other animals. After the great Calabrian earthquake it is said that the neighing of a horse, the braying of an ass, or the cackle of a goose was sufficient to cause the inhabitants to fly from their houses in expectation of a shock.

Many birds are said to show their uneasiness before an earthquake by hiding their heads under their wings and behaving in an unusual manner. At the time of the Calabrian shock, little fish like sand eels (*cirricelli*), which are usually buried in the sand, came to the top and were caught in multitudes. In South America certain quadrupeds, such as dogs, cats, and jerboas, are believed by the people to give warning of coming danger by their restlessness; sometimes immense flocks of sea birds fly inland before an earthquake, as if alarmed by the commencement of some sub-oceanic disturbance. Before the shock of 1885 in Chili, all the dogs are said to have escaped from the city of Talcahuano.

The explanation offered by Professor Milne of this apparent prescience is that some animals are sensitive to the small tremors which precede nearly all earthquakes. He has himself felt them some seconds before the actual earthquake came. The alarm of intelligent animals would then be the result of their own experience, which has taught them that small tremors are premonitory of movements more alarming. Signs of alarm days before an earthquake are probably accidental; but sometimes in volcanic districts gases have emanated from the ground prior to earthquakes and have poisoned animals. In one case large numbers of fish were killed in this way in the Tiber, and at Follonica on the morning of April 6, 1874, "the streets and roads were covered with dead rats and mice. In fact, it seemed as if it had rained rats. The only explanation of the phenomena was that these animals had been destroyed by emanations of carbon dioxide."

Pelicans Flying South.

Residents in the north part of the city were treated early one morning recently to a rare and interesting spectacle in the flight south of a large flock of pelicans. There were several hundred of the great birds, divided into two sections. They were quite low, and the pouch under the lower bill and throat of each could be plainly seen. The first section was over one hundred in number, flying slowly in an almost unbroken single line, and crossing the river to the Illinois side just above the upper ferry. The second division came along immediately after, but instead of at once making passage over the Mississippi, began circling, as though at a loss which way to proceed. This movement was continued fully ten minutes, when a leader suddenly started in a bee line for the southeast, the rest trailing after and soon getting out of sight.

It was said by persons familiar with the bird that it was the American white or rough billed pelican, weighing when full grown about 18 pounds. The bill is 14 inches long, and the pouch is some 7 inches deep at the widest part. During the winter the species is found along the Florida and Southern coast, but in the summer goes to the interior of the fur countries at the North, where it breeds. It was claimed the going to the South at this time presaged early cold weather.—*St. Louis Globe-Democrat*.