

THE CROSSLEY REFLECTING TELESCOPE AND ITS NEW MOUNTING.

The new mounting for the Crossley reflecting telescope, presented in 1895 to the Lick Observatory by Mr. Edward Crossley, of Halifax, England, has been completed. The telescope, which has a 3-foot aperture and a focal length of 17 feet, 6 inches, was built about 1888 for the private observatory of Dr. A. A. Common, a wealthy English amateur astronomer, for the purpose of proving his theory of the construction of large reflectors and their mountings. Later the instrument was acquired by Mr. Crossley and set up in his private observatory. Recognizing the injurious effect which the climate of England would sooner or later have upon the telescope, and the great climatic advantages of the location of Lick Observatory, Mr. Crossley presented the telescope and its dome to that institution.

It was with the Crossley reflector that Dr. Keeler, in 1898-1900, did so much successful photographic work. The instrument is of peculiar interest, marking as it does the beginning of a new period in the use of a much-neglected form of telescope. The original Crossley mounting was unsuited for long photographic exposures by reason of flexure and other defects. A new and more stable mounting of the equatorial form was therefore devised by Harron, Rickard, & McCune, of San Francisco. The steel tube carrying the mirror and plate holder is attached to a heavy steel declination axis, passing through the middle of a long polar axis, which is supported at both ends. The polar axis is adjusted exactly parallel with the axis of the earth, so that by rotating the telescope on the polar axis at the speed of the earth's rotation and in the opposite direction, a celestial object will apparently remain stationary and can be photographed by exposing a plate for a long time. Since the bearings for the polar axis are on separate piers, some means were necessary for their ready adjustment. For that reason the surfaces on which the bearings rest have been made cylindrical in a direction at right angles to the polar axis. The bearing-plates can be adjusted in altitude and azimuth.

A leaning pier, 8 feet high, supports the north end of the polar axis, which pier is built up of heavy steel plates riveted to castings at the top and bottom and strengthened by two angle iron frames in the interior. The steel pier will in turn be supported by a brick and concrete foundation 6 feet high. The south bearing plate will rest directly on a brick and concrete foundation.

The polar axis is 14 feet long, in order to permit the lower end of the tube of the telescope to move freely under it in all positions.

The tube of the telescope consists of a strong cubical section, which is attached directly to the declination axis, and of five circular sections. Below the cubical section is a circular section of heavy sheet steel, to which is attached a cast-iron cell holding the mirror. The upper sections of the tube are of light sheet steel bolted to steel flanges. The last section is short and can be rotated about the axis of the tube. In the center of this end section the apparatus for holding the photographic plate and for guiding during the exposure is held by four webs of steel.

In this reflecting telescope, as in all reflecting telescopes, the

light from the star passes down through the tube to a concave mirror placed at its lower end, in the focus of which mirror an image of the object is formed. The focus of the Crossley reflector is 17 feet, 6 inches from the mirror. For the sake of convenience, a diagonal

order to obviate which, in the mounting of the Crossley telescope, the photographs will be taken in the principal optical axis.

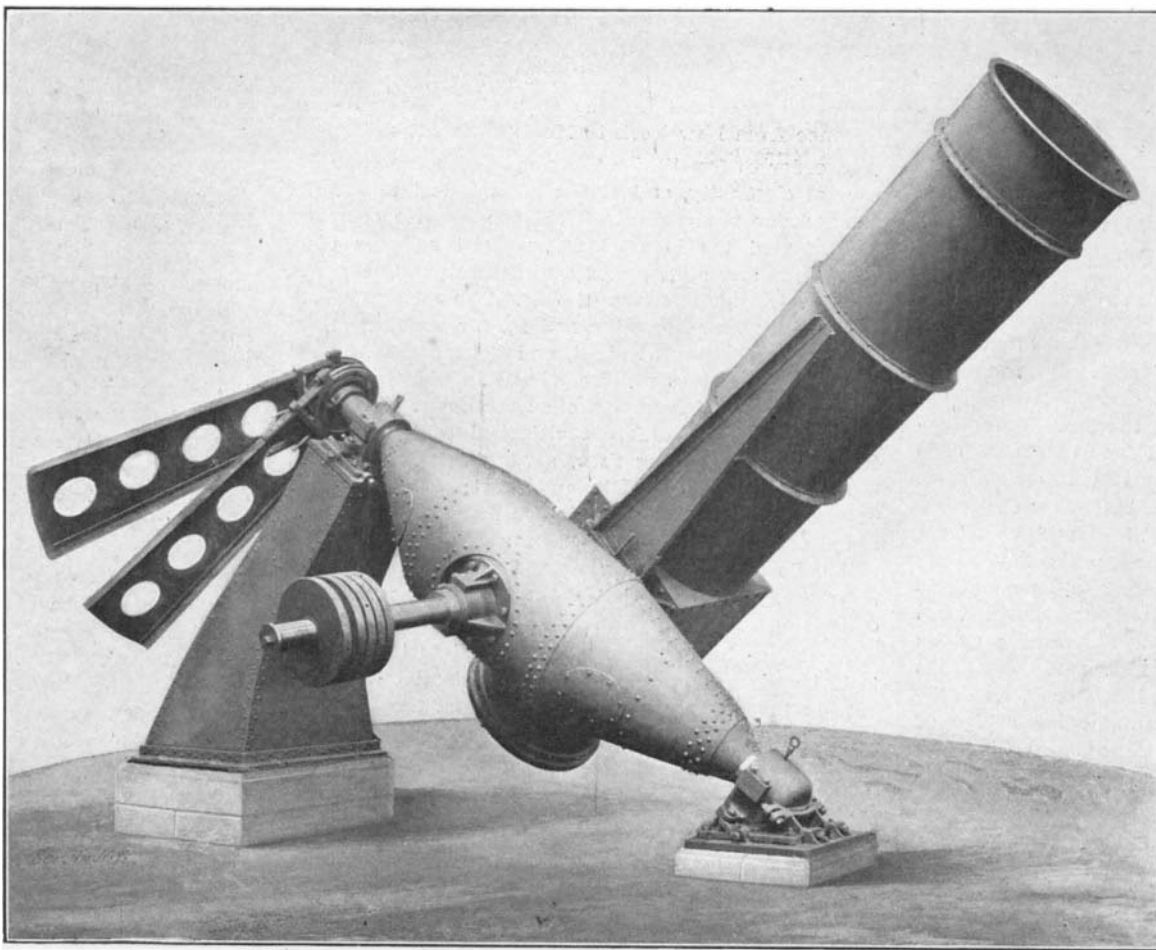
No matter how accurate the driving mechanism of a telescope may be, it is impossible to keep exact pace

with the apparent motion of the star toward which it is directed. Hence an auxiliary telescope is attached rigidly to the plate-holder to serve as a guiding-telescope. This guiding-telescope is provided with a pair of fine cross wires. During the time in which a photograph is being taken, the image of a star is kept at the intersection of these cross wires. If the star image moves from the intersection of these wires, it is brought back by means of two screws, which screws also control the plate-holder. The plate-holder and cross wires will be moved by rods which extend in from the side of the telescope.

The driving mechanism of the telescope is a clock train of the conical pendulum type, which drives two sectors of 8 feet radius, attached to the north end of the polar axis. A single sector will run the telescope for an hour. During this time the idle sector will be reversing, ready to be set in gear to run the telescope as soon as the first sector

has run down. The thrust of the polar axis is taken directly on a ring of hardened steel balls at the lower end, the greater portion of the weight falling on counterbalanced rolls. The telescope tube with the mirror and the various attached apparatus are counterbalanced by adjustable weights on the opposite end of the declination axis.

J. M. B.

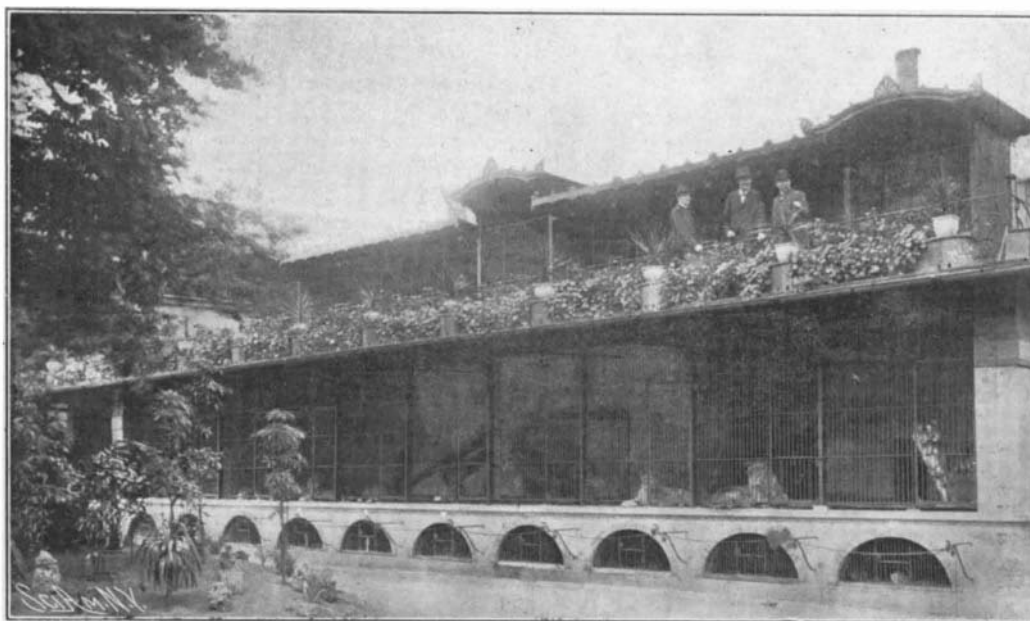


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flat mirror is usually inserted in the cone of light before it comes to a focus, so that the light is reflected at right angles and an image formed just outside of the main tube of the telescope. The introduction of this diagonal mirror causes a loss of light, in



Herd of Yak in Northern Thibet.



Animal Cages at Hagenbeck's.

THE TRADE IN WILD ANIMALS.

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BY HAROLD J. SHEPSTONE.

Hamburg is by far the principal depot for the shipment of wild beasts. Nearly the whole of the trade here is in the hands of one man, Mr. Carl Hagenbeck. Some idea of the immense amount of business done by this well-known dealer is evidenced when it is stated that in the course of a single twelvemonth he dispatched from Hamburg some 76 lions, tigers, and panthers, 42 different sorts of bears, 52 elephants, 64 camels and dromedaries and some 730 monkeys, besides a large number of other animals and birds. The greater portion of this vast collection is sent to America to the various towns and is purchased by directors of zoological gardens and by circuses.

During the week the writer was in Hamburg Mr. Hagenbeck shipped \$2,500 worth of animals to Cincinnati and \$3,500 worth to Philadelphia. He was also busy preparing a large consignment for the New York Zoological Society. When Prof. Hornaday, the Director of Bronx Park, visited Europe in the autumn of 1902 he spent \$17,000 among the European dealers in the purchase of animals. He bought 6 lions, 2 tigers, a leopard, jaguar, cheetah, 2 black leopards, mountain goats and sheep, a chimpanzee, an ibex, a wild hog, a number of snakes and a lot of large and small birds. When I mentioned this to Mr. Hagenbeck he admitted the fact that there is a growing interest in zoos and that in a few years' time the United States will boast of some magnificent gardens. He also told me that his thirty-six years' experience as an animal dealer had taught him that the three great nations

that possess a natural inborn love for animals and desire to know all about them are the Americans, the English, and the Germans.

The great worry of the big dealers is to keep their stock up-to-date. At the time of my visit to Hamburg Mr. Hagenbeck told me he was daily expecting some of his travelers from Siberia with a herd of 30 roe-deer, 15 ibex, wild sheep and several smaller animals and birds. One man was also bringing home 3 giraffes from Soudan, as well as some Kudu and other antelopes. In a week's time he was expecting a shipment from German East Africa, which included 20 zebras, 2 African rhinoceroses, some white-bearded gnus, water buck and other antelopes and a number of smaller animals and birds. From West Africa he was expecting several chimpanzees and also some young gorillas, while a boat due the following day from Australia was bringing in a consignment of 60 kangaroos, several big red "boomies" and a number of rare birds. There were also other travelers on their way to Hamburg from different parts of the world with more or less valuable collections of wild animals. As to his present

stock one has only to add that it is more valuable than the animals found in any one zoological garden the world over, to give some idea of its immensity and variety.

Altogether, Mr. Hagenbeck employs a staff of sixty European hunters. Many years ago he recognized the need of establishing depots in various parts of the world, from which he could replenish his stock as occasion required. He has five depots in Asia, three in Africa, several in Europe and one in America. These men employ the natives to catch the animals for them. Much could be written about the manner in which the various animals are captured. In Nubia, where most

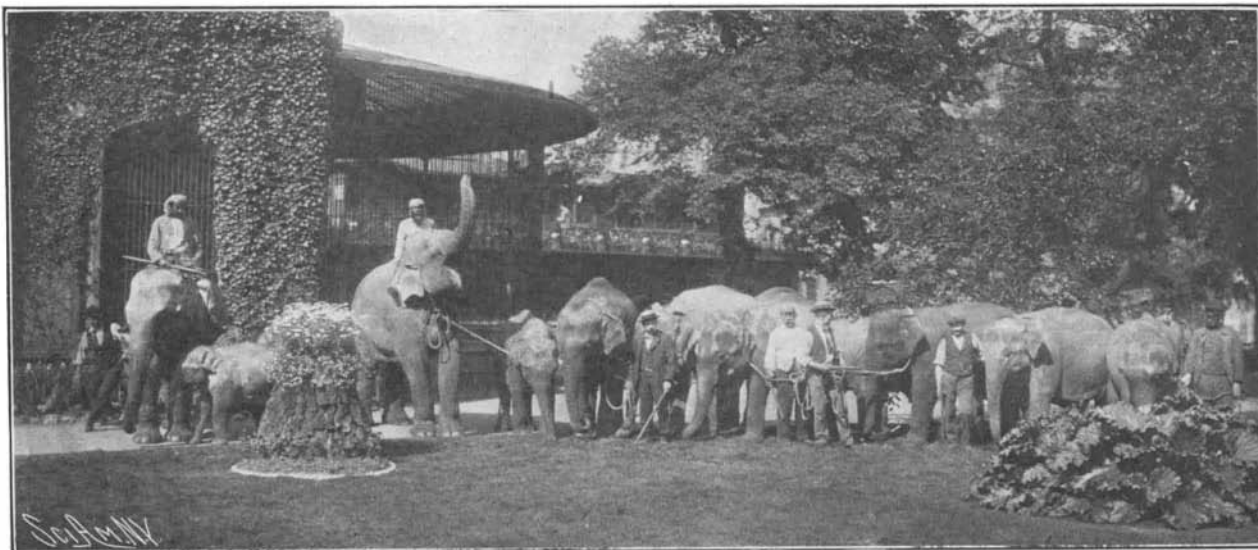
of the lions are now obtained, the natives, by carefully watching, know exactly when a lioness is about to have cubs. They then go to the den and kill the mother and carefully remove the young cubs to the camp, where they are brought up on tame goats' milk. When about two months old they are conveyed to the coast on the backs of camels and shipped to Hamburg. Lions are also obtained from Abyssinia and Senegal. The finest lion was that obtained from the Atlas Mountains of North Africa. This species now no longer exists, and there are only a few in captivity. Adult Nubian lions fetch \$1,000 apiece; Sene-

a mother with young she is at once shot and the cubs taken away and brought up on goats' milk.

It is the rarer animals, such as the hippopotamus, the rhinoceros, and the giraffe, that are difficult to secure. In the first place, it is practically impossible to secure an adult beast, and the young ones, when finally secured, are by no means easy to rear. The feeding of them is no light task. A baby hippo will drink thirty pints of milk a day, and a rhinoceros almost as much. To arrange for such a supply in a desert, hundreds and probably a thousand miles or more away from any civilized center, means that a large number of goats have to be kept with the expedition party. African elephants are also very scarce; indeed, only five have been imported into Europe since 1880. Mr. Hagenbeck puts this down to the recent wars in the Egyptian Soudan. A hippopotamus is worth from \$2,500 to \$3,000, a rhinoceros slightly more, while giraffes sell at from \$2,500, according to size, age and condition of the animal.

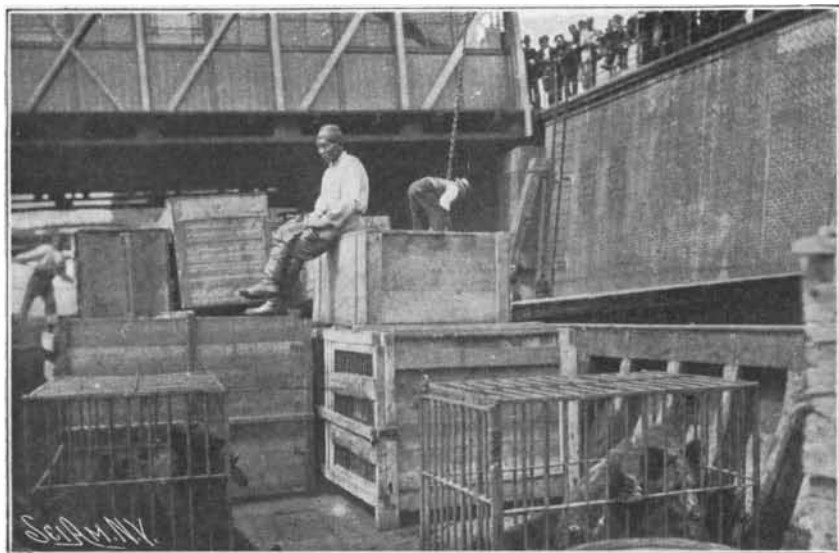
Up to 1880 giraffes were very cheap, and were imported from the Egyptian Soudan in large quantities.

Between the years 1880 and 1900, however, only three were brought to Europe, two from South Africa and one from Senegal. They are caught by African hunters, who search for them on their quick Abyssinian horses. When they come to a herd of giraffes they drive them forward as fast as they can at such a pace that it is impossible for the young ones to keep up with the mothers. They are then easily caught and supplied with little halters and finally brought into the camp, where they are fed on goats' milk, also on corn, and various kinds of plants. Zebras, unlike giraffes, are fairly plentiful. Mr. Hagenbeck showed me a letter from one of his travel-

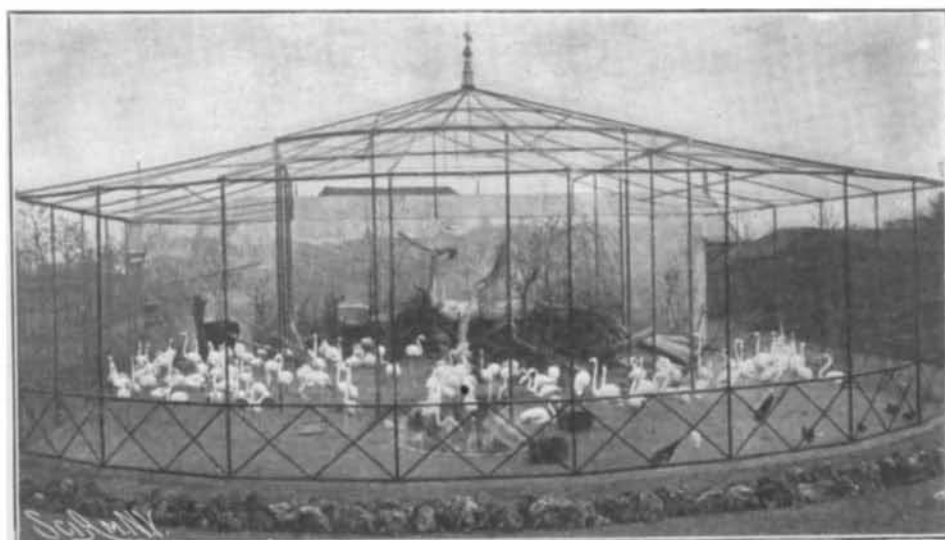


Indian Elephants Worth from \$1 250 to \$2,000 Each.

gal lions range in price from \$500 to \$750. Tigers vary in price from \$375 to \$1,500 apiece and more, according to variety and rarity of the animal. Siberian tigers, for instance, sell at the latter figure. They are large, beautifully striped creatures. In the winter they grow a long woolly winter coat. A very singular variety of the tiger tribe comes from Russian Turkestan. Its characteristic is that its hind quarters have brown stripes instead of black on a yellow ground. Mr. Hagenbeck imported one three years ago and sold it to the Berlin zoo. In Bengal Mr. Hagenbeck's agent employs a number of natives who catch adult tigers in pitfalls, while if they come across



Unshipping the Wild Animals at Hamburg.



A Model Aviary, Containing 102 Flamingoes and 100 Other Birds.



Herd of Camels at the Hagenbeck Depot in Siberia.

THE TRADE IN WILD ANIMALS.

ers informing him that at a recent drive which he had organized in German East Africa fully 400 zebras were surrounded, besides a number of antelopes, some of the latter being entirely a new variety. As the corral was not large enough the larger portion of these animals were allowed to escape. Finally, however, 85 zebras and 15 antelopes were captured.

Curiously enough, Mr. Hagenbeck does not insure his animals after dispatch from Hamburg. He prefers to take the risk. The insurance rates are much too heavy, for if proper care is exercised the mortality is very slight. In the case of large consignments Mr. Hagenbeck sends one of his own men to attend and feed the animals on the voyage. In a recent shipment to the Mikado of Japan, which included lions, Polar bears, panthers, kangaroos, antelopes, monkeys, as well as a collection of larger birds, such as eagles, vultures, etc., the whole collection arrived safely after a journey of nine weeks with the exception of one monkey. In another recent shipment of \$17,500 worth of animals to the Sultan of Morocco, the mortality was very small, one tiger dying of sunstroke while crossing the desert, while one crane succumbed to seasickness on the voyage. The shipments to America have been particularly successful, the losses sustained through death or accident being very trivial.

In conclusion, attention may be called to Mr. Hagenbeck's recent experiment in the acclimation of all kinds of tropical animals and birds. He is firmly convinced that almost any tropical animal can be acclimated to stand a northern climate. During the winter of 1901-02 he kept out in the open at his park at Stellingen, a suburb of Hamburg, a pair of South African zebras, an African eland antelope, several Indian antelopes, large and small Brahma cattle, Indian deer, a pair of South African ostriches, a casowary from New Guinea, several Indian and West African cranes, as well as other tropical waterfowl and birds. All these animals were placed in unheated stables and were allowed to go out in the open whenever they pleased. What Mr. Hagenbeck did was this: He left the dung in the stables from the middle of November until spring. When it got too high a part of it was taken away and new straw placed on top. This dung gives off a natural heat and makes a warm bed for the animals to lie down upon. During the winter referred to the thermometer in Hamburg registered a temperature as low as 10 deg. F., yet the animals kept exceedingly well. Indeed, Mr. Hagenbeck lost a number of other tropical animals at his other depot which were kept in heated stables. The Duke of Bedford is evidently a believer in this simple method of acclimating animals, for he is keeping three very fine giraffes, which he purchased last summer from the great dealer, during the past winter in unheated stables. Their bed consisted of 9 inches of peat upon which the dung was allowed to remain. Up to the time of writing the animals are quite healthy and doing well.

London, England.

HAVE THE LOWER ANIMALS OTHER SENSES THAN OURS?

BY J. CARTER BEARD.

If a person who could see, were to find himself in a region, the inhabitants of which had never known or heard of creatures that were not, like themselves, blind, the use of his eyes might enable him to perform acts which must be incomprehensible to them.

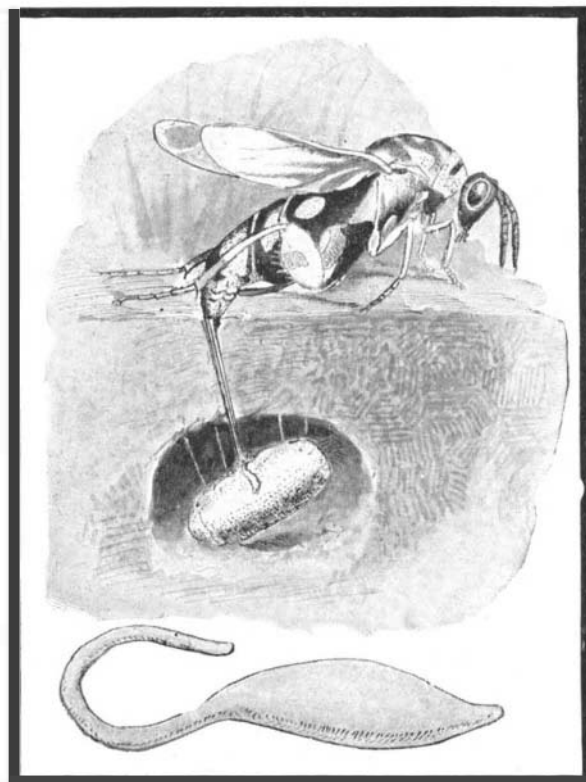
Imagine the bewilderment and surprise of these unseeing people in their encounter with one who could describe objects and recognize individuals without contact, avoid pitfalls without ascertaining their existence by the sense of feeling, and even announce the presence of objects at a very considerable distance.

Doubtless such sightless folk, if they were reasoning beings, would try in various ways to account for their visitor's achievements.

In doing this, moved by the impulse that leads us to measure the faculties of others by our own limitations, they might be inclined to credit him with a development of hearing or of smelling or of some other power exercised by themselves in apprehending external things, sufficiently extended to meet the case. The simpler and, all things considered, the more probable explanation that the performer possessed a sense absent in themselves, might be the last to occur, or, perhaps, prove acceptable when suggested to them.

In their unwillingness to accept such an interpretation of the facts, they would follow many of our scientists, who, until quite recently, have been reluctant to ad-

mit that a number of the lower animals possibly possess other senses than ours. So much new and undeniably affirmative evidence is, however, now being offered on this point, that there can be no longer any substantial reason for doubting that the five senses man imperfectly exercises are by no means all that are possible to sentient creatures. One such sense not possessed by human beings, but to a greater or less degree almost universally present in mammals, birds,

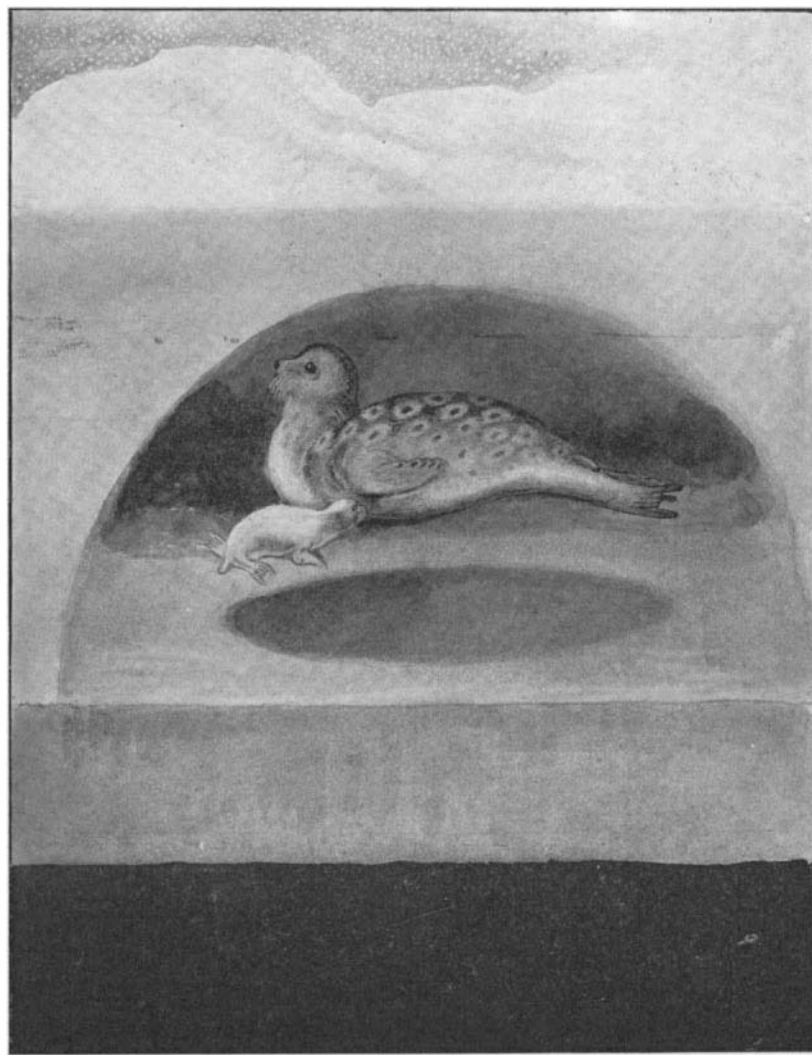


PARASITIC WASP PREYING UPON THE EGG DEPOSITED IN A WALL BY A MASON BEE.

reptiles, fish, and insects, is what perhaps may be called the sense of *localization*. It enables its possessor, apparently by its sole use, to find a desired spot. It is evidently closely connected with an instinctive and perfect memory of distance and direction. That the homing pigeon exercises it to some extent, though undoubtedly aided by the landmarks it recognizes, is indisputable; that the honey-bee has it in its fullness and perfection cannot, after the careful experiments of Albrecht Bethe in Germany, be doubted.*

Perhaps as striking an instance of its use as any, is that related of the ringed seal (*Phoca fasciata*), which furnishes the Eskimo of Greenland and of the

* *Psychical Qualities of Ants and Bees*. Albrecht Bethe. Dürfen wir den Ameisen und Bienen psychische Qualitäten zuschreiben? Archiv f. d. Ges. Phys. Vol. LXX, pts. I, II, pp. 15-100 January, 1858.



SECTION OF THE HOME OF A RINGED SEAL AND HER SUCKLING YOUNG.

Arctic archipelago with food and clothing. The female seal, when about to have young, forms for herself an *igloo* or domed cavity in the snow just above the breathing hole which she keeps open in the ice. Here her baby is born, and rests, sheltered from the fierce Arctic gales by the roof of snow overhead, on the ice near the breathing hole. To supply herself and the little creature with food, the mother seal has to swim for miles through water black as midnight without the faintest ray of light to guide her on her way; no light can penetrate the strata, dozens of feet thick, of ice and snow above. Aided by none of the faculties we exercise in apprehending external things, but by some mysterious power, of which we can form little or no conception, she follows swift, elusive fish in all their turnings, secures her prey, and returns, unerringly, to her own particular At-luk, or breathing hole, however distant, where her young one awaits her.

I. H. Fabre, the celebrated French entomologist, tried several experiments with mason bees (*Chalicodoma pyrenaica*); results which are useful in confirming those of Bethe on the honey-bee, and still further strengthening his position, inasmuch as the mason bee is very different from the former, living as it does but a short time in the winged state, and not having opportunity to become acquainted with localities as distant as those to which Fabre carried it. One of these series of experiments made with bees, testified very convincingly to the fact that the sense of sight has nothing at all to do with the recognition of objects or of localities by the insects in question. A boulder, to which a partially finished nest of a *Chalicodoma* was attached, was, during the temporary absence of its builder, removed a short distance, but in plain sight of the place formerly occupied by it. The bee returning, flew quickly to the spot where she had been carrying on her building operations, and walked about over the place, evidently much puzzled to imagine what had become of her unfinished dwelling. She then flew off, but speedily returned, and again sought diligently in the selfsame spot for her absent nest. This she did a number of times, occasionally passing in her flight within a very few inches of the object she was in search of, without once recognizing it. When the nest and the boulder to which it was attached were moved back again to within a very short distance of the locality to which she had always returned, the bee would at times actually alight upon the stone, visit the nest, run about over the boulder as if to examine it, and then fly away again.

It is evidently its location in space and not its appearance that enables the bee to recognize its nest. Another nest put in place of her own was adopted by *Chalicodoma*, without any question, although the nests were very different in appearance, the one consisting of a single incomplete cell, and the other of many cells.

These same powers and the same limitations belong to this localizing sense in wasps. *Bembex*, for instance, forms her nest in sandbanks that are sometimes acres in extent. Before leaving her burrow, the insect covers it over with sand, masking it so completely that it is entirely indistinguishable from the surrounding surface. On revisiting the nest, however, which she has to do in storing it with food, she flies without hesitation directly to it.

The little wasp (*Cerceris tuberculata*) possesses this sense in a high degree, perhaps also another, for in choosing the beetles with which to store the burrows she digs in the soil for her future larvæ, she never gets outside a particular family of these insects, but, remarkable as it may appear, will take specimens altogether different in appearance, shape, size, and color, provided they belong to the right family. The range of selection, so wide in respect to varieties, so limited as to kind, seems to point to some sense of which we know nothing, but which supplies *Cerceris* with the power of discrimination required.

Fabre captured a dozen female *Cerceris*, dropped a spot of white paint on the thorax of every one, put each into a paper roll, put the rolls containing the prisoners into a box from which they were liberated one and a quarter miles from home. Five hours afterward, when he visited their home, four had returned, and he had little, if any, doubt that the others also found their way there. He afterward took nine of the insects to the town of Carpentras, a distance of two miles, and released them in the public street, in the center of a populous quarter. Each wasp, on being released, rose vertically high enough between the houses to clear the roofs, and flew off in a southerly direction, in a beeline for her nest. On visiting the homes of the little wasps next day, he