On the Intelligence of Dogs

WHEN reading in NATURE of November 12, 1885, the abstract of Sir John Lubbock's paper "On the Intelligence of Dogs," I called to mind an incident of a little Blenheim spaniel which belongs to my mother.

The readers of NATURE may perhaps be a little tired of stories relating to the intelligence of the dog, especially when these are illustrations of the effects of training. My excuse for troubling you now is that the following incident seems to indicate a singular power of *reasoning*.

"Middy" was about nine months old when he was picked off the streets of Melbourne, and he had many traits of the "larrikins," as the human waifs there are called. He had been three months in our family, and we had almost begun to despair of breaking him in to civilised life.

One Sunday my sisters set off for Sunday-school, and were surprised, on nearing the church, to find "Middy" at their heels. He was told to "go home," and he was found at the house on their return. Nothing more was said on the subject, which was forgotten by the next Sunday. But when my sisters entered the school-room on that day, great was their amusement to see the little dog seated calmly as a scholar in one of the classes! He behaved quite quietly during the lessons, and then left with the children, and trotted home alone. To prevent constant repetitions of this behaviour, he had to be caught hours before school-time and shut up. He was very clever in evading capture—crept into hiding early in the day, and bolted when we were off guard. On these occasions he was certain to be found in his place at school.

It perhaps should be especially noted that "Middy" had never been to the church before, and that a whole week had elapsed between his first and second attempts.

MARY KNOTT

7, Kaga Yashiki, Tokio, Japan, January 20

Frost in Devonshire

THE Rev. A. D. Taylor, Rector of Church Stanton, a parish in Devonshire, some 900 feet above sea-level, writes me under date of the 22nd inst. :—

"We have had for three days the most wonderful rime. The trees have been covered, every twig and bud, with ice, on the average an inch at least in depth. I have measured several pieces, and have found them 1¼ to 1½ inches from base to edge. The whole place has been like fairy-land, or a silver country. To-day it has all fallen, with a continuous rushing and rattling on the bushes for four hours. The very leaves of the laurels were so frozen that you could take off each leaf a perfect *ice-leaf*—an exact reproduction in transparent ice, of about twice the thickness of this (ordinary letter) paper, of the laurel leaf—every vein and unevenness of edge distinct and clear. The children collected scores of them, and very lovely they looked. I have never seen anything of the sort which would compare with it. The people call it *rängling* (phonetic spelling), a queer word of which I never heard before."

Keen frost in an excessively moist air no doubt sufficiently explains the beautiful phenomenon itself; but can any Devonshire man explain the country people's word?

Bregner, Bournemouth, February 24 HENRY CECIL

"Pictorial Arts of Japan"

IN my review last week of Mr. Anderson's "Pictorial Arts of Japan" I inadvertently wrote the "eight Nirvanas" of Gautama instead of the "eight incidents (more properly 'features'—*pa siang*) of the Nirvana." F. V. DICKINS

University of London, Burlington Gardens, W., March 1

DISCOVERY OF A NEW ELEMENT BY CLEMENS WINKLER[1]

IN the summer of 1885 a rich silver ore was found at Himmelsfürst, near Freiberg; it was pronounced by A. Weisbach to be a new mineral, and was named *Argyrodite*. T. Richter examined its behaviour in the blow-pipe flame, and found that it consisted chiefly of sulphur and silver together with a little mercury, which latter element has never before been found at Freiberg.

[1] From the *Berichte* of the Berlin Chemical Society, No. 3.

The author has analysed the new mineral, and finds that the amount of mercury only amounts to 0·21 per cent., whilst silver is present to the extent of 73-75 per cent., and sulphur to the extent of 17-18 per cent. He also finds a very small quantity of iron, and traces of arsenic. However often and however carefully the analysis was conducted, a loss of 6-7 per cent. always remained unaccounted for. After a long and laborious search for the source of this error, Clemens Winkler has at length succeeded in establishing the presence of a new element in argyrodite. *Germanium* (symbol Ge), as the new element is called, closely resembles antimony in its properties, but can, however, be sharply distinguished from the latter. The presence of arsenic and antimony in the minerals accompanying argyrodite, and the absence of a method of sharply separating these elements from germanium, made the discovery of the new element extremely difficult.

The author, having a more detailed communication in view, confines himself to the following particulars :—

When argyrodite is heated out of contact with the air, which is best effected in a current of hydrogen, a black crystalline and moderately volatile sublimate forms, which melts to brownish-red drops, and which consists principally of germanium sulphide, together with a little mercury sulphide. Germanium sulphide dissolves readily in ammonium sulphide, and, on the addition of hydrochloric acid, is thrown down again in a pure state as a snow-white precipitate, which is immediately dissolved when treated with ammonia; the presence of arsenic or antimony colours the precipitate more or less yellow.

On heating germanium sulphide in a current of air, or on warming it with nitric acid, a white oxide is produced which is not volatile at a red heat and which is soluble in potash solution; when the alkaline solution is acidulated and submitted to the action of sulphuretted hydrogen, the characteristic white precipitate is produced.

The oxide is readily reduced by hydrogen, whilst the sulphide on account of its volatility is more difficult to reduce. The element, like arsenic, has a gray colour and moderate lustre, but is volatile only at a full red heat, and is decidedly less volatile than antimony. Its vapour condenses to small crystals recalling those of sublimed iodine; these show no tendency to melt and could not be confounded with antimony.

When germanium or its sulphide is heated in a current of chlorine it yields a white chloride which is more readily volatile than antimony chloride; its acidulated aqueous solution yields a white precipitate with sulphuretted hydrogen.

The author intends to undertake the determination of the atomic weight of germanium, even if it can be decided only approximately, as this will show whether the new element is to occupy the vacant position in the periodic system between antimony and bismuth.

THE STORY OF BIELA'S COMET[1]

II.

BRANDES, one of the two German students spoken of, was riding in an open post-waggon on the night of Dec. 6, 1798, and saw and counted hundreds of these shooting-stars or meteors. At times they came as fast as six or seven a minute. These meteors which Brandes saw that night we know now were bits from Biela's comet. In November 1833 occurred the famous star-shower, which some of you saw. The facts of that shower gave to two New Haven men, Profs. Twining and Olmsted, the clue to the true theory of the shooting-stars. From that date

[1] A Lecture delivered by Prof. H. A. Newton, on March 9, 1874, at the Sheffield Scientific School of Yale College, U.S. From the *American Journal of Science*. Continued from p. 395.

shooting-stars have belonged to astronomy. The November meteors were admitted a new constituent of the solar system. Three years later, M. Quetelet, of Brussels, found that shooting-stars are to be seen in unusual numbers about August 10 of each year. A few months afterwards Mr. Herrick made independently the same discovery; but he also told us of star-showers in April and January. What Brandes had seen in December 1798 led Mr. Herrick, moreover, to expect a like shower in other Decembers, and he asked that shooting-stars be looked for on December 6 and 7, 1838. This shrewd guess was justified, for on the evenings of those days hundreds of these meteors were seen in America, in Europe, and in Asia by persons thus induced to look for them. These shooting-stars also had once been parts of Biela's comet, though this fact was not dreamed of at that time.

In the course of time we came to know more about the meteoroids: that in general they moved in long orbits like comets, rather than round ones like planets; that some of them were grouped in long, thin streams, many hundreds of millions of miles long, and that it was by the earth's plunging through these that we have star-showers; that the space travelled over by the earth has in it everywhere some of these small bodies, probably the outlying members of hundreds of meteoroid streams.

Also the periodic time and the path of the stream of November meteoroids were found out. Then came the interesting discovery that in this stream, and in that of the August meteoroids, lay the paths of two comets. Then Dr. Weiss of Vienna showed that the meteors seen

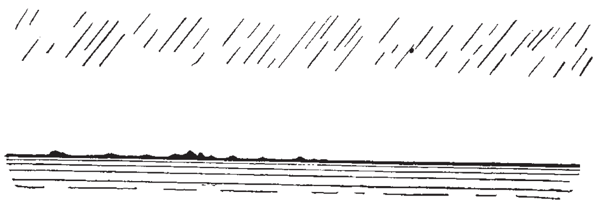

FIG. 9.

by Brandes in 1798, and by Herrick in 1838, as well as many meteors seen near December 1 of other years, and the Biela comets, all belonged to each other.

It is then properly a part of my story to show you the behaviour of one of the streams of meteoroids. Standing several hundreds of miles away, see them enter the upper atmosphere. They are entirely unseen until they strike the air. They then come down like drops of fiery rain a few miles, in parallel lines, burning up long before they reach the ground (see Fig. 9). The air is in fact a shield, protecting the men below from a furious bombardment. The region of the luminous tracks is many miles above that of the highest mountains.

Go farther away. Parallel lines may show the paths of the meteoroids (Fig. 10), though the bodies themselves are too small to be seen. They strike a little way into the air, to some persons coming from the zenith, to some coming obliquely, to some skimming through the upper air—and unseen by all upon one whole hemisphere. I need hardly remind you that sunlight, and twilight, and clouds often come in to prevent the seeing of the star-flights by persons below.

Go still farther away. From outside look in toward the sun upon the earth and meteoroid stream. The meteoroids in fact are not to be seen. The stream is of unknown depth, perhaps millions of miles deep. Its density increases in general toward the centre. We cross the densest part of the November stream in 2 or 3 hours, and the whole of it in 10 or 15 hours, while the passage of the August stream requires 3 or 4 days. The Biela stream is crossed obliquely, the meteoroids overtaking the earth. The August stream is nearly perpendicular, and the November stream meets the earth.

Again go still farther away, out to the point from which we first looked down upon the earth and comet. We then see (by the mind's eye) the meteoroids strewn along the elliptic orbit of the comet for hundreds of millions of miles, forming a stream of unknown breadth, but in the

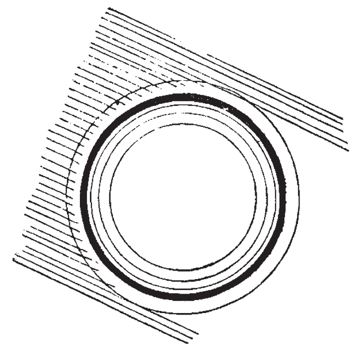

FIG. 10.

scale of the first figure shown you about $\frac{1}{50}$ of an inch in thickness.

Come back now and stand inside the stream, at its densest part. You in fact see nothing; but the meteoroids are all about you scattered quite evenly, and distant each from its nearest neighbours 20 or 30 miles. They all travel the same way and with a common motion.

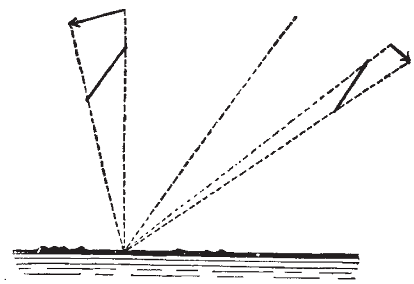

FIG. 11.

Once more change your place and look up from the earth's surface. The meteoroids can now be seen, for when they strike the air they burn with intense light, becoming shooting-stars. As it is from this position only that we ever see them, note their behaviour with more care. A shooting star coming toward you appears only as a bright stationary point in the sky. That point is a

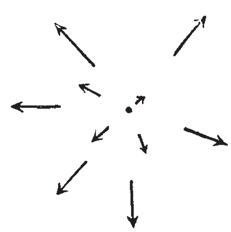

FIG. 12.

marked one in every star-shower, and is called the radiant. The meteors to the right and left of the stationary one are, in fact, moving in the common direction, but they seem to move in the sky away from the radiant (Fig. 11). In other words, the tracks produced backward will all meet in one point in the sky (Fig. 12). This radiant-point may be in the horizon, or in the zenith, or at any place between. It will in general rise in the east and set in the west, like the sun or a star, keeping always its fixed place among the stars.

Need I tell you how much we would like to have some of these bits from the meteoroid streams to handle, to try with the blowpipe and under the microscope, perhaps thus to learn something of their history? We do have something like this. At times large meteor masses come crashing into the air. They burn with a light bright enough to be seen over several States. Coming down usually a little lower than the shooting-stars, most frequently to a height of 25 or 30 miles, they break up with a noise like the firing of heavy artillery, to be heard over several counties. Fragments scattered in every direction fall to the ground over a region 10 or 20 miles in extent. I can show you several such fragments. There are over a hundred of them in our College Cabinet, one of which weighs nearly a ton.

Between these stone-producing meteors and the faintest shooting-star I cannot find any clear line of division. We have meteors that break with a loud detonation, but no fragments are seen to fall. One such was seen in 1860 from Pittsburgh to New Orleans, and from Charleston to St. Louis. It exploded over the boundary line of Tennessee and Kentucky. We have others which are only seen to break into pieces, no noise being heard. Then we have those which quietly burn out. Like the larger ones, these may leave smoky trains that last for minutes. One such I have seen for 45 minutes as it slowly floated away in the currents of the upper air.

Thus through the whole range, from the meteors that give us these stones and irons for our museums, down to the faintest shooting-star hardly seen by a person watching for it, we pass by the smallest differences. They differ in size, in colour of flame, in direction, in train, in velocity. But in astronomical character all seem to be alike. They move in long orbits like comets, and like comets at all angles to the earth's orbit. In fact, a meteoroid is a small comet, not having, however, the comet's tail.

Let us turn from this long digression again to the story of Biela, and tell you what we saw of it in November 1872. We of course looked for a few fragments from the comet the last week in November, but not quite as early as the 24th. But on that evening they came, in small numbers it is true. Before midnight we saw in New Haven about 250 shooting-stars, three-fourths of them from Biela. Very few of them were to be seen the next morning and evening. Then for a day or two it was cloudy. But in the early part of the evening of the 27th they came upon us in crowds. Over 1000 were counted in an hour. By 9 o'clock the display was over. But we saw only the last few drops of a heavy shower. Before the sun had set with us the shooting-stars were seen throughout all Europe, coming too fast to be counted. At least 50,000, perhaps 100,000, could have been seen then by a single party of observers.

Notice what was really seen. Here is a chart of the paths of the shooting-stars as actually seen on that evening, and drawn with care at the time upon maps of the stars (Fig. 13). You see a few stray flights cutting wildly across the others. These are strangers to the system.

You see also that the paths do not, as we had reason to expect, all meet in one point. This is not due to errors of observing, for we see it in every star-shower. It is probably because the small bodies glance as they strike the air, just as a stone skips on the water. In fact, we often see the meteors glance in the air—the paths being crooked.

The meteors came from the northern sky. A German astronomer, Prof. Klinkerfues, at once thought that if this was the main body of the comet it ought to be visible as it went off from us. For this, however, we must see the southern sky. He telegraphed to Mr. Pogson at Madras in India: "Biela touched earth Nov. 27. Search near Theta Centauri." Mr. Pogson looked for the comet and found it. On two mornings he saw a round comet with decided nucleus, and having on the second morning a tail 8′ long. But clouds and rain returned the next day. This is the last that has been seen of Biela's comet.

Was this Pogson comet one of the two parts of Biela seen in 1845 and 1852? This is yet an open question among astronomers. It may have been, but I think it was not. The Biela comets should have been nearly 200,000,000 miles away. Their orbits had been computed with care. The comets, as single or double, had been observed for 80 years, that is 12 revolutions, and we knew well their orbits. All known disturbing forces had been allowed for. It could hardly be that they should have gone so large a distance out of the way. It is much more probable that this was a third large fragment, thrown off centuries ago. The two observations made by Mr. Pogson were not enough to compute an orbit from, but they do

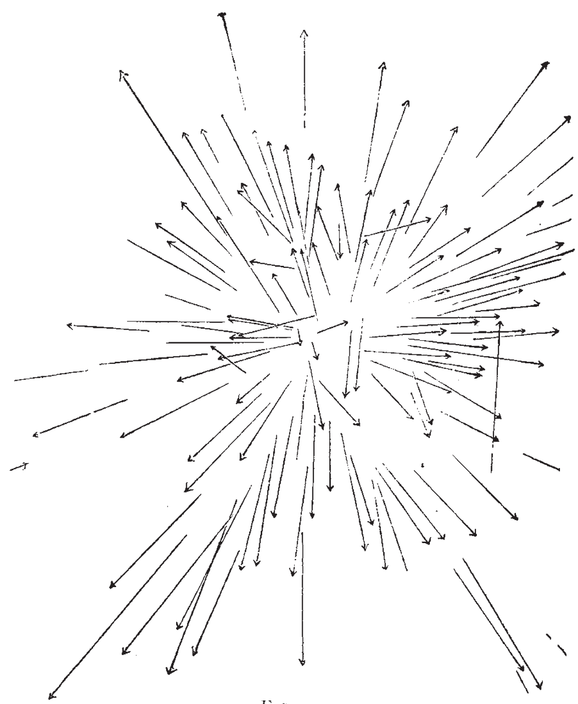

FIG 13.

show that his comet was very near us, and were such as one travelling in the Biela stream might give. But they also show that the earth did not pass through the Pogson comet centrally.

Orbit of the Biela Meteors.—In 1798, when the earth was at N, and Brandes saw the fragments from Biela, the comet was at C (Fig. 14). In 1838 Mr. Herrick and others saw such fragments of the comet at N, 300,000,000 miles ahead of the main body at A, and in 1872 we met like fragments at N, 200,000,000 miles behind the main body, which should have been at B. Thus the fragments are strewn along the comet's orbit, probably in clusters, for at least 500,000,000 miles.

My story of Biela's comet and of its fragments has covered 100 years. Do we get any glimpses of its earlier life, and can we guess how it grew into its present shape? Yes, we may make our hypothesis. But we must not forget that to tell others how God must have made the world is bewitching to many minds, and that of the thousands of trials at world-building almost all have been grievous failures. With this caution let me give you a plausible form of this early story of Biela.

Once upon a time, hundreds of thousands of years ago, this comet was travelling in outer space, among the fixed stars, too far away to be attracted by the sun. What I mean by this outer starry space may be told by the help of the pictures I have shown you. In them the earth's distance from the sun is 10 inches, and the comet's longest range about 5 feet. Upon the scale of these figures only a few of the nearest fixed stars, perhaps two or three only, would be in the State of Connecticut. In this starry space the comet was travelling. What had happened before I do not try to guess. How, when, by what changes, its matter came together, and had become solid, I do not know, nor whether, in fact, it had not always been solid.

In the course of time its path and the sun's path through space lay alongside of each other, and the sun drew the comet down toward itself. If the comet had met no resistance as it ran around the sun, whether from the ether that fills space, or from the sun's atmosphere, and if it had not come near any of the planets, it would have gone off again into outer space whence it came. Some such cause robbed it of a little of its momentum, and it could not quite rise out of the sun's controlling force, but it came around again in an elliptic orbit to remain thenceforth a member of the solar system. It may or it may not then have been a great comet, like Donati's (in 1858).

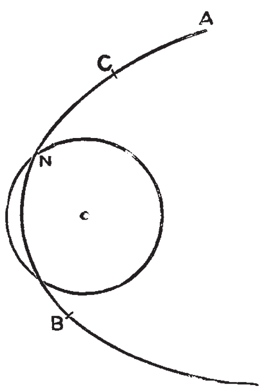

FIG. 14.

It was probably a small one. It may have made its circuit of the sun in tens of years or in tens of thousands.

At some time, probably in the early historic ages, it came near the huge planet Jupiter. When it had gone out of his reach it had just momentum enough left to go around the sun in its present orbit of $6\frac{2}{3}$ years. It went away from Jupiter an entire and single comet. As it came near the sun, his burning heat acting upon the cold rocky body of the comet cracked off and scattered in every direction small angular bits. At the same time a very thin vapour, shining by its own light, was set free. To this vapour both comet and sun had an unaccountable repulsion. It was driven off first by the comet every way. But soon that which was sent toward the sun was driven back again, and it went streaming off into space to form the comet's tail, a process ably set forth by Prof. Norton.

This matter which made the tail of the comet never got back. It had, moreover, nothing whatever to do with the meteoroid stream. The meteoroids are solid fragments. To them the sun, at least, had little repulsion. The comet was so small that perhaps the force with which a boy can throw a stone would have sent the bits of stone entirely off the comet, never to come back. Those which were shot forward from the comet near P (Fig. 1) went up along the orbit with greater velocity and rose higher from the sun than the comet did near D. Having a longer road to travel, they took a longer time to come around to P in each circuit. On the other hand, those bits which were shot backward followed the comet with less velocity and could not quite rise to D, and so having a shorter road to go over came sooner back to P, gaining on the comet at each circuit. Thus the stream grew longer slowly, and new fragments being thrown off at each circuit, the meteoroid stream grew in length to its hundreds of millions of miles. At times, the main comet has broken into two or more parts, giving us the double comets of 1845 and 1852, the Pogson comet of 1872, and the double meteor stream of November 1872.

THE NAVIGABLE BALLOON[1]

M. RENARD, captain of the Chalais-Meudon navigable balloon, has presented to the French Academy of Sciences a report of the experiments made with that balloon last year. Before starting on a fresh campaign in 1885, it was found necessary to make certain modifications in the construction of the balloon, affecting the ventilator, voltaic piles, commutators, &c. To measure the velocity of the balloon, an anemometer, the registrations of which would be too strong, seeing that the spiral is placed in front, was impracticable. There was no inconvenience, on the other hand, in the use of an aërial log. A balloon of gold-beater's skin, 120 litres in capa-

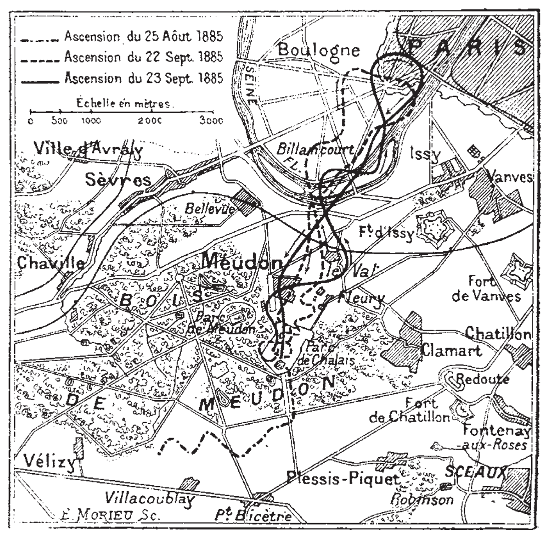

FIG. 1.—Map of the journeys of the *La France* balloon.

city, was accordingly filled in part with common gas, so as to keep exactly in equilibrium in the air. This balloon was attached to the central extremity of a bobbin of silk thread just 100 metres in length. The slightest effort is sufficient to unroll this bobbin when the central thread is drawn. The other extremity of the thread is wound round the finger of the operator. To obtain a measurement of speed the balloon is let go, when it quickly flies to the rear, and, on reaching the end of its line, conveys a perceptible indication of the fact in the finger holding the thread. The instant of its departure and that of the twitching sensation in the finger at its terminus are marked on a chronometer counting tenths of a second. Although the force transmitted to the small balloon during the unwinding of the thread is very slight, it is yet necessary to take account of it. Repeated trials in a closed place showed that the little balloon swerved 7 metres per minute, or 0·117 metre per second, under the influence of this light effort. If, then, t be taken as the time in seconds elapsing in the process of unwinding, the way traversed by the navigable balloon during the opera-

[1] From *La Nature*.