

known to readers of NATURE in connection with animal intelligence, a proof of the above letter was sent to the bird's headquarters for confirmation. Although I cannot now regret that all these interesting details have been thus elicited, most readers will agree with me in wishing that the first account had been also written in M. d'Abbadie's characteristic style. However that may be, I am sure that I shall only be expressing the wishes of every reader as well as my own in taking this opportunity of thanking him cordially for his amusing and interesting response to my appeal for corroboration.—J. H.

[The following is M. d'Abbadie's letter :—]

MY DEAR SIR,—I have met few people who can pen a narrative quite accurately as you have done. Were I writing history, I should add that "Koko" (a *Cacatua moluccensis*) seems to hail with satisfaction the appearance of a coffee-tray. As soon as it is laid on the table he lifts by its central knob the sugar bowl's cover, picks up a lump of sugar, and drops it in an empty cup, on which he taps with his beak to intimate that he is thirsty, for dry sweets are not to his taste.

This bird is the wonder and plague of my life. One day curiosity (?) impelled him to pull into shreds my only kaleidoscope. He got for his industry a few touches of a whip, which he tore to pieces twenty-four hours later, showing apparently that memory is one of his gifts. He has a knack of tearing my pens and papers, sometimes with good reason. As, however, I arrogate those privileges to myself, "Koko" is excluded from my study. Its door, partly glazed, has a pad to prevent draughts, and, before I added a bolt, was closed only by a knob two centimetres thick. Climbing along the pad eighty centimetres above the floor, he looked sily with one eye through the glass, and if the coast was clear he then proceeded to business by turning the knob with his powerful beak and then pulling it, while one claw pushed against the doorpost, the other holding on to the pad. Another door has a lock, and servants thought to exclude the intruder by turning the key, but "Koko" soon learnt to turn it back before applying his energies to the knob. Having thus put the door ajar, he descends cautiously with beak and claws along the pad, opens the door by a push or pull of his beak, as the case may be, and, stopping on the threshold, exclaims modestly, "Koko!" like a Wolseley or a Graham announcing his recent victory.

I say *modestly*, for this bird assumes often a haughty tone when uttering what we call his public speech. It is a rambling gabble, and, like the sayings of a French orator who shall be nameless, it is wholly unintelligible. However, its varying tones are splendid. Those of indignation and command prevail, but in the course of seeming argument "Koko" expresses also and most forcibly concession, interrogation, pity, disdain, ridicule, contradiction, and even logical inference. Without having read the Roman author who advises orators to take hold of their beards when pausing to reflect, "Koko" halts now and then his worthy torrent to seize his chin with his claw, as if pondering on the best line of action. Other appropriate gestures add to the seeming reality of his discourse. I have seen him stand suddenly on one leg, double up the other claw like a fist, and deal a blow on the air as if to knock down an enemy. In spite of their wide sleeves, our barristers might well envy the fulness of gesture imparted by his wings. He raises them expanded over his head, then throws them down impetuously before himself with a seemingly clenching argument. I have heard that Burke used his arms in the same way when beginning his outbursts of eloquence.

The wisdom of nations has sometimes found it necessary to put even statesmen in durance vile, and "Koko" has not escaped the lot of his betters. As, however, he contrived to unfasten several kinds of common spring padlocks, and even one which requires, like my door, three simultaneous manœuvres, my astronomical artist boasted of making one which would puzzle even a Christian. Our bird was chained with this ingenious invention, and immediately busied himself for about two hours pressing on every side the brazen problem. It seemed to cause a heavy expense of thought for his slender brains. On the following day he opened this new-fangled padlock, but with evident difficulty. Finally, having mastered it the third morning, he then freed himself with the greatest ease. Withal he cannot get rid of a padlock that requires a key, nor has he yet pushed back a loose bolt on the very door where he overcomes a fastening apparently more complicated. May we infer that bird reason differs from human reason?

Although he has not been in a theatre, "Koko" whistles when displeased. He can laugh, bark, and cackle. Two first-rate players at five laid a wager that they would be the gainers in my private court, even with their feet tied together. This forced them to jump in order to meet the ball, and their eagerness brought on several falls, some dozens of witnesses laughing at each mishap. "Koko" had always inspected the five games from his favourite perch on a neighbouring balcony. He now wished perhaps to improve an incident new to his experience. Having alighted in the court, he proceeded to stand on one foot, then jumped, falling each time sometimes forwards, sometimes sideways, like the players, and took good care to laugh loudly at each pretended stumble.

The foregoing facts, where a bird's reasoning powers seem to rival those of men, suggest two questions: (1) Where is the boundary between them? and (2) whether intelligence depends, as is often supposed, merely on size of brain? Unable to answer these queries,

I remain very truly yours,

ANTOINE D'ABBADIE,
de l'Institut de France

Paris, May 20, 1884

METEOROLOGY IN VICTORIA

THE monthly and other publications on meteorology and terrestrial magnetism issued by the Melbourne Observatory continue to be regularly received by us, the last *Monthly Record* being for December 1883. Since we reviewed these *Records* (NATURE, vol. xiv. p. 153) we have observed with much interest the steady, and latterly the rapid, extension of climatological stations over the colony. During the ten years ending December 1883, while the number of fully equipped stations has remained nearly the same, stations at which temperature is observed have increased from 10 to 27, and stations for rain observations from 34 to 170. These 170 stations are conveniently classed into coast, watershed, and river-basin groups, and the individual gauges of each group are further arranged in the tabular returns in the order of their heights, which rise to about 4000 feet. The *Records* conclude with a detailed report for all the stations of thunderstorms, hail, snow, frost, gales, hot winds, auroras, earthquakes, &c., observed during the month.

While isobars can be drawn with tolerable correctness from the observations of a small number of stations, and isothermals from the returns of a few more, but still a comparatively small number of stations, it cannot be too strongly insisted on that a very large number of rain-gauges are required to give even a tolerable approximation to the actual rainfall of a country for a definite period, say, a week or a month, which may not seriously mislead those interested in the rise and fall of prices of agricultural and other products that depend on the weather. The meteorological authorities of South Australia and New South Wales are, equally with Mr. Ellery, so fully alive to the paramount importance of an adequate observation of the rainfall, that after a few years' continued vigorous effort this large portion of Australia will take rank, in respect of its rainfall, as one of the best observed regions of the globe.

At Melbourne the wind is observed and the results are discussed with admirable fulness. In summer the prevailing winds are southerly, and in winter northerly. The strongest winds are north and north-west, and the lightest east and south-east, the south-easterly winds in some seasons blowing with only about a third of the velocity of the north-westerly winds. The diurnal velocity of the wind falls to the minimum from about midnight to 4 a.m., and rises to the maximum from about 10 a.m. to 4 p.m. As regards season, the absolute maximum occurs at noon in winter, but in summer two hours later. Another important feature in the diurnal velocity of the wind is that from April to August the daily maximum is only a half more than the minimum velocity, whereas from October to February it is more than double. In other words, the maximum velocity rises to a greater extent above the daily mean during the period of the year when the temperature

is rising from winter to summer than when it is falling from summer to winter, agreeing in this respect with what has been observed in similar regions.

The *Monthly Records* give, in addition to the month's results, the averages of that month for each station based on previous years' observations. In the review referred to above we drew attention to the temperature observations at Portland as being evidently too high. In the following February (1877) the mistake was rectified, and since then the observations of temperature at this station agree with those made at the other stations. A comparison shows that down to January 1877 the published temperatures at Portland were about 5° too high. As regards the averages published since then, however, no allowance has been made down to December 1883 for this large error. The result is that while at the other stations of the colony the mean temperatures of the months since February 1877 rise above and fall below their averages as at other places, Portland all but uninterruptedly appears as very much below its average. Indeed, except the unusually warm months of September 1879 and February 1880, not one of the other forty-six months shows a temperature as high as the average. It is the more necessary to draw attention to this point seeing that the faulty mean temperatures of Portland still continue to appear in works on climatology, either in the text, or they have been used along with the means of other places, similarly faulty, in drawing the isothermals of the globe.

HABITS OF BURROWING CRAYFISHES IN THE UNITED STATES

ON May 13, 1883, I chanced to enter a meadow a few miles above Washington, on the Virginia side of the Potomac, at the head of a small stream emptying into the river. It was between two hills, at an elevation of 100 feet above the Potomac, and about a mile from the river. Here I saw many clayey mounds covering burrows scattered over the ground irregularly both upon the banks of the stream and in the adjacent meadow, even as far as ten yards from the bed of the brook. My curiosity was aroused, and I explored several of the holes, finding in each a good-sized crayfish, which Prof. Walter Faxon identified as *Cambarus diogenes*, Girard (*C. obesus*, Hagen), otherwise known as the burrowing crayfish. I afterwards visited the locality several times, collecting specimens of the mounds and crayfishes, which are now in the United States National Museum, and making observations.

At that time of the year the stream was receding, and the meadow was beginning to dry. At a period not over a month previous, the meadows, at least as far from the stream as the burrows were found, had been covered with water. Those burrows near the stream were less than six inches deep, and there was a gradual increase in depth as the distance from the stream became greater. Moreover, the holes farthest from the stream were in nearly every case covered by a mound, while those nearer had either a very small chimney or none at all; and subsequent visits proved that at that time of year the mounds were just being constructed, for each time I revisited the place the mounds were more numerous.

The length, width, general direction of the burrows, and number of the openings were extremely variable, and the same is true of the mounds. Fig. 1 illustrates a typical burrow shown in section. Here the main burrow is very nearly perpendicular, there being but one oblique opening having a very small mound, and the main mound is somewhat wider than long. Occasionally the burrows are very tortuous, and there are often two or three extra openings, each sometimes covered by a mound. There is every conceivable shape and size in the chimneys,

ranging from a mere ridge of mud, evidently the first foundation, to those with a breadth one-half the height. The typical mound is one which covers the perpendicular burrow in Fig. 1, its dimensions being six inches broad and four high. Two other forms are shown in Fig. 2. The burrows near the stream were seldom more than six inches deep, being nearly perpendicular, with an enlargement at the base, and always with at least one oblique opening. The mounds were usually of yellow clay, although in one place the ground was of fine gravel, and there the chimneys were of the same character. They were always circularly pyramidal in shape, the hole inside being very smooth, but the outside was formed of irregular nodules of clay hardened in the sun and lying just as they fell when dropped from the top of the mound. A small quantity of grass and leaves was mixed through the mound, but this was apparently accidental. The size of the burrows varied from half an inch to two inches in diameter, being smooth for the entire distance, and nearly uniform in width. Where the burrow was far distant from the stream, the upper part was hard and dry. In the deeper holes I invariably found several enlargements

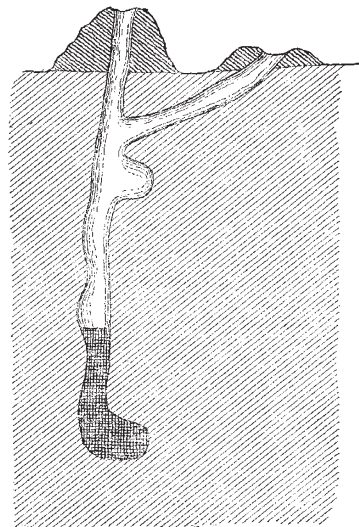


Fig. 1. Section of Crayfish burrow

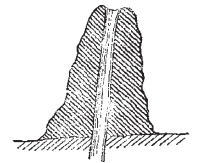


Fig. 2. Crayfish mound



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at various points in the burrow. Some burrows were three feet deep, indeed they all go down to water, and, as the water in the ground lowers, the burrow is undoubtedly projected deeper. The diagonal openings never at that season of the year have perfect chimneys, and seldom more than a mere rim. In no case did I find any connection between two different burrows. In digging after the inhabitants I was seldom able to secure a specimen from the deeper burrows, for I found that the animal always retreated to the extreme end, and when it could go no farther would use its claws in defence. Both males and females have burrows, but they were never found together, each burrow having but a single individual. There is seldom more than a pint of water in each hole, and this is muddy and hardly suitable to sustain life.

The neighbouring brooks and springs were inhabited by another species of crayfish, *Cambarus bartonii*, but although especial search was made for the burrowing species, in no case was a single specimen found outside of the burrows. *C. bartonii* was taken both in the swiftly-running portions of the stream, and in the shallow side pools, as well as in the springs at the head of small