

which either the one or the other is dredged is not stated. A still continued depression takes us through *Green Mud* to the Chalk Marl, which apparently is a true *Globigerina* ooze<sup>1</sup>; and this passes into a true White Chalk. The White Chalk is the result of still farther depression, for it overlaps the other deposits, and as the great change in the character of the sediment cannot have been due to the shallowing of the sea, and yet must have had a cause, we must conclude it was due to deepening. Its enormous extent and thickness and great purity proclaim it in fact to be an oceanic deposit, and there does not appear to be anything with which it can be compared except *Globigerina* ooze.<sup>2</sup> The White Chalk of England could therefore only have been deposited under the conditions of depth, or remoteness from land under which the deposit of *Globigerina* ooze is possible. If *Globigerina* ooze is not a "terrigenous" deposit, Chalk is not, and it does seem singular that it should be classed as such by Renard and Murray, unless indeed they are prepared to point to an area in which a similar terrigenous formation is taking place at the present day. If genera now confined to shallow-water are present in it, it only proves that there must have been deep-water representatives of those genera in the Cretaceous ocean. This is in fact probable from at least two considerations, the one that the examination of the abyssal fauna is still relatively "extremely slight and cursory," as Dr. Gwyn Jeffreys has so amply admitted in the address he refers me to. It is probable that thousands of casts of the dredge have been made in the littoral zone for one in the abyssal zone, and we are, therefore, not in a position yet to say that any genus may not have representatives in the latter. The second consideration is far more important. Dr. Gwyn Jeffreys states that "all of them (the Cretaceous Mollusca) are evidently tropical forms." Now there is strong evidence from the present distribution, and the deposition of the Chalk, that the sea did not communicate with Arctic seas. Prof. Prestwich, in his anniversary address to the Geological Society, pointed this out in 1871. But even if it had, the Arctic climate during the Cretaceous period was a warm one, and for these two reasons, or either of them, the abyssal depths of the Chalk ocean were probably higher in temperature than they are now, while the temperature of the more littoral zones may have been almost tropical. Heat and cold seem greater factors in the distribution of Mollusca than depth of water. Relatively cold-loving genera or species of genera that could only have found the necessary temperatures then at great depths, may now find suitable habitats in shallow water. The "tropical Mollusca" of the Chalk might for this reason have been able to live at much greater depths when such were warmer, but are of necessity now restricted to those in which suitable temperatures are to be met with; and since these are now all relatively shallow, Dr. Gwyn Jeffreys may be quite right in saying that these extinct species have a shallow-water facies, without our being obliged to accept his inference that the Chalk sea was a shallow one. But if we accept the Mollusca pure and simple as a test of depth, their evidence as adduced is untrustworthy owing to the association together of those of the Gray Chalk and the Irish Chalk band of Kilcorrig. Eliminating these, we have no patelloid shell left but *Hippomyx*, and the Chalk species was completely different in habit to anything living. I do not know the Chalk *Chama* (if the Irish form, this is a limpet) or *Pinna*, and these must be very rare and even possibly drifted shells. The unextinct characteristic genera are in fact reduced to *Terebratulula*, *Lima*, *Pecten*, *Armusium*, and *Spondylus*, and of these all but the latter are stated, in the address I am referred to, to have been met with in water 1450 fathoms deep.<sup>3</sup>

It would be impossible to dispose of a question of such importance in a mere letter. My object in writing is to elicit, if possible, the exact grounds on which Messrs. Murray and Renard base their statement that the Chalk was a shore deposit; and it would also be exceedingly useful if Dr. Woodward, Dr. Duncan, Mr. Davidson, and Mr. Carpenter would give their opinions, and the grounds on which they are based, on the probable depth required by each of the Cretaceous groups,

<sup>1</sup> *Globigerina* ooze is mainly composed, according to Murray, of 40 to 95 per cent. of carbonate of lime, oxides of iron and manganese, and argillaceous matter.

<sup>2</sup> Of reef-building corals there is not a trace either in it or in any contemporaneous formation, and nothing can be more opposed to all evidence than the supposition advocated, it will be remembered, by Wallace in "Island Life."

<sup>3</sup> There are few traces in the English Chalk of any Mollusca except those that possessed calcite shells, and what the rest were like as a group no one can say.

respecting which they are the chief authorities. Dr. Gwyn Jeffreys is the only one who has contributed anything definite towards a solution of this most important geological problem, and for this, while believing other conclusions may be deduced than those he has arrived at, I and many other geologists heartily thank him.

J. STARKIE GARDNER

### Animal Intelligence

THE following notes of facts observed in New Zealand may be thought of interest; in some way they may serve to illustrate Mr. Romanes' work on "Animal Intelligence": they are submitted without making an attempt to distinguish where they may overlap the fine line between instinct and intelligence. Cases which may show apparent intelligence or the reverse are recorded that we may arrive at a clearer view of the truth in animal life.

The dog cannot be passed over without mention; he is always to the fore where intelligence is required. Here, where sheep occupy so large a share in the employment of country people, the colly may be seen daily exhibiting its wonderful talents in controlling the movements of its simple charge. Its achievements are too numerous for recital.

Amongst birds we found the quail-hawk (*F. nova-zelandiæ*), quickly learnt to avail itself of the property of the new settlers; it attacked both poultry and pigeons with the greatest determination directly these foreign birds appeared at the stations and outlying farms. The harrier (*Circus approximans*), more stealthy than the falcon in its depredations on the poultry, perhaps not less destructive, is careful if possible to convey its prey to a quiet spot free from interruption, where its meal can be finished at leisure in security. It found out the use of cornricks and haystacks as mouse-preserves; in some places several harriers might be seen at one time perched on the thatch carefully watching for vermin. It killed the rabbit; the swift-footed hare it found out could be hunted to best advantage in company: several of them would join in the pursuit, wheeling softly with every double of the distressed animal, till, quite exhausted, it lay stretched out in death. The harrier, the gull, the tern, all used to put in their appearance after the large grass fires of former days had swept miles of country; lizards, as they crept from under the stones laid bare by fire, seemed the attraction for all these birds. One autumn, when laid up with rheumatism, lights were brought into the room rather early. I often heard the sound of scratching on the window-glass, and found it proceeded from the efforts of an owl (*Athene, N.Z.*) to secure moths from the lighted-up window-panes; this was repeated for many evenings during parts of the months of April and May, so that I always expected my evening visitor. As a mouser this same species learnt the value of stations near barns and stacks; frequently, many scores of times, have I seen it keeping its solemn watch on a post or rail of the barnyard (see *Zoologist*, 1873, p. 3621). The kakapo or night-parrot (*Stringops*) shows intelligence in its nesting arrangements: the chamber at the end of a long tunnel is covered at the bottom with a great accumulation of excreta; each of these is an inch or more in diameter—the bird is a vegetable feeder—the warmth derived from this mass is secured by the young, reversing the proverb, "It is an ill bird that befools its own nest."

The kea (*Nestor notabilis*) (see *NATURE*, vol. iv. p. 489). Its rapid development of a change of habit that led it to destroy sheep has proved very disastrous to many mountain sheep-farmers. It is remarkable that the discovery of the excellence of kidney fat should become known almost simultaneously through a long tract of country; how were beginners instructed to dig their beaks into the wool just above the sheep's kidneys? Horses have been wounded by them in the same part; all this shows a ready means of spreading information. One of the writer's sons snared a few fine specimens, but they very soon became aware of the snare and promptly avoided it. When thrown at, they learn to dodge the stone, just ducking or moving aside. One, imprisoned under an inverted bucket, after a time thrust its strong beak between the rim of the bucket and the floor, turned over the bucket and escaped.

The two cuckoos *Eudynamis* and *Chrysococcyx* offer a problem of peculiar interest as regards migration. The journeys they undertake and accomplish across wide expanses of ocean are amongst the most courageous and trying physical feats in bird history: "as bold as a hawk," "as brave as a gamecock," are proverbs that are befitting; but these birds deserve as much recognition for their adventurous daring.

When either of these species is observed flying, it will be

noticed that the wings are kept constantly in rapid motion; there is no sailing or soaring, gliding through the air on still expanded pinions, but the bird is sustained by determined work. Here in the South Island they are to be seen from the end of the first week in October (further to the north earlier) till March, or even April; the remainder of the year they are not seen in this country. Every part of the islands is known to the Maories; there is no district where they could winter without the fact becoming known. The whistler, or shining cuckoo (*Chrysococcyx*) has been observed in the month of October at Te Wakaru, Chatham Isles, on the beach and in trees exhausted, wet as though from spray; looking at the period of its arrival, and remembering that Te Wakaru is the north-east corner of the large island, it points to the probability that some birds arrive there direct from the warm and distant north, and not from New Zealand, from which the Chatham Island group lies easterly from Cook's Straits about 500 miles. From my own observation I am inclined to believe that with this species the first emigration sets in from the west coast of the South Island of New Zealand about the end of December, as I have observed adult birds in numbers on the sand dunes close to the sea, probably preparing for departure. They make use of the warmest domed nest of our native insect-eating birds, the very rare exceptions afford but two or at most three exceptions in thirty years' observation; in one of these cases an egg found in a nest of the blight-bird (*Zosterops*) approximated in colour those of the dupe; because it was dropped in an open nest? A good example of approximate coloration came under notice in the case of a wounded bittern which was secured and placed under a coop on a piece of grass; she laid an egg of a pale green colour; under ordinary conditions a buff egg would have very well matched the flags of dead sanpo (*Typha*) and faded water grasses, of which its nest is composed. The kingfisher (*Halcyon*) gives a good instance of cleanliness, most necessary in a close nest, containing from five to seven young birds, which remain at home until they can fly well; the entrance of the tunnel to the nest chamber is an upward slope, whilst the eggs are saved from rolling out by a ridge on the edge of the nesting place. In another species the flycatchers (*Rhipidura*) cleanliness is attended to thus: the young back themselves to the edge of the nest to void excrement, which is taken away by the old birds. In the slight nest of the wood-pigeon (*Carpophagus*) cleanliness is provided for by the open work of the structure, so that the dried excreta of the young pass through the spaces of the concave platform. The tui (*Prothemadera*) enjoys the faculty possessed by the keas, gulls, terns, and many other species, of quickly making known events of interest, as, for instance, in a gorge of one of the great rivers, some cherry-trees rewarded the care of a settler with a fine crop of fruit; a wandering tui found this out, immediately the fruit was attacked by numbers of these beautiful birds, and the crop cleared off. The tuis had to travel some miles from a wood to the cherry-trees. Another instance of the possession of this quality could be witnessed here at the present moment (April 23); from the midst of the massive armed leaves of a variegated aloe has arisen a stately and erect column of blossom reaching upwards to a height of twenty-four feet; its bracts, between thirty and forty in number, laden with rich golden-coloured flowers spread out in formal array. A bell-bird (*Arthornis*) first discovered the richness of the nectaries of this foreign plant. Soon bell-birds and tuis assembled there, a most pleasing sight; their ever-varying motions and postures could be distinctly seen as they flitted about, darted between or hung suspended from the blossoms whilst probing for the honeyed sweets. It has become a floral play-place, a stage enlivened throughout the day with songs and aerial movements; even when the sun has retired behind the western hills, when bees have winged away to distant hives, a bell-bird or two will yet linger, as if to the last minute they would extract some luscious drops.

Since its arrival here in 1856 the blight-bird (*Zosterops*) has shown some notable changes in habit that are in accord with the different conditions under which it now lives in this country: for some years after its arrival it built a suspended, somewhat hammock-shaped nest, in which it laid three eggs; finding from experience that its nest was unmolested by snakes or other egg-robbers, it saved itself much pains and labour by commencing to fix its home in a spray. It, like the goldfinch (*F. carduelis*), freely availed itself of the sheep paddocks, and collected wool as an excellent fabric for nests very readily obtainable; I have seen nests of this species almost entirely constructed of it. One of its familiar names was conferred because it helped to clear

fruit-trees of blight and other insect pests; it soon found out the excellent food that a variety of fruits afforded; when trees were netted to secure them from its attacks, it learnt to find out where the meshes of the nets were stretched to their full extent, and there made its ingress and egress to the fruit beneath. The robin (*P. albifrons*) visits conservatories for the sake of insects; we have known them make daily tours round a glass-house, waiting till flower-pots have been removed, when they have eagerly picked up the lurking insects that hid beneath, thus easily earning a hearty meal. The lark or pipit (*Anthus*, N.Z.) for a similar reason will leave uncultivated tussock land to follow the trench made by the gardener's spade, and thus get an abundant supply of the larvæ of the brown chafer-beetle. I wish to say I do not think this a general habit of the pipit, but I have seen several of the species thus well employed.

The yellow-breasted robin (*P. macrocephala*) and the wren (*Acanthisitta*) will at times use man's buildings for their homes. Nesting material offered to this robin and to the flycatcher have been readily accepted; the latter species made use of some red cotton wool thus put in its way, but worked it up so that it was not seen from the outside. In some cases I have known the last-named neat architect to add a rim to the nest when the young required more room. The chaffinch (*F. caelebs*<sup>1</sup>) here follows the traditions of its native land, tricks out the exterior of its beautiful nest with lichens, and in many cases supplements this material with fragments of newspaper, for lichen is scarce here; singularly enough this hereditary habit outweighs its sense of concealment, as it places its nest thus adorned on trees without lichen on their bark.

The sparrow (*F. domestica*) is remarkable for the ease and readiness with which it modifies its nesting habits to suit circumstances; in the very heavily topped ti palms (*Cordyline*), where the divergence of the branches is hidden by a massive thatch of long ensiform leaves, sometimes a common roof shelters many compartments; the gregarious instincts of the species are thus carried out at breeding-time; from one of these communities we have taken thirty-one eggs and fourteen young birds at once. On the shelterless "plains" it has been known to modify its old habits by building on the ground, or in heavy road cuttings its nest may be seen in a crevice of the bank, or it builds in some fissure in the cliffs over the sea, just below man's reach; it has taken possession of intricate passages in a heap of coils of fencing-wire; in this last-named instance poultry feathers for lining had to be brought from a mile distance; but then the situation promised security.

The weka (*Ocydromus*), as curious as a magpie, knows the value of a fruit-garden, and that a poultry-yard furnishes eggs. I have seen it pecking at the skin of a dead lamb with heavy blows, and the insects being driven out, it has tugged away at the decaying skin till it has been able to pick up the insects that lay underneath. The dotterel (*C. bicinctus*), red-bill (*Hamatopus*), paradise duck (*Casarca*), all simulate lameness or distress to lead wayfarers from their young and afford them opportunity for escape or concealment.

The Australian magpie (*Gymnorhina*) has given us some noteworthy instances of its intelligence and resource under difficulties: a pair bred here for some years; one season the young were taken, the wings cut very close. Some impatient creature who could not endure constant and sudden attacks shot the male bird; the young were given away except one poor one, which turned out to be a male. In the following season the old hen was seen building very high, as usual, in a blue gum (*Eucalyptus*); there she was observed feeding young; at length a young one flew from the nest, and, when sufficiently strong on the wing, together with the old hen left the district. Now the poor male with the wings cut was never able to rise from the ground further than by jumping; he had never flown at all, as the stumps of the quills remained in the wings. This was the only male to which the hen could have had access. Whilst the hen was intent on new family cares, the crippled male died. Another pair on the plains, where sticks were scarce, availed themselves of a supply of binding-wire from a patent reaper and binder; the wire cut in lengths furnished an ample supply of lasting material for the nest.

The big gull (*Larus dominicanus*) instantly finds out a dead beast, and makes the fact known; it attacks sickly lambs or sheep that are cast by pecking out the eyes, thus securing its prey by rendering it helpless. I have seen it ascend with a shell-

<sup>1</sup> See *Mittheilungen des Ornithologischen Vereines in Wien*, No. 3, März 1884, p. 35.

fish to a considerable height, and drop it on to a shallow in one of the bays, recover its prize, and drop it again and again to obtain the fish within. Many weeks before nesting time these birds visit the old breeding-stations, as if to estimate the repairs that will be necessary to render the old nests available; this visit is carried on with great clamour. A cormorant (*Graculus*) was shot at and wounded at a tench-pond at Rockwood; it kept in the pond; it could not fly. A dog was sent in to fetch it out; it faced the dog resolutely, which turned tail; this part of the animal was immediately seized by the cormorant, who was in this singular manner towed ashore; but its odd feat did not serve to save its life. The fantail flycatcher (*Rhipidura*) enters houses in pursuit of flies glancing from room to room; it soon clears them of these insects. Dr. Otto Finsch in his "Ornithological Letters from the Pacific" mentions this habit as witnessed by him here.

Amongst hymenopterous insects the Sphegidae offer instances of intelligence. A species of Spheg with orange-coloured body deposits the benumbed or torpid bodies of spiders in some crevice for future use. An individual of this species had its hole in a dry corner beneath the plate of a long veranda. One day I observed it dragging a victim along a gravelled walk that was parallel to the veranda; the small stones and grit made its progress very difficult. After very trying struggles with these impediments it displayed a remarkable degree of intelligence, by which it gained its ends. It altered its course and made for the veranda, ascending the smooth, painted board that adjoined the gravelled walk. After slowly traversing seven inches of perpendicular it came to a rounded beading which projected outwards. Now came its supreme moment of physical exertion. The body of the spider apparently was too heavy to render the aid of wings available. After several pauses in its progress it slowly yet surely surmounted the difficulty presented by the projecting beading, gained the level boards of the veranda, along which it travelled rapidly with its burden, which it sometimes dragged, sometimes pushed before it. By the expenditure of great exertion in surmounting the beading it gained a smooth and level run to its home of thirty-nine feet. A species of Mantis remains so still on a leaf of its own colour that it is difficult of detection; it takes its prey by surprise, darting forward its armed fore-limbs with a sudden spring.

I have had in the shrubbery a colony of Phasmæ for the last nine or ten years. In all that time they have remained almost entirely on one tree (*Oleurea Fosteri*). Yet, accustomed as I am to them, they place themselves so much in a line with the sprays of the tree that they are difficult to discern; in drizzling north-east weather some dark markings appear along their bodies, which match the wet sprays wonderfully. It should be noted that the Australian magpie, the halcyon, and many insect-eaters have for years bred and lived in the trees or banks near them; yet they still survive, notwithstanding the proximity of these enemies to insect life.

T. H. POTTS

Ohinitahi

THE following extract from a letter which I have just received from Mr. J. H. Wheelwright appears to me of sufficient interest to publish in your columns, as it serves to give, among other things, a good deal of new and first-hand information on one of the most important branches of comparative psychology, viz. that relating to feral and partly wild domesticated animals.

GEORGE J. ROMANES

Cattle very easily relapse from domestication. They become distinctly nocturnal in their habits; their sense of smell is very strong. Wild cattle degenerate rapidly in size, owing, I think, to the persecution of the young heifers by the yearling bulls. In three or four generations in Queensland wild cattle revert to one uniform colour, a dun colour or dirty brown with a yellowish stripe along the spine, and a yellow nose. Wild cattle will remain all day long concealed in the depths of thick, inaccessible jungle—"bungalow scrub" or "mallee" we call it in Australia—issuing forth at night to graze and drink, and it requires much care and very hard riding to entangle a few of them among a lot of quiet cattle and secure them. Australian cattle have many habits their domesticated progenitors have lost. For instance, in summer-time grass becomes very scarce near the rivers, and the cattle walk in from their feeding-grounds as much as ten or fifteen miles to water, marching in long strings and feeding back again. Young calves of course could not do this. I have frequently noticed two or three cows far out on the plain, who, when they saw me, would lift their heads and watch me. Presently I would

come across a kind of *crèche*, a mob of perhaps thirty little calves all lying snugly in some small, sheltered dip of the ground, left there in charge of the sentinel cows by their mothers who had gone in to water. Now as soon as these calves saw me they would try to hide—do it very well too, under any little bush there might be handy, and lie close until I got off my horse and touched one; then he would jump up, and, no matter how young, make a staggering charge at my legs. He would give a peculiar cry at the same time, which would bring the guardian cows in at a full gallop and give me reason to mount at once. Cattle have extraordinary *homing* power; so have horses. Cattle recognise *individuals* in a very extraordinary way. I have had considerable experience in droving large herds, say 1000 or 1200 head, long journeys extending over many months. I have been struck with the fact that, a week after that herd has been travelling, every beast in it seems personally acquainted with every other: that is, if a strange cow or bullock were to join the herd, that cow or bullock would be immediately expelled. When a herd is travelling thus, each beast in a very few days takes up his position in the mob, and may always be found in the van, the rear, or on the right or left wing, the strongest cattle leading. That cattle and horses can *smell* water is a delusion. Cattle and horses always have their particular friends; at night when cattle are *camping* on a journey, there is always much bellowing and fuss until certain *coteries* of friends get together and lie down comfortably. A beast blind of, say the *left* eye, always travels at the outside of the *right* wing of the drove. A beast that has been scratched sufficiently to draw blood will be hunted and pursued by all the rest. Cattle have a habit of appointing certain *camps* or *rendezvous*, where, on any alarm, they congregate. Half-wild cattle are sometimes very difficult to drive off these camps. Wild cattle are singularly clever in concealing themselves, as are all wild beasts, and will hide in half a dozen little bushes no one would suppose would hold a calf.

Wild "dingo" puppies, taken away from their mothers, are easily reared, but never lose their inborn savagery: they are not to be trusted near poultry, sheep, or cats. The chief difference between them and their civilised brethren is, if, say a collie pup misbehaves himself and is kicked, he yelps, sticks his tail between his legs, and runs away; whereas his wild brother, with his tail erect as that of a Dandie Dimont terrier, snaps viciously at the foot which kicks him. I have owned a pure-bred dingo ("warrigal" we call them) which ran with our kangaroo dogs, and the dog would worry one of his own kind with as savage a zest as would any of the great powerful hounds with which he had associated himself. As to feigning death, I think the Australian "dingo," or "warrigal," a good case in point. We once ran a wild dog with three powerful kangaroo dogs, noted for their killing powers; they caught him, worried him, and he lay for dead; at any rate the hounds thought he was done for; they lay down quite contentedly to regain their wind. We cut off the warrigal's brush, and he gave no sign. Just as I was getting on to my horse, I saw the supposed corpse open one eye. Of course we put the thing beyond a doubt. A kangaroo dog has been known to run down a dingo bitch at heat, line her, and then kill her. The worst and most dangerous wild dogs in the Australian pastoral districts are *half-bred ones*. Kangaroo dogs should be, I think, about three-quarters greyhound—the rest either mastiff or bull-dog; such a dog should be able to catch and kill almost anything.

A doe kangaroo, when hunted and hard pressed, will throw the young one out of the pouch into any handy clump of scrub or tussock of grass. The "Joey" accepts the situation, and makes himself as small as ever he can; in fact, in looking for him, all you ever can see are his bright eyes. Young kangaroos seem to possess exactly the same instinct as the calves of wild or semi-wild cattle, that of concealing themselves. Young kangaroos soon adapt themselves to circumstances, and make themselves comfortable at the bottom of the pocket of a jacket.

I remember that once upon a time, about 1856, we caught a brood of wild ducklings, which we took home and put under a hen. These ducklings, not one of them fledged, walked a mile and a half along a very dusty road to the place whence we had taken them, and rejoined, as I hope, their progenitors. Our black boys tracked them.

#### Diffusion of Scientific Memoirs

IN some of the numbers of NATURE which have recently reached me I find that Prof. Tait has broached a subject of