THE DISPERSAL OF PLANTS BY BIRDS

By J. B. CLELAND

The dispersal of plants by birds has a particular interest for us in South Australia, as it is leading to a considerable change in the aspect of our surroundings. For instance, the name Green Hills had already in the 1850's been given to the hills above Beaumont, and sketches made soon after South Australia was founded show these hills to have been mostly grassy. The Quaker, James Backhouse, in 1838 described them as such. At the present time these hills at Beaumont and Magill are quickly losing their grassy appearance as a result of seeding with olives, chiefly distributed by Starlings, and are being covered with shrubs. Moreover, many of our eucalypts are being destroyed by mistletoe, which is distributed by birds, and probably also by possums (Phalangeridae). The South African shrub, *Osteospermum moniliferum,* is spreading extensively at Belair, and is ousting native plants.

At first sight it may be thought that, after enumerating the above, there may not be much more to say about the subject, but on consulting the literature it was at once evident that this was not the case.

H. N. Ridley, in *The Dispersal of Plants throughout the World* (1930), has no less than 131 large pages devoted to the subject of "Dispersal by Birds," and I shall draw upon his store of material extensively.

Birds may distribute the seeds of plants, and sometimes even viable fragments of plants themselves, in several ways. They may do so most frequently by eating the fruits or seeds and either passing the seeds through the intestines and voiding them, or by regurgitating them as pellets. Birds may be ripped to pieces by hawks and thus setting free, in the case of finches for instance, grass and other seeds that would otherwise have been destroyed in the gizzard. Less common means of dispersal consist of small seeds being carried in mud on the feet of birds, and fruits or seeds or portions of plants being entangled in their plumage.

I propose to deal with the subject by first of all considering the plants in South Australia, and to some extent those in other parts of Australia, which seem to be distributed, in part at least, by birds. Having looked at the question from the plant side, we can consider it from the ornithological aspect.

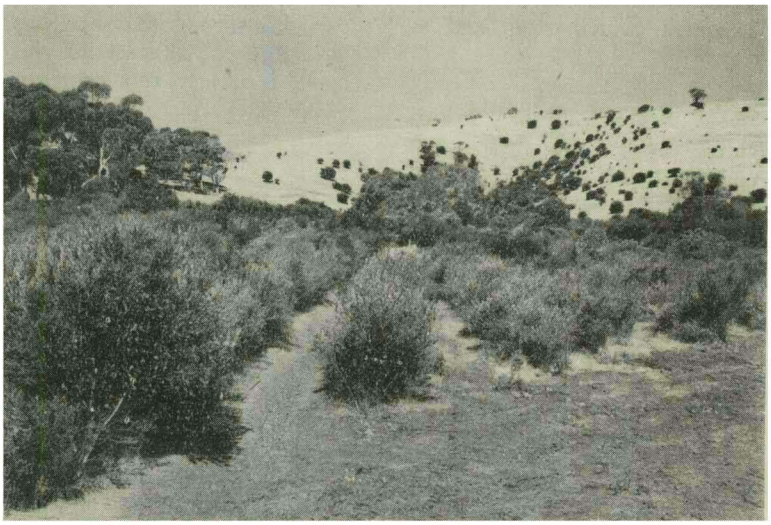
A. PLANTS WITH EDIBLE FRUITS

The following introduced plants are now being disseminated on the Adelaide Plains and the adjacent Mt. Lofty Ranges: Olive *(Olea europea);* Blackberry *(Rubus fruticosus* and *R. laciniatus);* Hawthorn *(Crataegus oxyacanthus);* Neapolitan Medlar *(C. azarolus* var. *sinaica);* probably the Dog Rose *(Rosa canina);* Sweet Briar *(Rosa rubiginosa); Osteospermum monoliferum;* and the Box-thorn *(Lycium ferocissimum);* also to a lesser extent *Myrtus communis, Rhamnus alaternus,* and the climber *Asparagus medeoloides.*

There is no doubt that the olive is chiefly distributed by Starlings. Olives have been found in these birds by Mr. Oliver Fuller in the eastern suburbs; they can be disturbed in numbers from olive plantations when the fruit is ripe. The sites of Malcolm Tweedie's apricot orchard near Sunnyside, and of an old vineyard below Sir Stanton Hicks' house at Glen Osmond have become covered by young olive trees growing up in rows, indicating where Starlings had settled on the trees or vines and voided stones. The hillsides at Beaumont and Magill are becomingly thickly covered with olives, whose seeds have been carried sometimes a distance of nearly a mile from the fruiting trees. Some, I believe, consider that Magpies *(Gymnorhina)* are chiefly responsible, but the seeding, to my mind, is far too extensive for them to have done so. Silvereyes *(Zosterops lateralis),* which frequent the olive plantations in numbers, probably find the fruits too large to ingest.

I believe the Silvereye is a common dispersing agent of the two blackberries and *Rhamnus.* Starlings, Blackbirds, Noisy Miners and probably Wattlebirds *(Anthochaera)* have been seen feeding on blackberries.

Asparagus, a creeper with showy, elongate-ovate leaves, is grown occasionally in gardens; odd plants near the foot of trees or shrubs may be found from time to time in the National Park, Belair, and on the Adelaide Plains, and a few years ago this creeper



COVER PICTURE

Olives growing in rows on the site of an old orchard, and scattered over the hillside beyond, from seeds deposited by Starlings.

—Photo: Waite Institute, 1951.

was found extensively covering native shrubs between Goolwa and Currency Creek, and also near the Tod River Reservoir on Eyre Peninsula. The fruits are about the size that *Zosterops* and other small fruit-eating birds might ingest, but the distribution so far afield in some cases suggests that a bird with a more extensive range of flight, such as the Starling, may be responsible. The garden *Asparagus* seeds may similarly be dispersed.

I have found in my garden a seedling fig growing in a pocket of decayed wood containing dust-borne soil a few feet up the trunk of an almond probably nearly a century old. It evidently must have been conveyed there by a bird, probably a Silvereye, from the adjacent fig trees. During the First World War, when living in Sydney, a young fig tree came up, in the garden of my newly-built house on what was previously bush land. There is little doubt that it had been brought by a bird and that bird was most likely *Zosterops;* (Crows, Magpies and Starlings have been seen feeding on figs.) These occurrences are of particular interest as showing that the cultivated fig *(Ficus carica)* in Australia can set fertile seeds. Fertilisation is achieved by the agency of minute hymenopterous insects. Each species of fig has apparently a different species of hymenopteron as its fertiliser. The species necessary to fertilise the Smyrna fig has been introduced into Australia. Nevertheless seedling figs are rarely seen, and these two examples are, I think, all that I have met with. It is interesting to note that in Cyprus, J. Holmboe (quoted by Ridley) records *Ficus carica*, our garden fig, as distributed by birds on many trees (as epiphytes), and even the olive on *Ceratonia.*

COVER PICTURE

Olives growing in rows on the site of an old orchard, and scattered over the hillside beyond, from seeds deposited by Starlings.

—Photo: Waite Institute, 1951.

In Central Australia the native fig *(Ficus platypoda)* is widely distributed on the bases and sides of rocky hills. Its orange-colored fruit becomes browner and soft when ripe, and is eaten by the native but is insipid. Western Bower-birds *(Chlamydera guttata)* frequent these fig-trees, which spread out extensively over the rocks, giving abundant cover, and it seems likely that they may be responsible for the spreading of the seeds.

One of the most striking examples of the distribution of fig seeds by birds is seen in the case of *Ficus rubiginosa* of the coastal brushes of New South Wales. The seeds of this fig may be deposited in forks or hollows in the trunks of forest trees. In fact, this may be the only situation in the forest where such seeds would have the chance of establishing themselves after germination; they would be beyond the competition of the many other seedlings of the forest floor, and they would also have access to more light. After germination, the roots descend the trunk of the host towards the ground, interlacing as they do so. By the time the forest floor is reached, the interlacing roots of the fig have begun to strangle the host, which eventually dies and rots away, leaving the fig now standing in its own strength but with a trunk composed of a lace-work which gradually becomes obliterated by fusion.

At my request, Mr. A. G. Strickland, Chief Horticulturist, Dept. of Agriculture, has supplied the following information from one of his officers as to the distribution of plants, more particularly the seeds of fruit trees, by birds.

Mr. H. K. Kemp, Senior Horticultural Research Officer, writes:—

"I can recall no instance of fig or grape seedlings occurring unexpectedly in tree shelter where birds may have been responsible for spread. Commonly noted examples are, however, the olive, hawthorn, blackberry, *Coprosma lucida, Rhamnus,* and elderberry.

"In the larger fruits, the Starling is certainly the chief vehicle, and is capable of stripping *Crataegus, Coprosma* and *Rhamnus* in very short time. I have not noted them feeding on blackberry, however, and I think one of the smaller parrots is chiefly responsible for the very serious spread of blackberry into hills orchards. This matter is worth particular note in this connection. It is a considerable problem to growers, the blackberries becoming established on the uncultivated area beneath the trees, where it can be extracted only by costly hand labor. It is so expensive to control that the diffi-

culty in doing so has been put forward as a major argument against contour banking. I think rarely is the Sparrow responsible for wide spread. This bird, although feeding freely on these small berries, as I have noted repeatedly, eats the flesh and spits out the seed on the spot so that it would be rarely carried far, except by accident."

Ridley quotes Morris as saying that very few orange trees had been planted in Jamaica till just before he was writing (1887-8), and that nearly all the trees had been planted by birds. Ridley adds, "this, indeed, anyone visiting Jamaica might guess, noting that the trees of the orange and other citrus fruits are scattered all over the country, in places where they were most unlikely to have been intentionally planted." Gosse, he says, records that a species of Hang-nest (Icterinae) and a Turtle-dove fed on the oranges.

Tindale and Hackett (Film of Mann Range, 1933, vide *"Man,"* London, 1937) have recorded a very interesting example of the distribution of seeds by Crows, and I have referred to this subject previously *(Pap. Proc. Roy. Soc. Tasmania,* 1939, p. 6). Native women collect in their coolamons seeds of the Desert Kurrajong *(Brachychiton Gregorii)* which have been regurgitated by Crows (probably *Corvus bennetti)* when they come to the rock-holes for water. The seeds are pounded between millstones into a meal, cooked and eaten. The Desert Kurrajong grows only on the sandhills, and obviously seeds dropped (1) around the rock-holes are in an unsuitable situation to grow, but doubtless others may be dropped in the sandhills as the birds fly.

If the seeds are thus passed intact, one wonders what edible matter accompanies them, and why the Crows ingest them. The late J. M. Black, in his "Flora of South Australia," says the fruit consists of 5 or fewer hard ovoid follicles, 4 to 5 cms. long, containing about 12 seeds, each seed with a loose brittle hairy coat which remains attached to the inside of the follicle when the seeds drop out, giving it a honeycomb appearance.

Most of us are familiar with the similar fruits of the Common Kurrajong (*B. populneus)* and of the Flame Tree *(B. acerifolius).* Several young trees, probably of the latter species, have appeared in the interstices of the large pavement slabs between the main front building of the University of Adelaide and the Elder Conservatorium, and another is several feet high, growing through the asphalt and wooden steps leading down to the new Physics Building. Ascending the Gleeville spur at Beaumont is a wall of loose flat stones—a *Brachychiton* is growing from amongst these, the nearest tree being at least a quarter of a mile away.

The Ivy *(Hedera helix)* has been planted extensively, especially in the hills. Whilst clinging to a surface such as a wall, it does not flower and fruit until it sends out branches away from its support. Ivy was planted in the National Park in its early days, and it is possible that some of the plants growing amongst the rather inaccessible rocks have originated from seed carried by birds. Records are required of birds feeding on Ivy berries in this State (so far I have only the Blackbird), and of the appearance of spontaneous plants away from parent trees. A number of small Ivy and Holly plants near Mt. Lofty Summit are possibly bird-distributed. Ridley says that the Ivy is well-known as a source of food for birds, and the fruits are greedily eaten by Blackbirds and the Thrush. He says that the former eat a large number of berries when abundant, and disgorge the seeds at some distance from the plant, only swallowing the pulp. He adds—"I have seen a large number of these seeds, or, more correctly, pyrenes, lying on the side of a nest, where doubtless the pulp had been used to feed the young. In such abundance are they to be found that during the war against Germany they attracted the notice of certain people who, struck by their curious appearance, sent them to the Royal Gardens, Kew, as suspected poisonous sweets dropped from German aeroplanes."

Lantana camara has spread very extensively in the coastal brushes of New South Wales and Queensland, forming almost impenetrable masses. Ridley says that *L. mixta,* introduced as a showy garden shrub from South America, has spread extensively in Ceylon and Singapore, and even appeared in Krakatao in 1919, the small black drupes

(1) Condon, *S.A. Orn.,* 16, pt. 1, p. 3, says, "Examination of specimens by the writer has revealed that the seeds are ejected as pellets and not in the faeces."

being very attractive to small birds. There has been no spread of this shrub in South Australia, though various forms of *Lantana* are grown in gardens.

The African Boxthorn *(Lycium ferocissimum)* was introduced into South Australia as a hedge-plant before the 80's of last century and has spread very extensively in the surroundings of Adelaide, particularly near the coast. It is a danger to public health as a harborage and food for rats (*Rattus rattus* in particular); the sharp spines ending the branchlets cause injuries, and tetanus has followed their penetration. Furthermore, the fruits may probably be attacked by the Mediterranean Fruit and Queensland Flies. Its distribution, sometimes a considerable way from mother plants in open fields and sometimes under perching places, indicates that birds are important agents in its spread. Silvereyes and Sparrows frequent the bushes and presumably are chiefly responsible, but Starlings, Blackbirds and rats may also be agents in dispersal. The Purple-crowned Lorikeet has been found eating the fruits, and also the Noisy Miner.

The much-used hedge-plant, *Coprosma lucida*, has fruits which are eaten by the Mistletoe-bird, Silvereye, Red Wattle-bird, and probably other species.

The introduced South African shrub, *Osteospermum moniliferum*, has spread extensively at Belair, and is causing concern in the National Park by overgrowing the native vegetation. Young plants come up so frequently round the bases of eucalypts that there is no doubt that birds are aiding its dispersal; the Starling is almost certainly responsible, though it has not yet been observed eating the fruits. Ridley says of this shrub that it "is interesting as being one of the few *Compositae* which have fleshy, eatable black fruits. . . . The achenes are almost black, and are eaten by natives and children. The genus consists of 50 species, all African. This one is the only shrubby one, and apparently the only one with eatable fruits; the rest of the species are herbs." The fruits as occurring in South Australia seem much drier than the above extract would suggest.

B. PLANT DISPERSAL BY WADERS AND OTHER BIRDS

Many Charadriidae nest in Siberia and visit Australia during our summer months (and the northern winter ones). At least fourteen species come down in considerable numbers and frequent fresh pools, swamps, rivers and lakes. One can only wonder if they have been responsible, over the ages, for the introduction into Australia of many species of plants.

Ridley goes into the question of the transmission of the seeds of plants, or even portions of growing plants on the feet, or even in the plumage of birds, particularly the Waders. Thus he says the marsh bird "brings the seeds of marsh plants to marshes only; aquatic birds bring those of water-plants to pools or rivers, and so on. They do not commonly stop on dry ground and so disperse the seeds they convey on soil useless to the plant. Naturally the birds which can convey seeds in this manner are birds which habitually run along the ground. . . . Seeds so conveyed must be small, such as the seeds of *Polygonum*, sedges, grasses, etc., and this method of dispersal probably accounts for the very wide distribution of some of the sedges, and especially such plants as *Polygonum hydropiper* and *P. minus*. These are two of the very few flowering plants common to Europe (England), the Malay Archipelago, and Australia. They are not weeds of cultivation brought by man, as they do not grow on cultivated land, but by the sides of streamlets. Ridley quotes from Kerner as having "examined the mud taken from the beaks, feet and feathers of swallows, snipe, wagtails, and jackdaws, which birds take very long flights . . . and found seeds of a considerable number of species embedded in it."

C. DISTRIBUTION BY VISCID PLANTS

Ridley, after mentioning *Loranthus*, refers to two genera of the family *Nyctaginaceae* with viscid fruits, both of which are represented in Australia. One is *Pisonia*, a maritime woody climber or tree, of which F. M. Bailey records three species in Queensland. The perianth tube is very viscid and there are many records of birds being rendered helpless by their feathers being stuck together by the sticky fruits. He quotes R. H. Govett in "A Bird-Killing Tree" *(Proc. Inst. New Zealand*, 1883, XVI, 364), for the record of a dozen *Zosterops* and a House Sparrow being caught by the glutinous pods of *Pisonia Brunoniana*, which also occurs in Queensland.

It can readily be understood how a bird, escaping with only an occasional fruit attached to its feathers, might be able to spread *Pisonia* even from island to island. The other genus is *Boerhaavia,* herbaceous plants with glandular processes on the fruits. *B. diffusa* is common in our Far North and is a weed in my garden; it has an edible tap-root and prostrate stems. I have not seen birds feeding on this plant, nor does it seem likely that they would come in contact with it.

D. OUR NATIVE BIRDS AS DISTRIBUTORS OF PLANTS

Emu and Cassowary:—North says that the fruits of the Quandong *(Eucarya acuminata),* the Sour Plum or Emu Apple *(Owenia acidula),* and the Prickly Pear form a large portion of the food of the Emu. It has been an extensive spreader of the latter pest. J. A. Boyd, quoted by North, mentions that in the Herbert River district in North-Eastern Queensland, when the Quandong is ripe, the dung of the Australian Cassowary is a mass of stones of this fruit.

Mallee-Fowl: — Robert Grant informed North that he had found the stones of Quandong and of *Owenia acidula* in the crops and stomachs of Mallee-Fowls in Western New South Wales.

Quail:—Ridley points out that quail are liable to be caught by birds of prey and in this way seeds in their crops may be liberated and so dispersal of plants may occur. He quotes M. M. Makai for the statement that *Synoicus australis,* the Australian Brown Quail, was introduced into New Zealand and that these birds were "most active agents in the spread of blackberries and gorse in Auckland." Thomson is his authority for the statement that *Coturnix pectoralis* (Stubble Quail) in New South Wales eats occasionally fruits of *Solanum nigrum* (a common weed with us in waste places) and of *Phytolacca decandra* (Ink Plant, not yet recorded for this State), the achenes of *Ranunculus* and the seeds of *Stellaria media* (Chickweed).

Pigeons:—We have no Fruit Pigeons in South Australia, but these birds in the subtropical brush forests of the Eastern States are doubtless responsible for the distribution of the seeds of various fruits, amongst them those of *Ficus rubiginosa,* which may begin its existence as an epiphyte as mentioned elsewhere. Ridley says that the Nutmeg Pigeons *(Ducula)* of the East Indies may feed on the aril of the nutmeg, which forms the soft aromatic crimson network called the mace round the black or dark brown nutmeg itself. He says that "it is probable that the birds sometimes swallow nutmeg and all, and, digesting the mace, pass the seed by evacuation, as it has long been stated that the Dutch in the eighteenth century attempted to keep the nutmeg in cultivation only in Banda and Amboina, so that they might have control of the market, but their efforts were defeated by the pigeons, who conveyed the seeds to other islands." Our Bronzewing Pigeons may frequently be disturbed feeding along hedges of *Acacia armata* (Kangaroo Bush), but I doubt whether they distribute this or other Acacias.

Waders:—These have already been dealt with under "Dispersal by Migratory Birds."

Australian Bustard (Native Turkey):—Mr. J. M. Black in his "Flora of South Australia" says that *Myoporum deserti,* which has a yellow drupe, is sometimes called "Turkey Bush" because this bird is fond of its fruits.

Ducks, Geese and Swans:—These, with their broad-webbed toes, are fitted for the transport of seeds of water- and swamp-plants from one lake or swamp to another, sometimes probably over considerable distances.

Birds of Prey:—The only role these birds are likely to play in the distribution of plants is that they may intercept birds such as pigeons and finches with crops full of seeds which are dispersed when the prey is torn in pieces.

The Mistletoe Bird:—South Australia has 12 species of *Loranthus* and of the allied *Phrygilanthus,* and one Jointed Mistletoe. From their parasitic habitat, seeds must be transferred from plant to plant by mammals or birds. The Mistletoe Bird is admittedly the most common spreader of their viscid fruits, but some maintain that possums also do so, and there are other birds which feed on the fruits. For instance, in *"The Emu,"* 50, p. 325, 1951, K. A. Hindword and A. R. McGill, in their account of the 1950 camp-out at "Derra Derra," near Bingara in New South Wales, state that the Painted Honeyeater *(Grantiella picta)* and the Spiny-

Cheeked Honeyeater *(Acanthagenys rufogularis)* were feeding on mistletoe berries. The Mistletoe Bird *(Dicaeum)* has not been recorded from Kangaroo Island, and for long it was thought that no mistletoe grew there. In the last few years, however, *L. micraculosis* var. *Melaleucae*, which parasitizes various *Melaleuca*, has been found on that island; this species is also common on tea-tree along the Coorong.

Mrs. Coleman, in her interesting "Further Notes on the Mistletoe" *(Vic. Nat.*, 66, Feb., 1950, p. 191), describes having seen Mistletoe Birds voiding the viscid seeds and drawing the left foot swiftly backwards twice or thrice, as if to wipe off the seeds as they were voided —quite unnecessarily in this instance, because they had dropped on to a branch. Another bird "defaecated, flung a foot backwards and apparently caught the dropping on its leg. It then picked it off the leg and wiped it on a bough." Mrs. Coleman was surprised at the small amount of nourishment that the bird could obtain from each fruit if the seed passed contained so much viscin. Birds feeding on mistletoe berries must also frequently get the sticky fruits on the outside of the bill and adjacent parts, and get rid of these by wiping the fruits off on a branch. Mistletoe berries noted by Mrs. Coleman as being found on a telephone line must obviously have got there by this latter method, and not by being passed by the bowel.

The Mistletoe Bird has been found feeding on apples and the berries of *Coprosma*, as well as the fruits of *Loranthus*.

E. INTRODUCED BIRDS

Ridley says that the Starling is a voracious fruit-eater in America and that it "seems to adapt itself readily to any baccate or drupaceous fruits in any country it happens to be introduced to." He quotes authorities for its feeding on strawberries, raspberries, elderberries, tomatoes, mulberries and the fruits of hawthorn, and of species of *Rosa* and *Prunus*, and the seeds of *Melilotus alba* (white melilot) and of white trefoil. With us it certainly feeds on olives, figs, blackberries, and even apples, and is probably responsible for the spread of hawthorn and its relative, *Crataegus azolus*, and of *Osteospermum;* it has also been seen eating kurrajong seeds.

Ridley says the Goldfinch is a well-known feeder on the achenes of thistles, groundsel, *Taraxacum* (English Dandelion) and other *Compositae*, and that it is "accredited with destroying large quantities of the seeds of these plants which are so objectionable to agriculturists." However, he quotes Thomson for stating that in New Zealand it spreads two species of *Centaurea*, and W. W. Smith that it disperses *Onopordon acanthium*, Scotch Thistle, which is not common in South Australia. I have disturbed Goldfinches feeding on *Centaurea calcitrapa*, Star Thistle, in May, and on *Cynara cardunculus*, Wild Artichoke. He also mentions that Meyer found the remains of at least 100 Goldfinches in a small area near the Thames, the birds having been torn to pieces by a hawk—intact achenes set free from the carcases might be expected to grow.

Ridley refers to the House Sparrow as eating small dry seeds such as those of *Amaranthus, Plantago*, chickweed, goosefoot, shepherd's purse, *Polygonum*, groundsel, etc., and mentions that Collinge found that some of these were passed in a germinable state. It may distribute plants, Ridley points out, by dropping building material for its nests which may contain seeds. The Sparrow, in my opinion, has decreased greatly in numbers round Adelaide in the last sixty years.

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