FALCO ELEONORAE

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INTRODUCTION

Eleonora's Falcon *Falco eleonorae* is a bird about which less is known and more confusion has prevailed than almost any other European species. The explanation no doubt lies in its comparative rarity, the inaccessibility of its breeding stations, and its very late breeding season. The aim of this paper is to summarize knowledge of this species by bringing together the fragmentary data in the literature and incorporating my own notes based on visits over the last six years to eleven breeding colonies in different parts of the bird's range.

Eleonora's Falcon was discovered on the islet of Toro off Sardinia in 1836 by Alberto della Marmora and described by Gené in 1839. It was named, rather fancifully, after the last independent native ruler of medieval Sardinia, Eleonora, *giudice* of Arborea, who died in 1403 leaving to posterity a code of laws which included regulations for the protection of falcons. In the thirty years after della Marmora's discovery the existence of a dark phase in Eleonora's Falcon led to its confusion with the closely related Sooty Falcon *Falco concolor* of the Red Sea and east African coast (e.g. v. Warthausen 1860, Verreaux & des Murs 1862), and this confusion was increased by Erhard's (1858) description of a bird he found breeding in the Aegean, and which was clearly *F. eleonorae*, as a new species *Falco dichrous*, and by Lindermayer's (1860) inclusion of three separate falcons in his list of Greek birds, *F. arcadius*, *dichrous* and *eleonorae*. This tangle was resolved by Krueper in 1862, who insisted that Erhard's *F. dichrous* was Gené's *F. eleonorae*, and that *F. concolor* was not a European species. He followed this up, in 1864, with a detailed account of the breeding and habits of the genuine Eleonora's Falcon—the result of a prolonged stay on Naxos—which has remained the most important single contribution to our knowledge of this species. It was another 35 years before Heinroth's (1899) description of Eleonora's Falcon's plumage added to this appreciably, though scattered contributions, throwing light particularly on the breeding distribution, had appeared in ' Ibis ' and elsewhere in the intervening years (e.g. Sclater 1868, Saunders 1871, Lilford 1889). In this century notable advances have been made by Reiser (1905) and von Wettstein (1938) in the Aegean, by Munn (1931–2) in Majorca, by various German ornithologists in Crete during and after the war (Niethammer 1942, Stresemann 1943, Sielmann and Stresemann 1956, Makatsch 1958), and by the members of the Cyprus Ornithological Society (the Annual Reports of which are hereafter cited as C.O.S.); while in 1954 Stresemann settled the question of the migration of Eleonora's Falcon.

A number of local names for Eleonora's Falcon have been recorded, though some are probably no longer widely used: from the Canaries, *aleta* (v. Thanner 1913); from the Balearics, *esparver* (Saunders 1871), *falco* (Munn 1931–2), and *tortés* (Moreau & Moreau 1954); from Sardinia, *stori* and *zerpedderi* (Giglioli 1907); and from the Aegean, *βαρβάχι* (Krueper 1864).

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CHARACTERS

In flight, Eleonora's Falcon may be distinguished from the Peregrine Falcon *F. peregrinus* by its more slender body and longer tail (about 2 in. longer). It glides on characteristically bent wings, and often remains motionless for a moment with tail fanned out like a Kestrel. Munn (1931–2) watched it in Majorca circling high up with outspread wings and tail. It is more leisurely on the wing than the Peregrine and Hobby *F. subbuteo*, giving an impression of elegance and agility rather than power and speed. When perched, its wing-tips lie exactly level with the end of the tail. Dark-phase individuals are unmistakable in the field, since they are wholly dark-brown or sooty black—much darker than the uniform grey male Sooty Falcon. Typical light-phase birds have a similar plumage pattern to the Hobby but are darker underneath owing to the more heavily streaked breast and the rufous tinge of breast and belly; indeed from a distance they often look wholly dark except for the white chin and cheek. A few light-phase birds are a good deal lighter underneath and more closely resemble the Hobby. The juvenile light-phase bird is like a juvenile Hobby but the dark-streaked under-parts are rufous rather than buff.

The length of the adult is 15–16 in., and the difference in size between the sexes is small. The minimum and maximum published measurements of the male's wing are 300 and 335 mm., and those of the female's 310 and 366 mm. (Heinroth 1899, Reiser 1905, Hartert 1912–21, Arrigoni degli Oddi 1929, Niethammer 1942); while the average wing-lengths given by Heinroth (1899, 36 specimens) are 316 mm. for males and 324 mm. for females, and by Reiser (1905, 44 specimens), 315 mm. for males and 327 mm. for females. This difference of about a centimetre in wing-length does not serve to distinguish the sexes in the field, but at very close range the female's more powerful build, especially about the head and bill, is apparent.

Some ornithologists have attributed the two phases in Eleonora's Falcon, which are an obvious case of dimorphism, to differences of age (e.g. v. Wettstein 1938), although evidence to the contrary was provided by a light-phase bird which retained its characters during the 6½ years it was kept in captivity by Gurney (1867). Others have attributed these phases to differences in sex (e.g. Swann 1922), though there is ample proof to the contrary from sexed specimens. Published estimates of the proportion of dark to light birds are, with a single exception, of little value. An accurate count of these birds, as they wheel and swoop in the air, is exceedingly difficult to make, especially as the two phases are not always easy to distinguish at once in the field. One can therefore attach little credence to the estimates—which appear to have been made in this way or even less critically—of 20% and 30% dark from Crete (Stresemann 1943, Sielmann & Stresemann 1956), nor to those from the Balearics of c. 13% and 20% (Hobson 1955, v. Jordans 1927–8). On the other hand, attempts to establish the proportion from museum specimens are bound to reflect the collector's bias towards the rarer form. Thus the proportion of dark birds to light calculated from 26 specimens examined by Heinroth (1899) is 42%, while Reiser's (1905) 33 specimens yield a figure of 39%—both of them much too high.

Accurate counts of perched and/or sitting birds are now available from each end of the bird's range, Cyprus and Mogador. In Cyprus, 8 out of 32 birds at one colony were dark (C.O.S. 1957–8). At Mogador seven random counts of ten birds gave an average of 1 in 5 dark; while three different total counts of all birds the phase of which we could identify on a cliff slope where 74 pairs were nesting gave 1 in 4 dark (11/40, 12/45,

7/33). In the colony as a whole the phases of 25 pairs were established, giving the proportion 14 in 50 dark. The average figure from these total counts, which is 26%, is virtually the same as the Cyprus figure of 1 in 4 dark. At Mogador there were three or four intermediate birds out of a total of some 200. The evidence does not suffice to say whether the proportion of the two phases differs between the sexes, or not. The dark-phase birds are normally identifiable before fledging, and Stresemann (1943) was in one case able to establish that a mixed pair had two light and one dark young.

Apart from the very few genuinely intermediate birds, the presence or absence of white or cream on the chin and cheek classifies all birds as either light or dark-phase. Much has been said about the variation of the plumage of each phase (Krueper 1864 made 4 distinct types of plumage; Heinroth 1899 made 3). Some of this—for instance the different shades of brown-black to slate of the light-phase bird's upper-parts—is probably due to the condition of the plumage, and some—the leg-colour ranging from very pale yellow to bright yellow—to age. At Mogador in 1959 we were able to watch a large number of individuals at close quarters, and the most important variations were as follows :

Dark phase. A few birds were more or less coal-black all over. Most were dark brown. In these latter there was normally no moustachial stripe and no trace of rufous on the thighs, under tail-coverts and belly. The feathers of the breast were often edged with lighter brown, so that the dark streaks, so apparent in the light-phase bird, were discernible. Some individuals had lighter feathers in the back and wings. In a few birds some rufous occurs on the lower belly, thighs and under tail-coverts, and the moustachial stripe may be faintly adumbrated.

Light phase. The upper-parts varied from the brown-black of the dark phase to slate. The chief variation of the under-parts was in the size of the dark markings and the extent of the rufous. In some birds the white/cream was limited to the chin and cheek, there being a sharp demarcation-line across the lower throat between this and the rufous, streaked breast. In others, the rufous began gradually and the breast was less heavily streaked dark. In some birds the streaks on the lower throat and upper breast were fine and narrow, in others broad, but in all individuals the lower breast was broadly streaked.

Soft parts. The colour of the legs and feet varied from very pale yellow to bright yellow. The cere and skin round the eye were either whitish or tinged lemon, never bright yellow. The bill was whitish-blue at the base, darkening towards the black or nearly black tip.

GENERAL HABITS

Breeding does not begin until late July, but birds are normally present at the breeding colonies, especially in the evenings, from late April onwards, and have been recorded roosting at them in May (Watson pers. com.). Here they may be seen swooping at each other, gliding, and diving at great speed with closed or half-closed wings from a height of 100 feet or more almost down to the sea (Murphy 1926, Walker pers. com.). Two observers record a noise similar to that of a Snipe *Capella gallinago* drumming during or at the end of these dives (Krueper 1864, Walker pers. com.). In early summer the bird ranges widely and may be found, for instance, all over the large islands of Cyprus (C.O.S. 1957–8) and Crete, which have coastal breeding colonies. At this time of year large gatherings occur in favoured localities, apparently representing the breeding populations of quite extensive areas. Von Wettstein (1938) watched such a gathering on 20 May on Anaphi in the Aegean, which consisted of some 80 birds flying about and hawking for insects near the summit of the island, and Munn (1931–2) describes how the birds used to gather over the pine-woods round the Albufera, near Alcudia,

Majorca, in late May and June, prior to their dispersal to the breeding islets in July (see also v. Jordans 1927–8), after which he saw them only occasionally.

From mid-July onwards Eleonora's Falcons usually hunt within eight or ten miles of the breeding colony over open country, scrub, trees, and the sea. Marshes and lagoons are favourite spots, and those near the breeding colonies, like the Akrotiri salt-lake in Cyprus, are frequented throughout the summer (Walker pers. com.). Eleonora's Falcon hunts either singly or in groups and a hatch of insects sometimes attracts quite large numbers. Thus Munn (1925) once saw it in numbers feeding on *Anomala devota*, " a small beetle which was issuing forth out of the sandy soil ", and Walker (pers. com.) describes from Cyprus impressive gatherings of Eleonora's Falcons feeding on flying ants $\frac{3}{4}$ inch long which sometimes occurred in swarms at dusk. These were caught about 100 feet up in the birds' talons and then transferred to their beaks. I have seen small birds closely pursued and stooped at repeatedly from short range, both low over the sea and higher up, but have never actually seen a kill. Not all prey is taken on the wing: in Cyprus a bird was once seen to take a Kentish Plover *Charadrius alexandrinus* off the ground (C.O.S. 1958–9).

Although Eleonora's Falcon has been seen hunting at all times of the day, it is markedly crepuscular, as mentioned in many of the published records (see especially Krueper 1864, Polatzek 1908, Munn 1931–2, C.O.S. 1957–8). During the breeding season a general exodus of birds from the breeding colonies takes place at or shortly before dusk. At Kapsali, on the main island of Kithira, opposite a breeding islet five miles offshore, my wife and I used to see Eleonora's Falcons coming in each evening over the land, but we never saw them during the day; and at Andraitx, Majorca, Preston (1956–7) often saw them over the town at dusk—doubtless from the colony at Dragonera some six or seven miles away on the coast. In 1959 Carruthers and I watched this phenomenon at Mogador from the breeding islet itself, and birds were seen to leave the colony for the mainland in a continuous stream from shortly before dusk onwards. Even more striking evidence of the concentration of feeding at or near dusk (and perhaps dawn) at Mogador in August was the fact that we never saw a bird make a kill nor even a bird carrying prey during a fortnight's stay on the breeding islands. On one occasion two Swifts *Apus apus* and two Nightingales *Luscinia megarhynchos* were brought to one nest between 6.30 p.m. and 8.0 a.m.

When breeding, Eleonora's Falcon is not particularly shy. If a breeding colony is approached birds leave their perches and circle over the intruder, calling excitedly, but those incubating often allow approach to within 10 or 20 yards. Once they have left their nests, agitated wheeling and calling continues until the intruder has left the area. An incubating bird at Mogador allowed us to approach repeatedly to within 5 yards or less, and another, with chicks, stood by them while she was photographed without a hide from a range of just over 3 yards (Plate 2). None of the birds we photographed showed any apprehension of the hide, normally returning to its nest within a few minutes of the withdrawal of the photographer's assistant.

Eleonora's Falcon perches on cliffs, rocks, walls, trees (Dixon 1882, v. Jordans 1924, Munn 1931–2, Archer 1937) and even flat ground (Walker pers. com., the bed of a dry salt-lake).

The usual call of Eleonora's Falcon, reminiscent of a Kestrel's but harsher and more strident, is a repeated " kee kee kee " or, as Makatsch (1958) puts it, perhaps rather better, in German, " kjä kjä kjä ". Often the second and third notes are much stressed. This call varies, and a subdued, deeper version of it is heard from the nest. Other calls made at or near the nest are a (usually) repeated, drawn-out " kweek kweek kweek " which is quite different from the normal call since each note is much prolonged, and a subdued rapidly repeated " ker ker ker " associated with feeding at the nest. The food call of the young is similar to this latter.

FOOD

Insects predominate in the spring and early summer and birds in the breeding-season. Thus, of 26 dated stomach-contents recorded in the literature for the months of May to July inclusive only 5 contained bird remains (Brooke 1873, Lilford 1875, Giglioli 1889, Murphy 1926, Munn 1931–2, Moltoni 1937, v. Wettstein 1938); while of the 9 recorded from August to October, 7 contained bird remains (Lynes 1912, Moltoni 1937, Meinertzhagen 1940, Stresemann 1943). The young falcons are fed almost entirely on small birds, and a very high proportion of these are migrants. Out of c. 250 birds or parts of birds which we examined at Mogador in late August 1959 and which had been left lying near the falcons' nests, only about 5 were probably not migrating at the time; and all the 38 birds whose remains were collected by Cott in similar circumstances on the Roque del Este in the Canaries were migrants (Bannerman 1931). When the young are in the nests far more prey is killed than is actually needed. Lynes (1912), when he visited an islet off Lemnos inhabited by about 12 pairs of Eleonora's Falcons, in late August 1907, found that it " abounded with the remains of freshly-killed birds, chiefly Wrynecks and Hoopoes "; and Cott's islet was in the same state in September 1931. At Mogador in 1959 untouched carcases or portions of them were rare at first but became increasingly abundant after the chicks had hatched. They were found at first lying haphazardly near the nests, but it soon became apparent that regular " larders " were being established, either in niches in the rocks or in low bushes, within a yard or two of the nests, and some of these " larders ", by the time we left on 27 August, contained up to 15 or 20 birds or parts of birds, placed usually with the head inwards and the tail feathers protruding. Many of them were complete carcases, unplucked; others were headless, or lacked primaries and secondaries; others again consisted of the lower part of the back, legs and tail only. Other carcases, mostly complete or with only the wing-feathers removed, were to be found about the island, up to 20 yards from the nearest nest, neatly placed in some niche or hollow in the rocks.

Most pellets consist in the main of either bird or insect remains, but a few are mixed. They vary in length from 25 to 50 mm., and in breadth from 10 to 15 mm. Those consisting chiefly of bird remains are about 10 to 15 mm. longer than insect pellets, since they have a tapering end or " tail " of about that length. They are grey, while the insect pellets are predominantly light brown, with, of course, a different texture. Pellets are not normally found in the nests.

There are few records of Eleonora's Falcon taking anything other than insects and birds, but Moltoni (1937) found the remains of a bat in one stomach, and Lynes (1912) mammal fur in two pellets. Krueper (1864) records remains of lizards from Eleonora's Falcons' nests, and Uttendörfer (1948) the remains of centipedes in two pellets.

Among insects, dragonflies, grasshoppers and beetles seem to be especially favoured by Eleonora's Falcon. Both ants and wasps (Hymenoptera) are taken on occasions (Walker pers. com., Stresemann 1943). Of the Coleoptera, Carabidae, Buprestidae, Curculionidae and Tenebrionidae have been identified among stomach-contents (v. Wettstein 1938, Palau-Camps 1956–7), and Eleonora's Falcons have been watched feeding on *Anomala devota* (Munn 1925). Odonata and Orthoptera have been recorded several times, and two of the latter have been identified specifically: the Moroccan Locust *Stauronotus maroccanus* and a grasshopper *Poecilimon cretensis* (Moltoni 1937, Uttendörfer 1948). Finally, remains of Heteroptera and Lepidoptera were found in one stomach (Palau-Camps 1956–7), and Munn (1931–2) on one occasion in Majorca watched several Eleonora's Falcons feeding on cicadas (Hemiptera) among the pines.

The following 41 species of birds have been reliably recorded among Eleonora's Falcon's prey (those marked with an asterisk only once): Little Crake* *Porzana parva*, Kentish Plover* *Charadrius alexandrinus*, Green Sandpiper* *Tringa ochropus*, Common Sandpiper* *Tringa hypoleucos*, stint sp.* *Calidris*, Black Tern* *Chlidonias niger*, Turtle

Dove *Streptopelia turtur*, Cuckoo* *Cuculus canorus*, Scops Owl* *Otus scops*, Swift *Apus apus*, Alpine Swift* *Apus melba*, White-rumped Swift *Apus affinis*, Bee-eater* *Merops apiaster*, Roller* *Coracias garrulus*, Hoopoe *Upupa epops*, Wryneck *Jynx torquilla*, Short-toed Lark* *Calandrella brachydactyla*, Golden Oriole *Oriolus oriolus*, Blackbird* *Turdus merula*, Black Rock Thrush *Monticola solitarius*, Wheatear *Oenanthe oenanthe*, Winchat *Saxicola rubetra*, Redstart *Phoenicurus phoenicurus*, Nightingale *Luscinia megarhynchos*, Grasshopper Warbler *Locustella naevia*, Aquatic Warbler* *Acrocephalus paludicola*, Melodious Warbler *Hippolais polyglotta*, Whitethroat *Sylvia communis*, Spectacled Warbler* *Sylvia conspicillata*, Rufous Warbler *Agrobates galactotes*, Willow Wren *Phylloscopus trochilus*, Chiffchaff *Phylloscopus collybita*, Spotted Flycatcher *Muscicapa striata*, Pied Flycatcher *Muscicapa hypoleuca*, Collared Flycatcher* *Muscicapa albicollis*, Tawny Pipit* *Anthus campestris*, Bertholet's Pipit* *Anthus bertholeti*, Lesser Grey Shrike* *Lanius minor*, Woodchat *Lanius senator*, Red-backed Shrike *Lanius collurio*, Ortolan Bunting* *Emberiza hortulana*.

Eleonora's Falcon has been seen pursuing Rock Doves *Columba livia* (Laferrère 1960, Walker pers. com.), but the remains of this species, as well as those of Domestic Pigeons and Quails *Coturnix coturnix*, which have been found near Eleonora's Falcons' nests (Krueper 1864, Hobson 1955, Laferrère 1960), might have been due to Peregrine Falcons, which are commonly present on the same islets and cliffs. Because they contain doubtful evidence of this sort, I have not included in the above list the lists of prey published by Contant & de Naurois (1958), Makatsch (1958) and Laferrère (1960). Contant implies that the falcons on Mogador Island frequently took Rock Doves and Barbary Partridges *Alectoris barbara*, which I find incredible, especially as the latter do not occur on the island and would have had to have been carried over a mile or more from the mainland. Makatsch's list attracts equal suspicion through its inclusion of Domestic Pigeon, Barn Owl *Tyto alba* and Rock Partridge *Alectoris graeca* from an island off Crete where the two latter species, as well as Peregrines, are present. Laferrère (1960) states that remains of *Alectoris barbara*, *Galerida*, *Passer* and *Carduelis carduelis* were found on the breeding islets of Eleonora's Falcon off Philippeville, but gives no evidence that they were killed by the falcons. That Eleonora's Falcon normally preys only on small birds up to the size of the Hoopoe is borne out by the absence of any larger species among 250 prey remains we examined on Mogador Island in 1959.

What species are most commonly taken by Eleonora's Falcon varies a great deal at different times and places. Thus in September on an islet off Lanzerote in the Canaries Cott collected 38 bird remains, among which there were 20 Whitethroats, but not more than four of any other species (Bannerman 1931). On Mogador Island in August out of some 250 prey remains, there were 75 Woodchats, 54 Swifts, 29 Whitethroats, 25 Nightingales, 15 *Phylloscopus* sp., and less than 10 each of the other species identified (Hoopoe, Redstart, Rufous Warbler, Melodious Warbler, Grasshopper Warbler, Pied Flycatcher and White-rumped Swift). On the other hand, in the eastern Mediterranean Hoopoes are taken much more freely, for Uttendörfer (1948) found 8 Hoopoes among 34 individual birds identified from pellets collected off Crete, while no other species was represented by more than 2 individuals. No doubt the route taken by autumn migrants is important here, and might explain, for instance, why the Golden Oriole and Red-backed Shrike have been recorded as killed in numbers by Eleonora's Falcons in the eastern Mediterranean, and never on the northwest coast of Africa, while the Nightingale, Grasshopper Warbler and Pied Flycatcher are taken in the latter area but have never been found among Eleonora's Falcon's prey in the former.

BREEDING

Eleonora's Falcon is a gregarious breeder, and there are no records of solitary pairs, though several Aegean colonies have only two pairs. The colonies usually number

from 5 to 20 pairs, but some have up to 100 or more. The majority are situated on uninhabited islets off the coasts of larger islands, but a few are on the steep cliffs of inhabited islands (Cyprus, Andros, Antikithira) and one has been reported on the cliffs of the African mainland (Hartert & Jourdain 1923). Those on islets may be quite dense: at Mogador some 80 pairs breed on a 7–8 acre islet just off the northern tip of the main island, and many of the nests are only a few yards apart.

Nest sites. The eggs are always laid within about 30 yards of the sea, and usually on or near a cliff. The commonest sites are open cliff ledges, holes and caverns in cliffs (in which the eggs are often tucked away several yards back in a dark and narrow crevice) and slopes or flat ground above cliffs. On the latter the eggs may be partly or entirely under a projecting rock or boulder, sheltered by a low bush, or even quite out in the open (Plate 1). They are sometimes laid in old nests: Lynes (1912) found a clutch at Lemnos in an old Cormorant's nest, and one at Mogador in 1959 was in what had probably been a Raven's nest. Krueper (1864) found several nests in more or less flat areas on small islets off Naxos, but such situations have not been recorded elsewhere, and on two of his islets which my wife and I visited in 1958 the birds no longer breed.

The distribution of nest-sites at one large colony was as follows:—(*a*) open cliff ledges, 36; (*b*) under large rocks on a steep sandy slope above the cliffs, 18; (*c*) on ledges or in cavities within a yard or two of the cliff top, 14; (*d*) in the open or partly under low bushes above the cliffs, 9; (*e*) in vertical pot-holes about 18 inches deep in large rocks about 20 feet above high water, 7; total: 84. Here there was some evidence that the sheltered sites were more favourable than those in the open, for 68% of the eggs under observation in the part of the colony where most of the nests were in sites of type (*b*) had hatched by 26 August, whereas only 44% of those in another part of the colony, where the nests were mostly in sites of type (*c*) and (*d*), had hatched by 27 August. The nests in type (*b*) sites were very much better protected from the persistent northeast wind at this colony.

No nest is made, the eggs being laid in a slight depression in sand or rock debris.

Clutch-size. I have traced records of 40 clutches from the Mediterranean, and of these, exactly half were of three eggs and half of two, giving an average clutch-size of 2·5 (Krueper 1864, Farquhar 1902, Reiser 1905, Lynes 1912, Stresemann 1943, C– – 1946, Makatsch 1958, C.O.S. 1958–9, Laferrère 1960). I can find no records of clutches of four from the Mediterranean, but these are quite common at Mogador. Thus in 1958 Contant (Contant & de Naurois 1958) had 2 clutches of four among 21 clutches taken, and Carruthers and I in the following year saw 10 clutches of four out of 59 examined. The average clutch-size at Mogador, calculated from these 80 clutches, is 2·9. Clutches of three are much more common than those of two (of our 59 clutches, 39 were of three and only 7 of two), and genuine clutches of one seem to occur, for we found three birds incubating single eggs, two of which hatched, and no evidence to suggest that they had lost eggs.

The larger average clutch-size and the clutches of four in the Mogador colony may be correlated with its larger size and density, for those in the Mediterranean from which clutch-sizes have been recorded were all very much smaller. The Mogador colony consists of a nucleus of birds on one small islet and some scattered outlying groups, and it may perhaps be significant that, while the average clutch-size of the nests in the nucleus was 3 (45 nests with 136 eggs), that of the outliers we could examine was only 2·7 (10 nests with 27 eggs). On the other hand there could be a geographical variation, since, at the other end of the bird's range, in Crete, Makatsch's 6 nests in 1958 all had clutches of two (cf. C.O.S. 1958–9: 2 clutches of three and 4 of two). The average clutch-size may, of course, vary from year to year. A freak clutch of seven has been recorded (Giglioli 1907).

Eggs. The eggs vary, like those of other falcons, both in general colour and in the degree of blotching. The ground varies from pinkish-white to pale brown, and the spots and blotches from pinkish-brown to pale sepia. Krueper (1864) records a completely white egg. Hartert (1912–21) gives the average of 91 eggs as 42·22 × 33·27 mm., with maxima of 46·6 × 34·1 and 45 × 35·5, and minima of 38·4 × 31·8 and 46·5 × 29·4 mm.

Incubation and fledging. Eleonora's Falcon breeds later in the year than any other European bird, eggs being laid from 15–20 July onwards into early August. There is no evidence that it ever lays much earlier than this.

At Mogador in 1959, of 7 clutches of three eggs, 2 took two days to hatch, 2 took three days, 2 took four days, and one took five or more days. There were several cases of two eggs hatching within 24 hours. It seems, therefore, that incubation starts with the first or second egg, and that these are laid at intervals of a day or more. In Crete Makatsch (1958) took 6 clutches of two eggs and found in each case that one egg was more incubated than the other, indicating that incubation began with the first egg.

At Mogador the female normally incubated, being called off the nest by the male to be fed, and Makatsch (1958) found the same in Crete. In only one case that I know of has the incubation period been accurately established (C.O.S. 1957-8): a clutch of three was completed on 29 July, and the first chick hatched on 25 August, giving a period of 28 days. The young from this nest flew on 5 October—a fledging period of 35–40 days. At Mogador in 1959 the first chick hatched on 14 or 15 August; about five hatched on each of the succeeding days; and by the time we left on 27 August just over half the 155 eggs under observation had hatched. The young must have flown between about 20 September and mid-October. At Akrotiri, Cyprus, in 1958, the first (2) chicks hatched on 22 August (C.O.S. 1958–9). Polatzek's record (1908) from the Canaries of a fledged young on 7 September is hard to credit. In Cyprus in 1957 " fledging was general " in mid-October (C.O.S. 1957–8), but in Crete in 1944 Stresemann (1954, Sielmann & Stresemann 1956) reports that most, if not all, the young had flown by 7 October. The latest record I find is of a bird " just fledged " on 22 October (Reiser 1905).

At Mogador, during the first ten days after hatching, food was brought to the vicinity of the nest by the male, and was then transferred from him to the chicks by the female, who was called off the nest for this purpose. Even when the chicks were nearly ready to fly, at the end of September off Crete, Sielmann found that the female remained near the nest, and that food was brought by the male to a neighbouring perch, whence she took it to the young (Sielmann & Stresemann 1956). On the other hand, at the same colony, my wife and I watched both birds going to a nest with young on 1 and 2 September 1958, though we could not be sure that they both brought prey.

At Mogador in 1959 Carruthers and I had 20 nests, containing 63 eggs, under observation until some days after the completion of hatching. Of these 63 eggs, 6 were either addled or found to contain dead chicks. Out of the 57 chicks which hatched from these eggs 5 were found dead near or in the nests when several days old, and 7 more were taken by Arabs for food. Elsewhere a much higher proportion of addled eggs has been recorded, for Lynes (1912) found 6 eggs addled out of 22.

BREEDING DISTRIBUTION AND NUMBERS

The breeding range of Eleonora's Falcon extends for some 3,000 miles from Lanzerote, in the eastern Canaries, to Cyprus. All the known Mediterranean colonies lie between 34° and 40° north. Although our knowledge is incomplete, it is clear that Eleonora's Falcon is by no means evenly distributed wherever suitable habitats occur within these limits, and many of the breeding colonies must contain extremely isolated populations. A distance of 800 miles separates the Mogador colony from the nearest to the northeast,

in the Balearics; and the small colony in Lampione is separated by at least 150 miles on one side and some 650 on the other, from the nearest colonies. The colonies fall into five groups: (*a*) Northwest Africa; (*b*) Western Mediterranean; (*c*) Central Mediterranean; (*d*) Eastern Mediterranean, (i) Aegean and Crete, (ii) Cyprus.

(*a*) *Northwest Africa: the Eastern Canaries and Mogador.*

So far as I know, the only breeding colony in the Canaries ever visited by an ornithologist is the Roque del Este, an islet some eight miles northeast of the northern tip of Lanzerote, where Cott found a colony of about ten pairs in September 1931 (Bannerman 1931, Cott 1956 : 319). Polatzek (1908) frequently saw up to 14 birds together in October 1904 in the valley of Tabayesco, Lanzerote, and he noticed that they came from the steep cliff which forms the extreme northeast point of the island. In 1913 von Thanner was told by fishermen that Eleonora's Falcon bred on the islands of Alegranza, Montaña Clara and, more numerously, on Roque del Este, all of them off the northeast end of Lanzerote, but neither he nor Bannerman (1914) saw them there in the early summer. Bannerman (1919) states that Eleonora's Falcon breeds on Fuerteventura and Lanzerote, and quotes Polatzek as recording many in August at La Oliva, Fuerteventura and Haria, Lanzerote. In 1957 a Cambridge zoological expedition was on Fuerteventura from 6 August to 13 September and, in spite of a careful look-out for birds, and visits to several suitable localities, including La Oliva and the islet of Lobos, saw no sign of Eleonora's Falcons, though a boy told them that a bird which " swoops on little birds and bites their heads off " nested on the cliffs at Gran Tarajal on the southeast coast (Hooker 1958). It seems, then, that Eleonora's Falcon, at any rate now, is a rare bird in the Canaries: there may be two or three small colonies off the northeast tip of Lanzerote, and possibly another on Fuerteventura. There are no records at all from the other islands. On present knowledge a total of 50 pairs is probably a generous estimate.

The colony on Mogador Island, less than a mile off the town, was visited in 1868 by Captain T. Waite (Sclater 1868), and Meinertzhagen (1940), in late October 1939, saw about 50 birds there, mostly fledged young. In 1959 Carruthers and I were able to make a detailed count and arrived at a total of 100 pairs $\pm$ 10. Hartert & Jourdain (1923) state that Eleonora's Falcon breeds " in numbers " on the mainland cliffs between Mogador and Agadir some 70 miles to the south. There seems no reason to doubt this and, on the analogy of other colonies on mainland or main island cliffs, this would be a large one, perhaps about the same size as that of Mogador.

There are thus probably about 250 pairs of Eleonora's Falcons breeding in the whole of this region.

(*b*) *Western Mediterranean: Balearics and Columbretes.*

Here there is a group of several small colonies extending over an area not more than 180 miles across. One of the largest is roughly in the centre of the area, on the island of Dragonera, off the westerly point of Majorca where, in May 1970, Saunders (1871) found Eleonora's Falcons " in great abundance " and Murphy (1926), in July, saw at least 20 birds in the air together. Recently Preston (1956–7) reported an " amazing number ", and v. Westernhagen (1958) saw 40 birds there in May. In July 1954 I saw no birds at all on or near Dragonera, and I cannot believe that this is a very large colony: perhaps 20 to 25 pairs. Elsewhere in Majorca Eleonora's Falcons have been seen frequently at Soller (Tato Cumming 1956–7, v. Westernhagen 1958), indicating a colony about half way along the north coast, and a few pairs have been seen in July on the cliffs between the bays of Alcudia and Pollensa (Murphy 1926). Ibiza has a colony at each end (Ticehurst & Whistler 1930, Moreau & Moreau 1954), the sizes of which I estimated in July 1954 as 8 and 20–25 pairs, but which Professor Hobson reckoned in the following year as 30–40 and *c.* 20 respectively (pers. com.). He also stated that Eleonora's Falcon breeds on Formentera, south of Ibiza. Nothing is

known from Minorca, but there is certainly a small colony on the Columbretes (Murphy 1926 saw birds there in July), about which I was told by a former lighthouse-keeper there.

The probable breeding population of this area may be set out as follows: Majorca, 25+25+10; Ibiza, 25+25; Formentera and Columbretes, 10 each; giving a total of about 130 pairs.

(*c*) *Central Mediterranean: Sardinia, Algeria, Tunisia, Lampione.*

It is reasonably certain that Eleonora's Falcon does not breed in Sicily (Krampitz 1956 does not mention it) or Corsica. In Sardinia I explored nearly all the likely breeding places in 1953, and can confirm Bezzel's belief (1957) that the islets of Toro and Vacca off the southwest corner are the only breeding-stations there. About 1870 Brooke (1873) reported 20–25 pairs from Vacca, but Lilford, in late May 1874, thought there were 60–80 pairs there, and a further 300 pairs on Toro. Later visitors have not confirmed his estimates, for in August 1894 only two nests were found and three birds seen flying together on Vacca (C– - 1946); in 1901 and 1907 Arrigoni degli Oddi (1929) saw no birds on Vacca and only a few on Toro; and in 1911 Bonomi could only report a few pairs on each island. In July 1953 I found at most 7 pairs on Vacca but was unable to visit Toro. These two islands together probably hold less than 50 pairs of falcons.

In Algeria only one breeding colony has been recorded, of about 25–50 pairs, on some islets near Philippeville (Laferrère 1960). This colony was only discovered in 1959, and there may well be others along the Algerian coast.

The status of Eleonora's Falcon in Tunisia is uncertain, but Gouttenoire (1955) reports breeding colonies from the islands of Galita and possibly Zembra off the north coast, and also from the Djebel Achkel. This is an isolated mountain some 15 miles southwest of Bizerta on the south shore of Lake Achkel which, if breeding of Eleonora's Falcon there were confirmed, would be a unique inland site. The only other colony reported in this area is on the islet of Lampione west of Lampedusa, where Giglioli (1907) in 1882 found about 12 pairs breeding.

A total of about 150 pairs for the Central Mediterranean is probably on the generous side.

(*d*) *Eastern Mediterranean.*

(i) In the *Aegean and Crete* almost half the world population of Eleanora's Falcon breeds, and there are more colonies, though many are small, than in the whole of the rest of its range. These colonies fall into three groups: Lemnos and the Northern Sporades; the Cyclades; Crete and Kithira.

In the north Lemnos had a colony of about 12 pairs in 1907 (Lynes 1912; see, too, Farquhar 1902) and the Northern Sporades six or more small colonies, three consisting of only 2 pairs, in 1894 (Reiser 1905); making a total for the northern group of colonies of perhaps 35–40 pairs.

In the Cyclades six small colonies of less than 10 pairs each were found by Krueper (1864) off Naxos and Paros in 1862, and another by Reiser (1905) in 1894; and Lambert (pers. com.) found another of *c.* 30 pairs in 1955. In August 1958 two of Krueper's colonies—the only ones we visited—had ceased to exist, but my wife and I found two more, of 2 pairs and about 8 pairs, off Paros (the latter had about 10 pairs in 1959, Watson pers. com.). We almost circumnavigated Paros on this occasion, and landed on nearly all the offshore islets, but found only these two small colonies. Elsewhere in the Cyclades colonies exist or have existed on Ananes (" large ", Bird 1935), Milos (said to be several pairs, Watson pers. com. 1960), Antimilos (several birds seen, Reiser 1905), Santorin (Lambert pers. com. 1958), Makria off Anaphi as well as perhaps Anaphi itself (v. Wettstein 1938), Karavi (one addled egg found in May, v. Wettstein 1938), Amorgos (Lambert pers. com. 1960), the southern tip of Andros (" large ", Reiser 1905),

Syra (2 young taken in 1894, Reiser 1905), and two islets off the eastern end of Mikonos (about 80 pairs on one of them, Krueper 1864). In this region may be included the colonies in Levitha and Kinaros (the latter said to be " big ", Lambert pers. com.), although they are west of Amorgos and actually in the Dodecanese. Estimating a total for this area of small islands, many of which have not been visited for years, is difficult, but our experience on Paros indicates that, even in the centre of the area, colonies are sparsely distributed, and most of them seem to be small. The breeding population of the Cyclades may perhaps be summarized thus: Naxos and Paros, 80 pairs; " large " colonies on Ananes, Andros, Kinaros, Mikonos, 250–400 pairs; ten remaining colonies of perhaps 10 pairs each, 100 pairs; a total of 430–580 pairs.

In the south there is a chain of colonies stretching from the southern tip of Kithira, through Antikithira and along the north coast of Crete to the eastern end of the island, with a single outlier off the south coast. Of the seven breeding colonies off Crete (Niethammer 1942), there are accurate estimates of the size of only one: Theodoro, off the coast near Khania. Here there has been a severe decline in numbers in the last two decades, from at least 60 pairs in 1942 (Sielmann & Stresemann 1956) to 12–15 pairs in 1957 (Makatsch 1958 and see below), though in 1958 we thought there might have been as many as 20. The whole of Crete may harbour 250–300 pairs, allowing an average of 20–30 pairs per colony, and an extra 100 for the colonies on Dia and Paximadi which Meinertzhagen (1921) noted in 1920 as " large ". The colony on Antikithira, which we found in 1958, is certainly a large one. As we passed down the southwest coast of the island on 28 August, there were Eleonora's Falcons wheeling over us along a two-mile stretch of rugged cliff. There must have been at least 100 pairs, and perhaps as many as 200. On this occasion we visited a number of islets off the southern tip of Kithira, but found only one colony, 15-20 pairs strong, on Avgo, the islet which Reiser visited in 1898 and on which, he was told by the local fisherman, some 150 pairs of falcons nested, providing them with a supply of fat young for the pot each autumn (Reiser 1905). In 1958, however, we found only one fisherman who knew of the birds and none who knew of them as a source of food.

The breeding population of the whole of this region is probably, then, approximately as follows: northern group (Lemnos and Northern Sporades), 35–40; central group (Cyclades with Levitha and Kinaros), 450-600; and southern group (Crete—Kithira), 350–500; giving a total of 850–1,150 pairs.

(ii) *Cyprus.* Although Eleonora's Falcon was recorded from Cyprus as long ago as 1875 (Lilford 1889), only the recent formation of the Cyprus Ornithological Society has led to the publication of details of its range and numbers, and even now much remains doubtful. All the colonies so far found are within 20 miles of each other on the cliffs along the south coast. Bourne (pers. com.) estimates that there are two colonies of about 12 pairs, one of 12–18 pairs, and a fourth, scattered along the cliffs of Cape Aspro, of 100–250 pairs. There is possibly another small colony at Venus's Rock near Kouklia, where birds have been seen repeatedly in summer (Bannerman & Bannerman 1958, Walker pers. com.). At the extreme end of Eleonora's Falcon's range, then, some 350 miles east of the nearest Aegean-Cretan colony, there is a group confined to some 30 miles of coast and consisting of 150–300 pairs.

Summary.

The approximate totals for each part of the range may now be tabulated

(*a*) Northwest Africa	250 pairs
(*b*) Western Mediterranean	130 ,,
(*c*) Central Mediterranean	150 ,,
(*d*) Eastern Mediterranean	
(i) Aegean—Crete	850–1,150 pairs
(ii) Cyprus	150–300 ,,

This gives a grand total of 1,550–2,000 breeding pairs. Owing to the probable existence of undiscovered colonies not allowed for in the individual estimates, this total may be too small; on the other hand, many of the estimates for Aegean colonies were made fifty or more years ago, since when, on the analogy of the only two colonies in that area about whose history anything is known, there has probably been a decline in numbers. It should be remembered, too, that the size of many colonies has only been guessed. In spite of these uncertainties, however, I would suggest that the total world population of Eleonora's Falcons is under 4,000 birds, about half of which breed in the Aegean and Crete.

The most important areas where large colonies perhaps remain to be discovered are the Dodecanese and Algeria. Birds have been recorded in summer from the Tuscan Archipelago (Arrigoni degli Oddi & Damiani 1911, Moltoni 1954), the Ligurian Sea (Giglioli 1889), Pantelleria (Moltoni 1957 a), the Adriatic (Moltoni 1957 b), the Ionian Islands (Reiser 1905) and elsewhere (e.g. Provence, Lévêque & Vuilleumier 1958, and even Central Spain, Lilford 1866), and, though most of these records are from the early part of the summer, it is possible that some of them represent hitherto undiscovered breeding populations. There was once a colony at Gibraltar, but this has long since ceased to exist (Bate 1928, on palaeolithic cave remains). Irby (1895) points out that the Rev. John White's " Hobbies ", which he says bred on the Rock, must have been Eleonora's Falcons and in the seventeenth century Eleonora's Falcon bred on the Iles d'Hyères (d'Arcussia 1644 : 60).

MIGRATION

Stresemann (1954) has reassessed the evidence and shown, contrary to some recent statements (Bannerman & Bannerman 1958, Peterson *et al.* 1958), that Eleonora's Falcon is a summer visitor to the Mediterranean and northwest Africa; that its principal winter-quarters are in Madagascar; and that the main route is via the Red Sea. He cites the eight late-autumn to early-spring Madagascar records and the single one from Réunion; refers to Archer (1937), who saw Eleonora's Falcons in April and May (though not in the autumn) passing through British Somaliland in company with Hobbies, and to Meinertzhagen's (1954) record of a female in the Gulf of Suez on 12 April 1948; and points out that there is a complete absence of winter records from the Mediterranean and northwest Africa. He does not mention the single Mauritius record, a bird obtained by Mr. Edward Newton after stormy weather in December, Gurney 1882; omitted from the 1952 Catalogue of Mauritius Birds, Rountree *et al.*). It is unlikely that the northwest African population of Eleonora's Falcons migrates through the Mediterranean and Red Sea, for this would entail a northeast direction for the first few hundred miles of autumn migration, followed by an easterly flight of over 2,000 miles through the entire length of the Mediterranean, and a further 3,500 miles south down the Red Sea and the east African coast. There are, however, no records yet from tropical west Africa.

The published dates of first arrivals of Eleonora's Falcons in their summer quarters, working from the east end of the range, are as follows :— Cyprus: 7 March 1954 (Bannerman & Bannerman 1958); 23 April 1957, 20 April 1958, 18 April 1959 (C.O.S.). On 20 April 1959 Walker (pers. com.) saw 4 birds arrive in the breeding area from the south. Crete: 27 April 1906 (Lynes 1912), 17 April 1944 (Sielmann & Stresemann 1956, 3 birds), 25 April 1944, 6 April 1945 (1 bird), 25 April 1945 (3 birds), 26 April 1945 (10 birds) (Stresemann 1954). Naxos: 25 April 1862 (Krueper 1864). Balearics: 26 April 1956 (v. Westernhagen 1958), 27 April 1957 (Detflesen 1957–8, Tato Cumming 1957–8, Congreve 1957). Mogador: 30 April (Bannerman 1919).

Stresemann's records from Crete and those of the Cyprus Ornithological Society are particularly valuable since they were made by observers residing on the spot. Although these records show that Eleonora's Falcon begins to arrive in the area of its breeding-

stations during the last ten days of April, the following records of birds (numbers in brackets) evidently on passage show that migration continues well into May:—Sheikh, British Somaliland, 17 May 1919 (3) and 5 May 1920 (2) (Archer 1937); Gulf of Suez, 12 April 1948 (Meinertzhagen 1954); near Benghazi, Cyrenaica, 15 April 1922 (Hartert 1923); near Rome (Colli Laziali), 25 April 1907 (Arrigoni degli Oddi & Damiani 1911); Malta, 4 May 1864 (Wright 1874); 26 May 1937 (de Lucca 1950), 3 May 1957 (de Lucca & de Lucca 1959); Algeria, *c.* 80 miles S.S.W. of Philippeville, 27 May 1859 (4) (Salvin 1859). The 90 birds seen by Dixon (1882) on 16 May near Philippeville, were probably local breeders.

There seem to be no records of Eleonora's Falcon migrating in the autumn. It leaves its breeding-stations in late October and early November. Meinertzhagen (1940) saw about 50 falcons, mostly juveniles, still at the Mogador colony on 26 October 1939. At a Cretan colony in 1944 no birds were present on 10 November (Sielmann & Stresemann 1956). In Cyprus in 1957 10 were still at one colony on 20 October, but only 3 were there on 3 November, and the last was seen on 7 November (C.O.S. 1957–8). In 1959, Walker tells me, 13 birds were still present on 13 October, but after 31 October no more were seen save for one on 8 November. Munn's latest record from Majorca was 9 November 1927 (Munn 1931). The earliest autumn record from the winter-quarters in Madagascar is 29 November 1930 (Stresemann 1954).

PREDATION

The young falcons are regularly taken by fishermen for food in all parts of the range—they are said to be " unbelievably fat " before fledging (Stresemann 1943). Although this could explain the decline in numbers on the island of Avgo off Kithira, it seems to have had no effect at Mogador, and is probably not a serious threat. Egg-collectors of three nationalities have in recent years taken series of clutches from Mogador, the Balearics and Crete, but the inaccessibility of many of the nests and the cost of expeditions to the breeding islets may perhaps keep their activities sporadic and therefore more or less harmless. The decline in numbers on the islet of Theodoro off Crete is to be attributed probably neither to the Eleonora's Falcon shoots organized by the local sportsmen, nor to the depredations of fishermen in search of sustenance (both of which activities have doubtless been carried on there for a very long time); but to the rats which now swarm on the island, and which have probably increased enormously in numbers as a result of its establishment after the war as a sanctuary for the Cretan Ibex, and the consequent installation of surface drinking-water.

SUMMARY

The known facts about Eleonora's Falcon are brought together, and contributions to existing knowledge made, under the headings Characters, General Habits, Food, Breeding, Breeding Distribution and Numbers, Migration, and Predation. It is shown that the breeding season is from mid-July to October, that Eleonora's Falcon is a largely crepuscular feeder, that it is a summer visitor to its breeding haunts, and that it is dimorphic. The total world population is estimated to be rather less than 4,000 birds.

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Falco Cleonorae

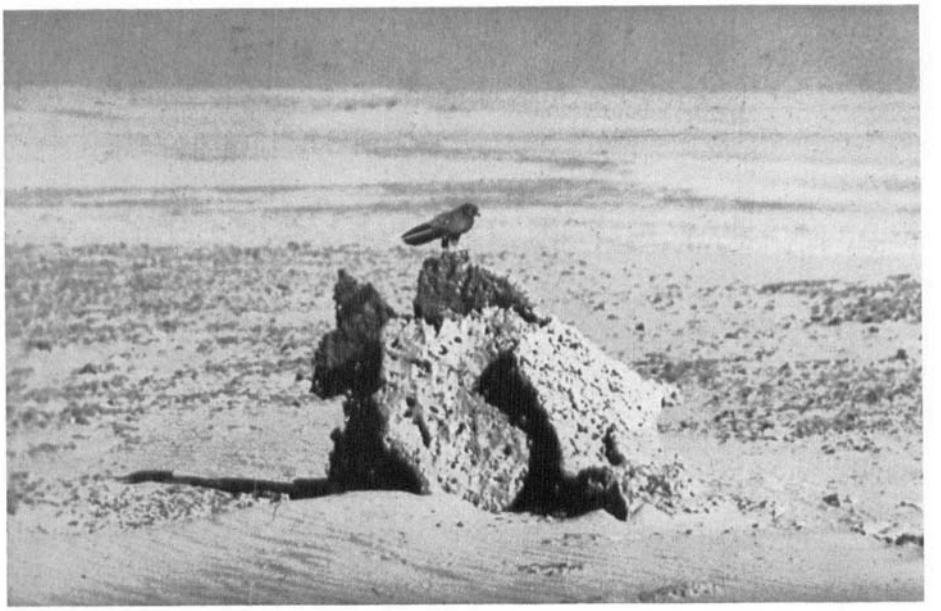
1. A typical cliff-top nest of Eleonora's Falcon.

2. Light-phase Eleonora's Falcon photographed from three yards without a hide at nest on a cliff ledge, showing prey remains which accumulate after the hatch.

3. Female light-phase Eleonora's Falcon incubating. This nest was on flat ground a few feet from the cliff top.

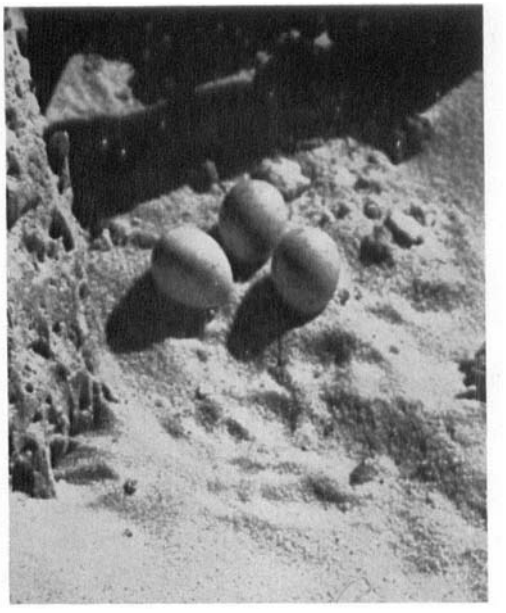
4. Dark-phase Eleonora's Falcon with prey at cliff-top nest.

Sooty Falcon *Falco concolor*



Perched on the camel cairn which constituted its nest-site. Note the terrain " devoid of all vegetation, either living or dead, and its utter barrenness complete ".

Alighting on the cairn of sandstone slabs.



The eggs were laid under the tilted slabs of rock and were brought out in order to photograph them.