

## THE BIRDS OF GOENOENG API <sup>1)</sup>.

By

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### 1. Particulars about Goenoeng Api.

The island Goenoeng Api (Fire-mountain), situated in the South-Banda sea, 60 - 70 km north of the island of Wetar (Zuidwester Islands), is formed by the summit of a volcano, rising directly from the Ocean bottom, 4000 meters deep to about 280 m above sea-level, forming an island approximately one km square.

This andesitic volcano, still in the solfatara stage, is uninhabited, although it is visited by fishermen from time to time.

Its inaccessible position, the isolated situation, and the fact that the island is reputed to be inhabited by demons, are probably causes which prevent frequent visits by man.

The Volcanological Survey did not possess data as to the time of the last eruption of the volcano. Solfatara, showing copious vapour formation with locally, high temperatures, is all that now remains of former activity. The lava has taken its course to the west, the western slope shows a broad zone of thousands of lava blocks, partly covered by vegetation.

In the centre of the island the  $\pm$  80 m deep crater is found, the lowest edge is on the W. side, 200 m above sea-level.

Dr. PH. F. KUENEN, as geologist of the "Willebrord Snellius Expeditie" (1929 - 1930) visited the island in April 1930. He comments upon this visit as follows: "This small island .....is peopled by enormous flocks of seabirds, but the climate does not allow of the formation of guano. The crater is opened on one side and two more great land slides have occurred on other sides of the island, one of which is submarine only" <sup>3)</sup>.

Because of the fact that Dr. KUENEN mentions a number of nesting oceanic birds, the Neth.-Ind. Soc. for Nature Protection approached the Neth.-Ind. Government in 1936 in an endeavour to have the island established as a nature reserve. A favourable decision was reached in December of the same year.

<sup>1)</sup> Papers on the same subject appeared already in:

a) *Limosa* 12, 1939, p. 43 - 79 and p. 141 - 165. b) 3 *Jaren Indisch Natuurleven* (11th Report 1936 - 38 of the Neth. Ind. Soc. for Nature Protection), Batavia 1939, p. 316 - 333. c) *De Trop. Nat.* 28, 1939 p. 27, 41, 82, 107, 127, 150.

<sup>2)</sup> The different parts of this paper are signed by the author: v. B. (VAN BEMMEL) or H. (HOOGERWERF). For each part only the author of this part is responsible.

<sup>3)</sup> *Scient. Results of the Snellius Exp. etc.*, I p. 174.

Except for very steep slopes and other barren places the island is entirely covered by vegetation which is, however, poor in species.

The author who visited the island from July 21 till August 11, 1938, noted in total twenty five species of plants which number should approximate the total number of species actually existing. Among the higher vegetation we observed *Pisonia sylvestris*, *Ficus*, *Terminalia catappa*, *Pandanus tectorius* and a few coconut palms, while the shrub was almost exclusively formed by *Trema virgata*, *Trema orientale* and *Caesalpinia crista*. Among the herbs we name *Cenchrus inflexus*, *Cyperus* sp., *Paspalum scrobiculatum* (on the crater bottom) and *Ipomoea pes caprae*. H.

## 2. The fauna of the island.

Except for the Oceanic-birds, the fauna appears to be very poor. During our sojourn not a single mammal was observed except for a large bat of unknown species. Every day dozens of rat-traps were laid out with various vegetable and animal bait, but not a single mammal was caught.

The number of non-oceanic birds was small, not more than 9 species could be observed, viz:—

<i>Hypotaenidia philippensis</i> nov. subspec. ....	(collected)
<i>Halcyon sancta sancta</i> VIG. & HORSEF. ....	"
<i>Coracina novaehollandiae melanops</i> (LATH.) .....	"
<i>Zosterops palpebrosa lettiensis</i> FINSCH. ....	"
<i>Megapodius?</i> sp. ....	(only seen)
<i>Falco peregrinus</i> subsp. ....	"
<i>Demigretta sacra sacra</i> (GMEL.) .....	"
<i>Collocalia</i> sp. ....	"
<i>Charadriidae</i> . ....	(heard)

Of *Falco peregrinus*, *Demigretta sacra* and *Collocalia* sp. only a single specimen was seen, while none of the other species was of common occurrence. No reptiles were observed, a striped sea-snake and small tree-lizards excepted. The snakes were not uncommon near the shore but did not occur at higher altitudes. The lizards were seen a few times in the wood around our camp. No *Varanus* nor land-snakes, which may do great damage in tropical bird colonies, were observed.

Among the evertbrate animals one species of crab was very common. A few times this animal was observed eating bird-eggs. Insects were also poorly represented. In addition to louse-flies (*Hippoboscidae*), which occur in the feathers of many oceanic birds, some butterflies were observed on a few occasions, while grasshoppers were seen fairly regularly. Aside from the isolated situation of the mountain the poor fauna may be caused by the dearth of fresh water. An intensive search for fresh water was organized since our water-stores decidedly decreased in quality, but no source was found not even after some heavy rain-storms. The more remarkable therefore appears the presence of

birds which we thought could not live without fresh water, like *Rallidae* and *Megapodius*.

As our sojourn seemed not to coincide with the extreme dry season, because the vegetation covered the mountain with a lush green, the situation seemed comparatively favourable. H.

### 3. General remarks on the oceanic birds of Gg. Api.

The great number of oceanic birds which brood on this island and the large number of specimens residing there outside the brooding season, are in pleasant contrast to the above mentioned poverty of other fauna. Although Gg. Api cannot compete numerically as a bird-island with analogous places in moderate or arctic zones we do not hesitate to call this volcano a very important tropical bird-colony, the protection of which is of great ornithological importance.

The following oceanic birds were observed:—

<i>Sula dactylatra bedouti</i> MATH. ....	(brooding and with young)
<i>Sula leucogaster plotus</i> (FORST). ....	(with young)
<i>Sula sula rubripes</i> GOULD. ....	(brooding and with young)
<i>Fregata minor minor</i> (GMEL.) .....	" " " "
<i>Phaeton rubricauda westralis</i> MATH. ....	" " " "
<i>Anous stolidus pileatus</i> (SCOP.). ....	" " " "
<i>Sterna anaetheta anaetheta</i> SCOP. ....	" " " "
<i>Sterna fuscata nubilosa</i> SPARRM. ....	(with full fledged young)

Most numerous was the tern *Anous stolidus* of which several hundreds of specimens were seen. Almost as numerous were *Sterna fuscata*, *Sula leucogaster*, *Sula sula* and *Fregata minor*. The Tropic Bird, *Phaeton rubricauda*, we suspect to be less numerous, although an actual census would be difficult on account of the cave-dwelling habit of these birds. Least common was the large booby, *Sula dactylatra*, and the Bridled Tern, *Sterna anaetheta*.

Birdlife seemed centered on the western slope of the volcano which is probably due to the occurrence of solfatara. Certain species (*Sula dactylatra*, *Sterna fuscata* and *Anous stolidus*) seem to actually seek the solfatara probably on account of the higher temperature. Moreover, this slope is on the lee-side and is therefore protected from the dry eastern monsoon winds.

The birds may be divided in two groups, those that nest in trees, and those nesting on the ground. To the first group belong *Sula sula* and *Fregata minor* and to the second *Sula dactylatra*, *Phaeton rubricauda*, *Sterna anaetheta*, and probably also *Sula leucogaster* and *Sterna fuscata*, while *Anous stolidus* seems to brood on the bare ground or between rocks as well as in shrubs and trees.

The breeding season was apparently at its height when we visited the island. The young of *Sula leucogaster* and *Sterna fuscata*, however, were almost without exception able to fly and no eggs were seen, so in these species the brooding-period was already over. In the case of all other species both small and almost full-grown young as well as freshly laid or incubated eggs were found. Due to our

short stay at the island the incubation time of various species could not be established.

The same reason holds good for the incompleteness of data concerning the age of the young birds, though many observations make it possible to do certain reliable estimations while in other cases the age could be established with certainty. If we take one month for the incubation period of the larger species and if we assume that the young are able to fly at an age of ten weeks, we obtain differences in season for the same species of at least 3½ months.

In the case of *Sula dactylatra*, *Sula sula*, *Fregata minor* and *Anous stolidus* the number of clutches in relation to the total number of birds seemed anything but small. Therefore, these clutches could not be considered retarded, as often can be found in tern-colonies. This situation appeared normal, and is true also for allied races of these birds at other places (Phillipines, Galapagos islands and elsewhere).

Dr. KUENEN found on his visit on April 14, 1930, a rather similar situation. A few species were brooding and also had young, as shown by his photographs.

During our visit the number of nest-building birds was small, however, so that we suppose that after our sojourn on the island the number of clutches did not considerably increase.

With a view on the important number of not-brooding birds that regularly visited the volcano, we may suppose that Gg. Api also lodges a big bird-population beyond the brooding season.

The feeding places of these oceanic birds apparently were situated, at least during our visit, at considerable distance from the volcano. Birds flying outward could not be followed even with powerful binoculars while homebound individuals seemed to come from a great distance too. Terns, however, we observed repeatedly feeding in the immediate environment. Adult specimens of *Sula dactylatra* and *Phaeton rubricauda* I never observed feeding, *Fregata minor* and adults of *Sula leucogaster* and *Sula sula* only a few times. Young boobies of all three species, chiefly birds too inexperienced to follow the adults, were observed fishing near the island nearly every day. Of course it is possible that the foraging far away from the brooding-colonies is only temporarily the case and may depend on direction and intensity of current and tide or weather-conditions.

Dr. HARDENBERG, Chief of the „Laboratorium voor het onderzoek der zee” at Batavia, whose opinion I asked regarding this foraging at great distance, thought it possible that owing to particular circumstances certain sea-regions can be rich in fish while other in the neighbourhood lying zones are extremely poor.

He gives as an example an island of the outer Banda-bow, the west-coast of which proved to be full of birds with plenty of fish in the sea at that side, while along the east-coast practically no birds were seen and fishes also seemed to fail.

BEEBE <sup>1)</sup> states about the foraging at great distance from the brooding-

<sup>1)</sup> “Galapagos: Worlds End”. Putnam’s Sons, New York 1924, p. 312.

grounds: "From dawn until seven o'clock dozens and dozens of flocks of boobies of two species came flying from the island directly toward and passed us, southwest, in the general direction of James. Remembering that the sea-birds of Daphne all flew due north every day, I realized that the intersection of the Tower and Daphne birds probably indicated an area of unusually good fishing ground, almost exactly on the equator and 90° 30' west longitude. The same instinct which impels the Florida pelicans to go forty or fifty miles to their fishing grounds takes these birds far out to sea, while, as we were to sea later, individuals could find an abundance of food close at hand near their nests."

According to BENT (U.S. Nat. Mus. Bull. 121, 1922, p. 196) SNODGRASS and HELLER did similar observations concerning *Sula dactylatra* of the Galapagos Islands. The species was observed fishing at sea, 300 miles from the island and it is probable that the birds, in pursuit of food, daily travel more than 100 miles from their breeding grounds.

From my observations of the feeding of the young, of the disgorging of the food by the young and of stomach contents, it appeared that the food consists chiefly of cephalopods and flying fish. Observations were facilitated by the fact that the young of the big kinds emptied their crop like herons when we approached too near.

In regard to the feeding of *Sterna anaetheta* and *Sterna fuscata*, our observations were insufficient to warrant conclusions. **H.**

#### 4. General remarks on systematics of Gg. Api birds.

The collections, made by Mr. HOOGERWERF during his stay in Gg. Api have given us not only a new subspecies, but have especially contributed to our knowledge of the juvenile plumage of different sea birds.

Particularly the material of *Anous stolidus pileatus* (SCOP.) and *Fregata minor minor* (GMEL.) was found to be very important on this point. Unfortunately the material of the young of *Sterna anaetheta anaetheta* (SCOP.) was too small to enable me to draw any conclusions, but it is not impossible that this species possesses a juvenile plumage, varying from that of its representatives in the western part of our Archipelago.

While identifying the material, a few points could not be explained, due to the fact that for a systematical research the series of a certain locality can never be large enough. Moreover our knowledge of the systematics of seabirds is often insufficient. This ignorance is ascribed to the universal distribution of these species and to the fact that no definite lines can be drawn between the various subspecies of these excellent flyers. In addition to this, each separate breeding-colony has its own characteristics, a matter to which I shall have to return later.

In general I have dealt separately with the various specimens in this collection, because the material was often not large enough to draw generalizing conclusions. Only in a few cases I have deviated from this method. This

precaution is the right thing to do, and I will make clear my contention with the following example. Two immature specimens of *Sula sula rubripes* (GOULD), (No. 9234 and No. 9235 in this collection), are about the same age. The colours of the plumage and the bare parts, however, are partly each other's conversion. If only one of the two animals had been collected and a conclusion had been drawn from that particular specimen with regard to the whole subspecies, we should have made a mistake.

It is hardly possible to draw any zoogeographical conclusions. Of the few races of land birds two are migrants (*Halcyon sancta sancta* VIG. & HORSF., *Coracina novaehollandiae melanops* LATH.); one is similar to the representative of the same "Rassenkreis" on Wetar, Kisar, Letti and Moa (*Zosterops palpebrosa lettiensis* FINSCH) and the other is a new subspecies of a "Rassenkreis" found both on Celebes and on Flores and bearing no special resemblance to either (*Hypotaenidea philippensis xerophila* nov. subspec.).

We have always to contend with a lack of literature and material for comparison in the Netherlands East Indies, and therefore I will not neglect to thank the following gentlemen for what they did to provide me with all the data I wanted:—

Mr. C. ANDERSON, (Australian Museum, Sydney);

Mr. F. N. CHASEN, (Raffles Museum, Singapore);

Prof. Dr. L. F. DE BEAUFORT and Dr. G. KRUSEMAN, (Zoölogisch Museum, Amsterdam);

Prof. Dr. H. BOSCHMA and Dr. G. C. A. JUNGE, (Rijks Museum Nat. Hist., Leiden).

Dr. M. BARTELS, (Soekaboemi). Lastly, I wish to express my sincere thanks to Miss A. C. W. VAN BEMMEL and Dr. N. J. FISSCHER (Hoorn) who translated my part of the manuscript.

v. B.

### **Fregata minor minor** (GMEL.).

*Pelecanus minor* GMELIN. Syst. Nat. p. 572, 1789, Eastern part of the Indian Ocean (cf. ROTHSCHILD Nov. Zool. XXII, 1915, p. 145).

#### *Material:*

Cat. Nos.	Sex	Culmen	Bill from gape	Wing	Tail
Btztg. Mus.					
13565	? pullus	27	38	—	—
9079	(♀) pullus	41	52	—	—
9080	? pullus	57	74	—	—
9081	♀ pullus	63,5	82	—	—
9082	(♂) pullus	68,5	89	—	—
9083	(♂) pullus	87	103	—	—
9084	♀ pullus	96	115	—	—
9085	(♂) juv.	93	110	410	247
9086	♀ juv.	95	110	470	306

Cat. Nos. Btzg. Mus.	Sex	Culmen	Bill from gape	Wing	Tail
9087	(♂) juv.	95	113	491	298
9088	♀ juv.	110	128	520	330
9089	♀ juv.	100	118	562	358
9090	♀ ad.	110	130	578	426
9091	♀ ad.	110	127	561	405
9092	♀ ad.	107	127	609	348
9093	♂ ad.	89	103	564	382
9094	♂ ad.	94	113	572	(370)
9095	♂ ad.	93	110	551	393
9096	♂ ad.	98,5	115	556	397

Number 13565 is a nestling of only a few days old and almost naked. The skin is light blue. On the head some rust-coloured down feathers (preplumules) are appearing, on the body some white ones. On the back and the wings the first black contour feathers make their appearance. Bill pink with dark tip, feet light blue. This is Phase I as described by Lowe (Nov. Zool. 36, 1931, p. 201) for *Fregata aquila* (L.).

The numbers 9079 - 9082 are nestlings of different age. Down all white, in the case of number 9079 the head is included. Of the three older specimens the down is light rust-coloured on the crown, under the eye and round the base of the bill. The two youngest birds have a group of black feathers on the back, at the left and at the right; the two older ones have already black blood quills in wings and tail. Iris dark-brown, feet light bluish grey, bill light bluish grey (of No. 9079 point of bill flesh-coloured; of No. 9080 the whole of the bill flesh-coloured). Bare throat bluish grey, orbital skin purplish.

Numbers 9083 and 9084 show a transition to the juvenile plumage. Forehead, crown and sides of head reddish brown. Underside, nape and shoulders all in white down covering, but back, wings and tail feathered. Wings have already the brown cross-bar of the adult covering. Iris dark brown, bill and feet light bluish grey.

Number 9084 has flesh-coloured feet, throat grey, orbital skin bluish grey.

The numbers 9085 - 9089 have the juvenile plumage, some specimens still with traces of white down. Head and nape ranging from very pale red to rust-coloured deep red.

A "rich cinnamon suffusion" of head, neck and breast is mentioned also by BENT (U.S. Nat. Mus. Bull. 121, 1922, p. 310) in "nearly every Pacific specimen", but as this author did not mention what species was meant, this statement is of little value.

The rust colour of the throat also covers a very small part of the breast and then changes into blackish brown. Number 9088 has a greyish brown zone between the red of the throat and the dark breast; Number 9089 has some reddish rust-coloured spots on dark breast. Belly clear white, undertailcoverts

black. All of them have a distinct brownish grey to pearl-grey wingband, the separate feathers of which have dark centres; iris dark brown, bill bluish grey, sometimes with a dark tip; feet ranging from bluish grey to flesh colour. Throat bluish grey, sometimes mingled with ochre. Two of the five birds are already fledged.

Of the adult ♀ ♀, Number 9091 has a violet and green glossed mantle, which is much less clearly visible on the other ♀ ♀. Of the adult ♂ ♂, number 9094 has a wingband which has the same colour as that of the adult ♀ ♀, in the other three specimens this wingband is very dark and slight. Mantle of number 9094 more green glossed and less violet than the others, and a much browner breast.

MEISE (Journ. f. Ornith. 78, 1930, p. 183) describes a similar specimen, which he considers a young bird which has not yet fully developed its colour. Number 9094, however, was found by a nest, containing one egg, so it had indeed attained to sexual maturity.

Adult ♀ ♀ have iris dark brown, bill flesh-coloured, feet bluish flesh-coloured, orbital skin red, throat flesh-coloured.

The adult ♂ ♂ have iris also dark brown, bill, however, black to deep grey, feet flesh-coloured to grey with deep grey toes and webs. The gular pouch ranging from flesh-coloured with light red spots to orange or vermilion. Orbital skin deep grey.

CHASEN and KLOSS gave to some specimens (originating from Boeroe) the name of *Fregata minor aldabrensis* MATH. (Journ. Mal. Br. Roy. As. Soc. II 1924, p. 65) but this was revoked by CHASEN himself (Bull. Raffl. Mus. 9, 1933, p. 73), after again examining the specimens in question.

The original determination was based on the supposed differences in colour between the subspecies *aldabrensis* and *minor*, which has been convincingly refuted by MEISE (l.c.). *Aldabrensis* is only distinguishable from *minor* by length of wings. This length is for *aldabrensis*: ♂ ♂ 585 - 606, ♀ ♀ 605, 621. The measures for *minor* are: ♂ ♂ 520 - 567, ♀ ♀ 561 - 599 (MEISE l.c. p. 184). The lengths of bills of both subspecies partly cover each other, the average length for *aldabrensis* being higher, namely: ♂ ♂ 116 - 130, ♀ ♀ 130 - 150 and for *minor*: ♂ ♂ 108 - 119, ♀ ♀ 127 - 133, 5 (MEISE l.c. and LOWE: Nov. Zool. 31, 1924, p. 307 - 308).

So the wing lengths ♂ ♂ 551 - 572, ♀ ♀ 561 - 609 and the bill-lengths ♂ ♂ 103 - 115, ♀ ♀ 127 - 130 of the Gg. Api birds fall within those of the subspecies *minor*. A specimen in the collection of the Buitenzorg Museum, from the surroundings of Bandoeng (W. Java), where it had evidently lost its way, has a wing length of 552, a bill length of 107 and therefore also belongs to the subspecies *minor*.

v. B.

#### The Eggs.

In all cases examined by me the set consisted of one egg, which is entirely white. As in the *Sulidae* the egg is covered with a thin lime-layer but this is a matter of little importance. Even at the end of the incubation-period the



eggs are much cleaner than those of the boobies. In 29 eggs the length varied from 56.5 - 72.5 mm, and the width from 41 - 47 mm. The largest egg measured 72.5 : 47 mm. **H.**

### Biology.

This species may be considered the most abundant of all bigger birds nesting at Gg. Api. As a rule the birds were quiet; they perched upon the nests or soared on their powerful wings in the air. At times I observed a whole flock of these birds hovering over the island seemingly not moving their wings, airily rising and descending at will without apparent effort.

Great dexterity and high speed were displayed when they tried to rob the returning tropic birds and boobies of their hard begotten catch. It is by this outstanding speed, developed in meeting and pursuing their victims, that *Fregata* finds itself rightly enlisted among the best flyers in the world. Many observers have expressed their admiration for the capacities of these phenomena of flight. BENT (U.S. Nat. Mus. Bull. 121, 1922, p. 312) formulated his respect of these ocean-dwellers in the following words: "The flight of the man-o'-war-bird is an inspiration; the admiring observer is spellbound with wonder as he beholds it and longs for the eloquence to describe it; but words are powerless to convey the impression that it creates. It is the most marvelous and most perfect flying machine that has ever been produced, with 7 or 8 feet of alar expanse, supporting a four pound body, steered by a long scissor-like tail. It is not to be wondered as that such an aeroplane can float indefinitely in the lightest breeze".

*Phaeton rubricauda* particularly fell a victim to the robberies of the man-o'-war-birds. In most cases, any attempt to escape its pursuer fails, and the air-duel ends in a surrender of the wildly shrieking *Phaeton*, whose disgorged food is immediately devoured by the conqueror. During these pursuits I often saw *Fregata* revolving round its axis and once I noticed how *Phaeton* was caught by the leg and in this way was caused to a quick surrender. Once I saw the tropic-bird trying to escape by quick diving, but even then the man-o'-war did not leave him alone, and followed him to the ground. *Phaeton* plunged into the dead crater, but the man-o'-war-bird swooped down upon its victim that disgorged its food upon the ground. It was devoured immediately which was the end of the fight.

Though without exception *Phaeton* does its utmost to escape the pursuit, it hardly ever succeeds and usually the air-duel ends with the defeat of the loudly shrieking tropic-bird, spilling its meal to see it devoured by its pursuer. This shrieking louds like a shrill "keee-keee-keee" or "hieuw-hieuw-hieuw" or like a hard "huw-huw-huw".

*Fregata* seems to choose its victims well, as only a few times this manoeuvre proved to be fruitless. Not only the tropic-bird, but at times also *Sula leucogaster* and *Sula sula* fell a victim to these piratical ways. I never saw *S. dactylatra* bullied out of their food but of course chances are that it may occur once in a while.

The food disgorged during the flight is in most cases snatched away before reaching the ground or the surface of the water. In such cases where it fell upon the lavablocks, the food was left untouched by the pursuers. Not rarely *Fregata* competes one with another in these vile proceedings, and often one may see a free for all fight for their share of the loot.

WORCESTER (Philipp. Journ. Sc. VI. 1911, p. 174) remarks upon the robberies of the red-footed booby by the man-o'-war-birds as follows: "The frigate birds promptly formed a skirmish line and, singly or in pairs, attacked all comers, compelling them to give up their fish".

SHIRAS <sup>1)</sup> as well as CHAPMAN made similar observations; SHIRAS (p. 221) remarks: "At times they (the boobies) were intercepted in midair and compelled to disgorge for the benefit of the man-o'-war-bird. The diet of that hawk of the sea consists wholly of flying fish or the toll collected from the good natured boobies, the present of which makes certain a supply of fish for the young of its piratical neighbor". CHAPMAN in the same paper (p. 225) says: "Occasionally they chased the adult boobies and made them disgorge in the air, but evidently, in the main, they did their own purveying, flying fish being taken from one bird that was shot".

MURPHY (Natural History, Vol. XIV, 1939, p. 133) too points to the molesting of the victim and remarks: "Stubbornness on the part of a booby may lead to a torn neck or a dislocated leg; in the booby-colonies one can often find cripples that attest the wrath of the implacable tyrant", while WORCESTER (l.c. 174) writes about this matter: ".....but less experienced or more obstinate individuals which at first refused to disgorge were vigorously punished until they changed their minds and threw up their fish which were most adroitly caught in the air by their piratical enemies. In one instance two frigate birds set upon a booby, one of them attacking him from above and the other flying below to catch the fish which he dropped, and getting five out of seven".

Of *Fregata minor* I saw only a small number fishing near the breeding-grounds. Flying quite near the surface of the water they caught the prey with their powerful beak.

A study of the stomach-contents of some collected specimens proved that also at Gg. Api squids and flying fish form a considerable part of the diet of these birds. Occasionally also some gravel, in one case a big marble-round nut and other vegetable matter which could not be identified, were found.

I never saw a man-o'-war-bird alighting upon the water, a fact which seems also to be not or rarely observed by other naturalists. MURPHY (Natural History XIV, 1939, p. 143) comments upon this matter: "But although the man-o'-war-bird views the ocean all its days, it is meticulous to shun contact with its surface, because in the water this perfect glider is even worse off than when grounded. Once down indeed, it is a helpless, floundering monstrosity, incapable either of making headway with its puny feet or of lifting itself back into the security

<sup>1)</sup> "Hunting wild life with camera and flashlight." Vol. II (Nat. Geograph. Mag. Washington).

of the air. Worst of all its plumage quickly becomes waterlogged because the oil-gland above its tail is a minute, atrophied affair, totally insufficient for the waterproofing purpose that this organ fulfills for all other sea-fowl".

DELACOUR & JABOUILLE (Trav. Serv. Océanogr. Indochine 3e Mém. 1930, p. 20) mention the fact that *Fregata* rarely descends upon the water, never dives and always snatches the food from the surface. They mention the food of *Fregata minor* to consist of squids, crabs, flying fishes and young turtles.

As follows clearly from the above description of the birds in this paper, it is quite easy to distinguish both sexes. Moreover, during the mating season, the male bird can be recognized on sight in the open by a magnificent red- or orange coloured breast-pouch which in this period is often inflated to a big bladder, from 10 to 20 cm wide. Speaking about *Fregata aquila*, BEEBE (l.c. p. 316) remarks: "Eyes, beak and feet were dull, but out of this sombreness, like fire out of lava, billowed the burning scarlet of the enormous breast-pouch. When distended with air this was like a huge bladder, completely hiding the bird. Its distention was not dependent upon conscious muscular action for I saw birds quite sound asleep, with their beaks resting upon the top of this balloon as if on a pneumatic pillow".

Probably this breast-pouch plays a considerable part in the mating ceremony. A couple of times I saw the male bird cajoling the female to the nest or to the outlay for the nest, displaying this gorgeous bladder. The sequence of actions, as observed by me in one case at a place where a nest was to be built in a tree, may be described as follows. A male *Fregata minor* was perched at a height of some two meters in the outer foliage of a big *Pisonia* tree. The fiery red breast-pouch was extended to a big balloon, in which the beak almost seemed to disappear. Sitting obliquely, the bird rocked head and neck to and fro, clattering its beak uttering a jodeling sound like "kleew— leew— leew—" or "leew— leew— leew". Now and again the bird flapped its wings. This "rite" obviously was intended for the female bird, hovering above the nest, as the male followed her in all her movements. The action reached a climax as she swooped down upon the nest and both birds flapped wildly their wings.

The female bird caressed the inflated breast-pouch with the beak, and now and then caught eagerly the other's bill. At the time no copulation followed this move. Next day I saw the male bird again perching at the same spot. This time it kept quiet, with breastpouch inflated. After some more days the birds were building their nest here, so this seemed another reason to consider the described behaviour as coinciding with mating.

A similar description has been given upon this matter by MURPHY (l.c. p. 134). He writes: "During the breeding season this (the breast-pouch) is inflated by a series of pumping, gulping actions until it attains the size and appearance of a red toy balloon. It is then the love-banner which produces the requisite excitement in the female, who alights at the tangled tops of shrubbery or swamp trees that the male has chosen for a nest. Both birds next

assume a backward leaning posture, face to face, raise their bills, allow their wings to droop limply, wave the head and roll the bodies exstatically while emitting incoherent gurgling and chuckling noises. At the same time the pointed iridescent feathers on the back stand up like bristles and the lovers swell and tremble with an amorous ador, of which the gorgeous red globe of the male is the most striking symbol".

Also BEEBE (l.c. p. 317) makes a note on a similar ritual by *Fregata aquila*: "Then another emotion obsessed him; he bent his head back until it sank between its shoulders the red balloon projecting straight upward, and the long angular wings spread flat over the surrounding bushes. The entire body rolled from side to side, as if in agony, while the apparently dying bird gave vent to a remarkably sweet series of notes, as liquid as the distant cry of a loon, as resonant as that of an owl. In our human inadequate, verbal vocality, I can only record it as kew-kew-kew-kew-kew-kew! In a higher tone the female answered him from the sky "oo-oo-oo-oo-oo!" and: "for a few minutes, the birds sat close together, going through various forms of dying ecstasies".

In a note on *Fregata* (Bull. Raffles Mus. 14, 1938 p. 47) WETMORE gives some particulars about the breast-pouch of the male *Fregata*. He remarks to this point: "While I am not familiar with this species (*F. andrewsi*) I do know quite well the males of *F. magnificens* and *F. minor strumosa*. In these the gular pouch is large and brilliant red in color, during the nesting season when it is displayed prominently. Males are attentive to the nest and undertake much of the work of incubation when the egg has been laid. As soon as this stage in the breeding is reached there is no longer display of the gular pouch which immediately begins to shrink in size and to change to a dull orange in colour. In a short time it can no longer be inflated to prominent size as I have demonstrated with a blow pipe on freshly killed individuals".

In this connection it seems of sufficient importance to stress that at Gg. Api several times I observed frigate birds with inflated gular pouch, which instead of its ordinary bright red colour showed a dull orange or still a paler tint; so it is likely that in *Fregata minor minor* the shrinking of the breast-pouch does not go parallel with the fading of the colour.

A great number of frigate birds found by me at Gg. Api had eggs and chicks. Freshly laid clutches as well as numerous young birds of almost all ages were observed.

The nests were built in different trees at very variable height above the ground. Few only were located at a height of from 1 to 2 metres, others about 8 to 10 metres up the trees, whereas most buildings were observed at a height of 3 to 6 metres. The nests are built in the dense foliage of the coarse-leaved *Pisonia sylvestris* as well as in the almost leafless *Ficus* and *Terminalia* trees, which at the period of my stay at the island shed their leaves. They seemed to show a marked preference for the small and sparsely leaved *Ficus* trees. At some of the steepest slopes, i.e. along the wall of the crater, I observed many nests built in the small *Ficus* shrubs. About the nesting places of *Fregata minor*,

DELACOUR & JABOUILLE observe (l.c. p. 20): "Leurs roqueries sont en général placées sur les îlots coralliens, isolés, couverts de végétation, d'arbres le plus souvent. Celle de l'île Adèle, au N.O. de l'Australie, est couverte de l'Ipomoea, sur lesquels les nids forment de véritables grappes, variant de cinq à six jusqu'à vingt".

The necessary material is probably stolen for the greater part from the nests of confraters. The material that is not acquired in this way is most likely snatched from trees and shrubs in passing flight. About the nest-building MURPHY (l.c. 134) remarks:

"Ordinarily the twigs are snapped off in passing flight from the tips of dead branches, or are filched from the red-footed boobies — the only species of its kind which uses wood or build upon the ground — while they are carrying them homeward for their own domestic purpose".

And further: "Both birds of a pair take part in nest-building, the female toting lumber while the male, with his rubber throat blown up, squats on the platform under construction, arranges the incoming sticks, and what is more important, protect them against pilfering by strange females. He dares not leave his post at this critical juncture because 'finding is keeping' is the morality of the tribe. Sisters, aunts and other men's wives swoop down on an unguarded nest and purloin every vestige within a twinkling".

At Gg. Api the nests consisted of small twigs and rarely exceeded in size those of the smaller heron-species, i.e. *Ardeola speciosa*, *Demigretta sacra*, *Egretta garzetta*, etc. They were as a rule so flimsy that one could observe the beautiful white egg through the twigs. The small care, given to the nest, may be the cause that rarely a young bird older than three weeks is found upon a nest. At that time only few twigs at the most, are left of this structure, more often even less and generally the nest has disappeared altogether. MURPHY (l.c. p. 134) as well as DELACOUR & JABOUILLE (l.c. p. 20), contrary to my observations, write how the structure is reinforced by the droppings of the young birds.

According to my observations both sexes have an equal share in the task of brooding, a fact which neither agrees with MURPHY's notes which run as follows: ".....but, from beginning to end, the major share of housebuilding, incubation, and guarding of the young seems to fall to the lot of the hen-pecked father".

After my experience the nest never contains more than one egg, and is not left alone for a moment. On our visit, which seemed to disturb the birds, it occurred that some frigate birds turned up to steal material from abandoned nests, thus wrecking the clutch. Once at a distance of about ten meters, I observed a male bird alighting upon such a deserted nest, taking the egg in its beak and smashing it upon the lava blocks! In this particular case however, the nest was not demolished, but the intruder sat down until the female bird chased him and recovered its seat on the plundered nest. A flowery description of such a nest-robbery is given by BEEBE (l.c. p. 316): "....., and instantly

there came a metallic twang of pinions — a loud wonk! wonk! — and another frigatebird swooped, caught up a twig, and as a polo-player at full gallop swings at a ball, so the bird reached, plucked, and was off. Another and another followed, and before the owner returned a half dozen sticks had been purloined by its neighbors. Down on the rumpled nest sank the first bird and began rearranging the ruins”.

Next observations do not at least agree with those done by me. DELACOUR & JABOUILLE remark: “A l’Ile Adèle c’est à peine si elles poussaient quelques cris à l’approche de naturalistes et ne s’envolaient que s’ils étaient à moins de deux metres. Pour obtenir les oeufs, ils furent plusieurs fois obligés de pousser la couveuse en dehors du nid” (l.c. p. 20).

At Gg. Api this species was rather shy and it was by no means possible to approach the breeding birds at such a short distance as these authors state.

During the first days of their life, the young birds are sheltered continuously. This may be regarded as a precaution against marauding of nest material and death to the young by sunburn, not so much as a precaution against murderous pirates endeavouring to kill them.

BAILEY (vide BENT l.c. 308), referring to the effect of death by sunburn at the west coast of Mexico, remarked that it did not take the hot sun a long time to kill any small young [of *Fregata magnificens rothschildi*] that the parents left unsheltered for even a few moments.

The call of *Fregata*, circling above the nest and young, sounds like “chee-chee-chee”, or “keeew-keeew”, while perched on the nest it rings like “ow-ow ..... kô-kô-kô”. The young respond by a “chee-eee-eet ..... chee-eee-eet”, begging with bowed head and fluttering wings. The bigger chicks, which pass a great part of the day upon the nest or at the place where this has been, produced, apart from a sound which may be compared with “kee-ee-eeuw ..... kee-ee-eeuw” another croaking cry when an adult bird came near.

Not always the chicks responded to the presence of older birds and on the other hand the young “begged” rather frequently at the approach of a strange bird. From this I conclude that not always the parents are recognized by their young.

The food is pecked by the young from the beak and throat of the parents with as much ado as in the case of boobies, and with as many apparently unnecessary movements.

This complex of action ordinarily completes itself in a short time, immediately after the parent has alighted near the young bird. After this the old birds perch at a safe distance from the young or disappear altogether.

As mentioned above the big young birds often sat upon the trees, devoid of nest material. I got the impression that they nearly never moved from the spot where originally the nest was built. They probably keep there till they are able to fly. Even our approach did not cause them to move from their place; they only snapped at the intruder with a clattering sound of the powerful beak in the direction of the assault.

From my observation on the development of the young I presume that they are able to fly at an age of about 10 to 12 weeks.

A couple of young birds taken along with us, are now kept at the Batavia Zoo and still are in a good condition. Their diet is seafish. The birds snatch the food thrown at them by the guards from midair, waiting placidly till it is within easy reach and never move to meet it. Also they never pick it from the ground or out of the basin. At this time — after about two and a half years of captivity — these specimens do not differ considerably from those shown on pl. 32 fig. 2 & 3 fourth from left. There is, of course, no definite proof that they would be identical with those grown up in their natural environment. The birds never get any exercise, though they are housed in a spacious cage. Moreover, it may be that the diet differs somewhat from that of the birds living in a state of nature. These two conditions may effect the colouring of the plumage. H.

### *Sula sula rubripes* GOULD.

*Sula rubripes* GOULD, Syn. Birds, Australia pt. IV.1838 App. p. 7 Terra typica, Australia.

*Material:*

Cat. Nos.	Sex	Culmen	Bill from gape	Wing	Tail
9228	♀ pullus	46	61	—	—
9229	♂ pullus	77	93,5	—	—
9230	(♀) pullus	77	96	290	210
9231	♂ pullus	77	96	328	210
9232	♀ juv.	79	98	375	221
9233	♀ juv.	81	103	378	221
9234	(♀) juv.	84	105	375	221
9235	♀ ad.	(83)	(103)	376	223
9236	♂ ad.	77	96	355	226

Number 9228: pullus in clear white down. Iris deep grey, bill black, feet light ochre coloured. Orbital skin black, rest of head light blue with deep grey spots. Numbers 9229 and 9230 both nestlings in white down, but feathers on back and tail greyish brown. Wingcoverts in same colour, quill-feathers dark brown with a silvery gloss. Iris grey, bill black, feet light ochre coloured, head dark grey, near throat light blue with grey spots. Number 9231 entirely greyish brown, head, wings, breast and neck are still wearing traces of down. Quill-feathers greyish brown with silvery reflection. Iris light grey, bill black, feet light ochre coloured and skin of head dark grey. Number 9232 a juvenile animal in brown plumage. Forehead still with traces of down. Colours of bare parts resembling the last specimen, but feet are light flesh-coloured.

Number 9234 and 9235 have a spotted transitional covering. Back and tail of one animal are white, of the other greyish-brown with white spots. Belly

white, one has breast dusty grey white, the other clear white. Head and neck light yellowish grey, shoulders and wing coverts greyish brown with white spots, quill-feathers dark-brown with silvery reflection. The change to adult plumage is evidently rather irregular, for, all that is white in one bird is brown in the other and conversely. Of one adult the iris is still light grey and of the other the iris is already dark brown. The latter, however, has pale feet and a pale bill, whereas the former already has a blue bill and brick-red feet. Head purple round the eye and light red to greenish on cheeks, throat bluish grey.

In both adults the eyelid is light blue, throat grey. Iris dark brown, bill light blue, feet light crimson with light blue nails. So the statement of Mr. TWEEDIE (CHASEN: Bull. Raffl. Museum, 9, 1933, p. 65) as to the colour of eye in adults is hereby confirmed; it is remarkable that one of the spotted immature birds has already dark brown eyes. The bare skin on the head of adults is less coloured than stated by Mr. CHASEN for birds of Christmas Island. The heads of the variegated animals on the contrary are very pied. CHASEN (l.c.) drew the attention to the fact, that in reality juveniles of this species (still showing traces of down) are already full-grown and their measurements tally with those of the adults.

The birds of Gg. Api are considerably smaller than those of Christmas Island, but they have a longer tail. Nevertheless it seems incorrect to me to separate the Gg. Api birds from *rubripes* on this account.

In order to do justice to each particular breeding colony, it should be given a separate subspecific value. However this method would entail an endless splitting up of species in a great number of races and this again would have a confusing rather than a clarifying effect. As long as we do not have exact data on the subject whether members of various colonies occasionally inter-mingle or not, there is no foundation to recommend the above mentioned suggestion. This is a matter, in which the experiment ought to assist systematics.

This also applies to what will be said below about *Sula leucogaster*. v. B.

#### The Eggs.

Several dozens of nests examined contained only one egg, which, like the egg of *Sula dactylatra*, is coloured a fine bluish-green, the lime-layer being usually much thinner. The eggs are much cleaner, the spots in some eggs are probably caused by the contact with the moist leaves of the nest, the birds never alighting on the ground and therefore not soiling their legs or body so much. In 15 eggs the length varied from 57 - 67 mm and the width from 36 - 41 mm. The longest and widest eggs measured 67:37 and 58:41 mm, respectively.

H.

#### Biology.

Contrary to the two other kinds of *Sula* described in this paper elsewhere I observed the red-footed booby at Gg. Api only living and nesting in the





CAMPBELL (BENT, l.c. p. 212) points out that the incubation period of the egg lasts 45 days.

The young emerge from the egg naked, but after a few days they are covered with a beautiful white down. After two or three weeks feathers grow. Probably the young will leave the nests at the age of 10 or 12 weeks. I could not obtain data on the time required for the adult plumage to develop.

Feeding the young shows also more resemblance to what is known of the *Phalacrocoracidae* than to that of the other species of the *Sulidae*. I got the impression, that the bill of the young bird was forced considerably deeper into the throat of the parent as is the case with *S. dactylatra* and *S. leucogaster*.

The fishing-grounds of this booby, just like that of *Sula leucogaster*, seem to lie at some distance from Gg. Api. The young birds and the rare adult ones, which I saw fishing near the island in company with juvenile and adult *S. leucogaster* and the young of *Sula dactylatra*, caught their prey by thrusting their head under the surface of the water while floating about. Never I saw the birds immerse completely, as has been reported a habit in this species. In the stomachs of some of the specimens collected at Gg. Api a nut and remains of squids were found. To this point and to the matter of food MURPHY (Nat. Geogr. Mag. 74, 1938 p. 248) remarks: "This species feeds upon fish and probably still more on squids. It usually flies far beyond the broken water of its own island shores, seeking an area of peaceful Ocean swell where flying fish break the surface and where squids approach when the sky darkens" and: "The birds ordinarily plunge into the sea from a height of thirty feet or more for their prey, but sometimes catch flying fish in the air when they have been driven from the sea by predators from below".

DELACOUR & JABOUILLE (l.c. p. 17) state how these birds catch fish by plunging, often from a considerable height into the water, causing thereby sometimes the death of the bird on the submerged cliffs. H.

### *Sula leucogaster plotus* (FORST.).

*Pelecanus plotus* FORSTER. Descr. Anim. ed. Licht., 1844 p. 278: near New Caledonia.

#### Material:

Cat. Nos.	Sex	Culmen	Bill from gape	Wing	Tail
9220	♂ juv./ad.	98	119	385	205
9221	♀ ad.	102	122	405	182
9222	♂ ad.	97	115	395	218
9223	(♀) pullus	91	110	300	165
9224	♀ juv.	—	—	330	165
9225	♀ juv.	92	110	393	201

The youngest bird in this series is Number 9223, a pullus for the greater part still in down covering. Tail, wings and back have dark brown feathers. Breast developing a crown of dark brown feathers, the rest of underpart covered

with dusty white feathers with light brownish grey tops mingled with white down.

Rest of body covered with white down. Iris light grey, bill light bluish grey, ridge of bill with umber coloured spots. Feet ochre coloured, throat flesh-coloured.

The two other juveniles (number 9224 and 9225) are already entirely feathered. One has a dusty white to light grey underpart, near the dark brown breast changing into brownish grey, the other has an almost completely brown underpart, the feathers of the belly having a white base and white tops. The semi-adult ♂ (number 9220) has a sooty white belly, the separate feathers of which have light brownish grey tops. So the colour of the belly-side is evidently rather variable in juveniles. The back uniform dark brown just as the other adults. Iris varying from dark brown to light grey. Bill light bluish grey. Feet ochre coloured, throat light bluish grey. Full grown animals have a light grey iris, greyish green bill; yellowish green feet and dark bluish grey throat. Orbital skin green. Sex-differences could not be found.

About the subspecific division of this species we are still in the dark. ROBINSON & KINNEAR (Bull. British Ornith. Club. 48, 1928, p. 64) give a table in which measurements of forms of this species from the Atlantic, Pacific and Indian Ocean are compared. They state that the differences are slight and moreover the several breeding-colonies of a subspecies are mutually varying. CHASEN (Bull. Raffl. Museum VIII, 1933, p. 67) reckons *Sula leucogaster* of Christmas Island among the subspecies *rogersi* MATTH., though with some reserve. In his "Handlist", however, he mentions Christmas Island as part of the area of distribution of *plotus* (FORST.). J. L. PETERS in his "Checklist of Birds of the World" considered *rogersi* as "probably the same as *plotus*".

The series of Goenoeng Api is too small to give sufficient information about the subspecific place. The few measurements fall within the average both of those given by ROBINSON & KINNEAR (l.c.) for Indian Ocean birds and those from the Pacific, except the culmen of the adult ♂ which would point to the last.

For purposes of comparison I mention here some measurements of *Sula leucogaster*, taken from birds of other localities.

	Cat. Nos.	Sex	Culmen	Bill from gape	Wing	Tail
	Btzg. Mus.					
Boeroe:	9218	♂	90	109	375	207
Isl. Middelburg (W. Java)	9219	♀	100	119	385	—
Noesa Baroeng (E. Java)	12476	♀	100	118	402	215
Strait of Malacca	12477	♂	87	102	272	205
Etnabaai (S.	Leiden Mus.	} ♂	97	113	381	217
New Guinea)	Exp. K.N.A.G.					
	1939 No. 0129					

The bird of Boeroe (see also SIEBERS: Treubia VII, Suppl. livr. 5, 1930, p. 219), is strikingly small and is within the limits of Indian Ocean birds. The New Guinea bird fully agrees with those of Gg. Api.

The difference between the two birds of Java and those of Gg. Api is very slight. On the other hand the bird of the Straits of Malacca is so very small, that it can only belong to the Indian Ocean group (cf. CHASEN, l.c.).

So long as there is thrown no light upon the systematics of this species by a close examination of large series of the whole area of distribution, it seems better to me not to suggest new subspecies, though it is obvious that in the long run the maintenance of a single subspecies for the East Indian Archipelago will appear impossible.

I used here the name *plotus* following CHASEN. Shortly after I had completed this paper Mr. CHASEN wrote me as follows:

"When I examined all the material in the British Museum and in Tring some years ago, I could not separate any form that was likely to be *rogersi* and if any new subspecies is required it would seem to be wanted for the Indian Ocean birds. Almost every breeding colony could be separated on some difference or other but we seem here to pass from the realm of practical systematics into that of biometrics, or even pure mathematics!

The final conclusion I came to was that the most reasonable course was to regard all our birds as *plotus*, within the range of which numerous "local strains" have developed, which are impossible to isolate in a satisfactory manner because birds from far away colonies will diverge in the same way. I think that in Malaysia we have two "kinds" of *Sula leucogaster*, but until some systematist working on a very large collection tells us more about the subspecies, I regard these both as *plotus*, but from different breeding colonies". **v. B.**

#### The Eggs.

Since I could not find a single egg of this species, I have to refer to information contained in literature concerning species of the same kind found brooding elsewhere.

MURPHY (Bull. Am. Mus. N.H. 1, 1924, p. 253) tells us that the clutch usually consists of three eggs, laid at a considerable interval of time.

About the size of the clutch BENT (Bull. U.S. Nat. Mus. 121, 1922, p. 203) remarks: "From the foregoing quotations it would seem as if two eggs was the normal set with the common booby (*Sula leucogaster*) but apparently sometimes only one egg is laid."

In 30 eggs collected on the island Raze of the Cape Verd Archipelago, CORREIA (in MURPHY, l.c. p. 253) gives the following measurements: Length varying from 53 - 64 mm, width varying from 37 - 43.5 mm. They resembled those of the other species of booby, though showing more variation in size and shape.

In 40 eggs belonging to the collections of the United States National Museum and his own, BENT (l.c. p. 204) gives the following average measurements:

59.4:40.2 mm. Maximum: 65.5:41 and 62:42.5 mm; minimum: 52.5:40 and 56.5:34.5 mm.

DELACOUR & JABOUILLE (l.c. p. 18) mention about the egg: "Les oeufs qui ressemblent à ceux des autres Fous, sont d' un blanc verdâtre et couverts d' une mince couche de chaux. Suivant les roqueries, ils varient de 68:46 à 61:41 mm. Leur nombre est invariablement de deux, qui occupent la faible dépression qui se trouve au milieu d'un nid presque plat."

Mr. M. W. F. TWEEDIE, on Christmas Island, Sept. 17, 1933, found two eggs of *Sula leucogaster* ? *rogersi*, one of which contained a large embryo. These eggs measured 62.8:41.5 and 64.6:41.8. Besides, TWEEDIE saw a young bird in down feathers, on 18th September (cf. CHASEN, l.c. p. 67).

### Biology.

Neither sets of eggs nor very young chicks of this species were observed. The occurrence of a great number of fully fledged young birds and two young ones, of approx. 4 or 5 weeks old (partly in down), justifies the supposition that Gg. Api is also the breeding-ground of these birds.

Though the birds seem very shy when not breeding, — as we could confirm a year later at the steep slopes of Noesa Baroeng, an island off the South-coast of East Java, — they seem to meet man as fearless as the other members of this family when breeding. To this point CHAPMAN (quoted after BENT U.S. Nat. Mus. Bull. 121, 1922 p. 204) remarks: "When perched on rocks about the border of the island, boobies showed a decided fear of man and generally flew before one had approached to within 30 yards of them; but once on their nests they were conspicuously tame, the degree of tameness being related to the advance of the nesting season".

The number of adult birds that occurred during daytime at the island was rather small. In the late afternoon, however, their number increased considerably and amounted to several hundreds at twilight. The greater part of the boobies perched on the small *Ficus*-trees, growing on one of the steepest western slopes of the mountain, where they passed the night. In this respect they behaved quite differently from the big booby *Sula dactylatra*, which I never saw perching in trees and shrubs or about these steep slopes.

Sometimes, I found the birds in the dense *Pisonia* wood, which covers the mountain for a great part. The two small young mentioned above were found in this wood and fed there by the adult ones.

Here, too, I found the only nest of this species on the barren soil. It consisted of a number of dead twigs, leaves and mouldy wood, in the nestbowl were some green leaves; it measured  $\pm$  50 cm in diameter and had been built against a  $\pm$  75 cm thick *Pisonia*-tree. An adult bird was perched on the nest as we first saw it, but later on we found it deserted. Therefore I am not absolutely sure that the nest actually belonged to this species, but I am inclined to consider it as such as no other bird would have built it in that place and because the

material resembled that mentioned by WORCESTER for the species (Philipp. Journ. Sc. VI, 1911 p. 169).

This author also observed twigs with fresh green leaves together with dead twigs and mouldy wood. As I did not find any other trace of old and deserted nests in this environment and the majority of the adult birds and young ones also were seen at open spaces, I presume that at Gg. Api as a rule *Sula leucogaster* does not nest between the vegetation.

Although this booby cannot so easily take wing from the grassfloor or lower shrubs, the fact remains that they attain a remarkable dexterity in flying up from the ground in the wood and between trees, which observations are confirmed by WORCESTER (l.c. p. 170). The same author states (l.c. p. 169) that the twigs are picked by the birds from the trees. Ordinarily the male birds carry the material to the nest where it is received by the female. Moreover, he observed that sometimes this material was thrown away and that assistance in the building of the nest by the male was not appreciated at all, which WORCESTER deduced from the fact that the material applied to the nest by the partner was removed by the female.

This author also mentions (l.c. p. 172) *Sula leucogaster* to nest and breed in shallow holes in the sand where no other nesting material was available than some decomposed driftwood. Once a bird of this kind was found to have made a hole into a log of wood into which the two eggs were deposited.

WORCESTER (l.c. p. 169) mentions furthermore that in many cases the nests were built close together and that the male birds were continually stealing nesting material from another's nests, which caused the different occupants to combat one another fiercely. He was unable to state if the birds were wounded in these fights. According to MURPHY (Bull. Am. Mus. N.H. I, 1924, p. 253), CORREIA writes: "The booby seems to be absolutely indiscriminate in the choice of a nest, any haphazard site will serve, and no building materials are used". This same author, citing ALEXANDER (Ibid., p. 252) tells how the birds deposit their eggs at the level ridges of steep rocky slopes of the seacoast, where a little soil had accumulated. The nests were scarcely 2 feet apart and consisted of a shallow hole, surrounded by some pebbles and rocky scales. At variance with all other authors consulted, DELACOUR & JABOUILLE (Trav. Serv. Océan. Indochine, 1930 3e Mém., p. 19) remark about nest-building: "Celui-ci se trouve de préférence sur les buissons ou sur les basses branches d'arbustes; il n'y a que lorsque ceux-ci manquent, que les Fous font leur nid sur l'herbe". AUDUBON (vide BENT l.c. p. 201) mentions also that the birds breed in trees in big nests, which probably are used many years in succession.

This statement has been considered by later authors as based on faulty observation. BENT, however, is inclined to believe it, as AUDUBON actually collected many specimens of *Sula leucogaster* at the breeding-place and, moreover, the breeding of this bird in trees has been reported by other authors.

According to WORCESTER (l.c. p. 170) the female *Sula leucogaster* is unwilling to leave the nest in which the eggs are laid and as a rule will do so only if she is pushed aside forcibly. Often the birds show a remarkable courage in defending the clutch, picking at the hand which is stretched out to the nest. Moreover, the nervous behaviour of these birds is noted in case man approaches the nest. Then the nesting material is removed and readjusted.

MURPHY (Bull. Am. Mus. N.H. I, 1924, p. 252) points to the irregularities which can be observed in the depositing of the eggs and to the fact that throughout the year newly laid eggs and young birds may be found. This statement is supported by similar observations by CORREIA. After MURPHY (Ibid. p. 253) CORREIA seems surprised that eggs as well as chicks in all stages of development may be observed at the same time. Local fishermen told him, that eggs as well as young birds were common throughout all seasons.

The same observer relates that the young are hatched naked and are carefully guarded by the adults to prevent sunburn and that, not until after two weeks, they are covered by a snow-white down. Most probably this will be the case at a much earlier age. MURPHY (Nat. Geogr. Mag. 74, 1938 p. 248) remarks that the down grows very soon, while I observed in *S. sula*, that the down appears within a couple of days after the young has been hatched.

At an age of 3 to 4 weeks the young present a marked resemblance to those of the bigger *S. dactylatra*; at a later stage, however, this resemblance vanishes. Concerning the time in which the young *S. leucogaster* grows self-supporting, CHAPMAN (vide BENT l.c. p. 205) remarks: "Evidently but one is reared, since approximately three months must elapse after the egg is laid before the young can fly and care for itself".

In this species too I never saw that 2 young were fed by one and the same parent. It does not seem probable, however, that the set will consist of one egg only, considering that this and other races of the same species, breeding elsewhere produce 2 or 3 eggs. The reason for the lack of one or two young in those nests may be the same as presumed for *S. dactylatra* (vide postea).

MURPHY (Nat. Geogr. Mag. 74, 1938, p. 248) remarks that 2 or 3 eggs are deposited but that, as a rule, only one young is reared. Concerning this unequal development of the eggs of the same set, CHAPMAN has remarked about *S. leucogaster* of the Bahama Islands (cited after BENT l.c. 202; compare also the notes about *S. dactylatra*): "Examination of the eggs contained in sets of two showed that either there was a marked difference in the development of the embryos or that one or both eggs were infertile. For example, of 13 nests containing 2 eggs, in 3 nests both were bad; in 10 both were good, but with every good pair there was about a week's difference in the age of the embryo. In 6 nests, each containing one young and one egg, 5 of the eggs were decomposed".

The following remarks of CORREIA (MURPHY, *ibid.*, p. 253) are interesting:

"In examining a set in one nest I observed that a chick was about ready to break the shell of one, while the second egg contained only a small embryo, and the third was so fresh that it might have been eaten. Again I saw three chicks in a nest, one so large as to be able take care of itself, the second capable of lifting its head only with difficulty, and the last emerging from the eggshell. Such incidents led me to believe that there is normally a period of many days between the deposition of the eggs".

The feeding proceeds in the same way as will be described for *S. dactylatra*. MURPHY (l.c. p. 253), citing CORREIA, writes: "They carry fish in their crops to the young, and the latter cause great confusion by their outcries and their efforts to introduce all their heads together into the mouth of the parent. The old birds however, calmly let the chicks tire themselves out before responding".

About the food furnished to the young, CHAPMAN (vide SHIRAS) remarks: "The young feed on squids and fishes, which in a more or less digested condition they obtain by thrusting their heads and necks down their parents' throats".

At Gg. Api the food consists principally of cuttlefish and flying fishes. The young birds repeatedly disgorged entire flying fish, among which I noted some measuring 25 cm.

Often I saw *Sula leucogaster* fishing in flocks near the island. Among these not only old and young specimens of *Sula leucogaster* were observed, but *Sula sula* also. Not once I saw the birds immerging completely. Head and throat were thrust into the water and the catch was gorged above the surface.

According to CORREIA (vide BENT l.c. p. 253) *S. leucogaster*, in hunting for food, plunges 5 to 6 feet deep into the water. In the stomachs of the birds, collected by him, have been observed herring, flying fish, needle fish, etc. The birds should prey until dusk, and perch on the rocks at night.

MURPHY, citing ALEXANDER (Bull. Am. Mus. N.H. I, 1924, p. 251) mentions that this booby hunts singly as well as in flocks of 15 to 20 birds. His description of the preying may follow here: "The dexterity with which the species catches its prey must be seen to be appreciated. As soon as the fish is sighted, the bird, with closed wing, shoots into the water, the next moment to reappear floating on the surface busy tackling its prey and looking for an instant like a bird mortally wounded. Sometimes however, a series of rapid twists and turns are indulged in prior to the dive, some 20 feet above the water. These movements may either result from the presence of a shoal of fish, the sight of which causes the bird to waver in its choice, or to a single fish having altered its course".

With regard to foraging, MURPHY (Nat. Geogr. Mag. 74, 1938, p. 248) tells furthermore: "It is a businesslike fisherman, doing much of its plunging just outside the breakers of its home-island, varying its altitude according to the depth at which fish are moving and keeping for its own sustenance whatever the man'o' war bird does not subsequently steal". And CHAPMAN (vide SHIRAS p. 225) writes: "The boobies are rather heavy bodied birds, but go far to



sea in search of fish and have the power to soar or glide long distances on set wings"; and further: "Boobies usually fish against the wind, flying low over the water and entering it in full flight at an acute angle and coming out at a similar angle still in full flight against the wind, some 30 to 40 yards beyond. While submerged they appear to fly as they do in the air".

A remark of MURPHY points to the possibility that *S. leucogaster* probably fishes at night too. He says (Nat. Geogr. Mag. 74, 1938, p. 248): "The depredations of the man' o' war birds cause the boobies to return to their island later than most sea-birds, even after their enemy has gone to roost. At times likewise they do some of their fishing at night".

I can not give any data upon this matter because I have not been able to make any observations at night.

We observed a great many dead and emaciated birds. As they were all young, full-fledged or almost full-fledged birds, the assumption seems to hold that they failed to find the sea and perished by lack of food. Apparently, a part of the adult birds desert their bigger young, leaving them too early to their fate. I was able to observe some of these birds, which were in an extremely bad condition for a couple of days; not once I saw them fed. After some days of starving they died with completely empty stomach.

BEEBE observed similar conditions at the Galapagos Islands for *S. nebouri* breeding there. He remarks (l.c. p. 270): "Here and there were dead mummified remains of boobies. Among these I observed no very young birds, and only five adults, while all the rest were nearly grown young. The partly ossified skull was unmistakable even where the plumage had fallen off and blown away, and I believe that the crisis of the entire life is the achieving of the crater's rim, after the wings have acquired sufficient strength and before the almost mechanical cessation of feeding instinct on the part of the parents. There is undoubtedly a trenchant survival of the fittest, at this brief temporal period, in value to the race far transcending the elimination of young birds by enemy gulls in mainland colonies".

Certainly not all young birds are treated in this nonchalant way for on Gg. Api many full-fledged birds were fed regularly by the adults, even young birds which I saw looking for food themselves near the volcano. CORREIA, too points to the fact that flying young are fed (MURPHY, Bull. Amer. Mus. N.H. I, 1924, p. 255).

The fact that in many cases the feeding takes place at widely diverging places, where no nests or traces of them were to be found, makes it probable that the victims described above were abandoned. From the above remarks we conclude, that the victims were inferior specimens, which at the age that most birds are able to seek their food could not find the food-sources. (For details see our notes on p. 456 concerning the behaviour of *Puffinus puffinus*).

*Sula dactylatra bedouti* MATH.

*Sula dactylatra bedouti* MATHEWS Austral. Avium Record 1, 1913, p. 189, (Isle Bedout. S.W. Austral.).

Cat. Nos. Btzg. Mus.	Sex	Culmen	Bill from gape	Wing	Tail
9213	♂ juv.	91	110	370	174
9214	♀ juv.	96	118,5	405	180
9215	♂ ad.	96,5	118	415	196
9216	♂ juv./ad.	96,5	117	(400)	184
9217	♀ ad.	103	127	417	196
9289	(♀) pullus	94	116	(347)	168

Number 9289 is a pullus, partly in white down covering.

In nape dark brown feathers with white tips. Wing coverts with much white down. Quills and tail dark brown, tail feathers with greyish white base; back and rump have dark greyish brown feathers with a vaguely outlined white margin. Belly entirely white. Iris dark grey, bill dull olive green, with deep grey base; orbital skin light olive green; bare throat light bluish grey; legs dark grey. Number 9213 and the bird just described are about alike; but it is older and shows traces of white down only on crown, throat and wings. Head and nape dark brown, with irregular white markings; wing coverts brownish grey with light margin on the separate feathers. Iris light bluish grey. For the rest like Number 9289.

Number 9214 is a somewhat older bird, which has already lost all its down. Neck and throat dark brown with irregular white markings. Skin of head and throat slate-blue. For the rest like Number 9213.

The other birds are adults, but number 9216 still has a remnant of the juvenile plumage in the form of irregular brown spots on the white rump; yellowish green eyes; yellowish green bill and grey skin of the head. In the fully developed adults the eye is yellow. As stated by HOOGERWERF, in living birds the ♂ has dark-yellow, the ♀ light-yellow or greenish-yellow eyes; bill bright yellow in male; in female yellowish green; skin of head in male dull black; of female slate-blue; feet olive green to bluish grey.

This form might be reckoned, with some reserve, among the subspecies *bedouti* MATH. It is, however, still an open question if *bedouti* can be separated from the subspecies *personata*. I had no material at my disposal of this last subspecies.

See for this CHASEN, Bull. Raffl. Mus. VIII, 1933, p. 69, and ibidem XI, 1935, p. 65, note). v. B.

## The Eggs.

The complete set consists of 2 eggs. Nests in which one egg was found,

contained two 5 to 7 days later. The shell has a fine bright blue-green colour almost entirely hidden by a dirty, rough lime-layer. Only in some eggs the colour of the shell shines through, which is also the case when the lime-layer has been scratched away by the nails or beak of the bird.

The lime-layer varies in colour from white to dark rusty-red, only in rare cases do the eggs lack the dark spots. Although the dark spots are undoubtedly and chiefly caused by dirt, they occur also on fresh eggs.

Twenty eggs, measured by me, varied from 56.5 - 72.5 mm in length, and from 40.5 - 45.5 mm in width. The longest and widest eggs measured 72.5:42.5, and 60:45.5 mm, respectively. Maximum variation in one set 6 mm in length, 2.5 mm in width. **H.**

### Biolog y.

The number of this bird at Gg. Api is small and does not exceed at a rough estimation a total of 100 to 150 birds. This number could only be observed in the afternoon when all animals had flown home with food, or visited the warmth of the solfatara's. In the morning ordinarily the number to be seen was limited to the breeding specimens, often accompanied by the partner.

We usually found the birds in pairs, not only when having a nest, but also when apparently possessing neither eggs nor young. Whether in such cases the birds always formed pairs could not be established.

As said before this species seems also to feed far from the breeding places.

Apart from the differences in colour of the beak and of the iris, the voice, though rarely heard, seems to be different in both sexes. In the female it reminds one of the call of the large sea-eagle *Haliaeetus leucogaster* and sounds almost as "hark-hark-hark", while the male produces a whistling sound. This observation agrees with those made by BEEBE on *Sula nebouxii*, and by SNODGRASS & HELLER on *Sula dactylatra* of the Galapagos Islands. However, sex difference was not correlated with voice by the latter authors.

BEEBE (Galapagos 1924, p. 271) remarks: "A blare of brazen, raucous trumpet-like notes mingled with squeaks and shrill whistlings. I killed a trumpeter and a whistler and found that they were female and male respectively, and I also recorded that the eyes of the two were wholly unlike. In equal shadow the pupil of the male was small, the iris almost clear yellow; in the female the pupil was about once and a half as large again and the yellow iris was more or less mottled with brown".

SNODGRASS & HELLER (vide BENT U.S. Nat. Mus. Bull. 121, 1922 p. 196) write: "The most common note uttered by the adults was a loud quack. Occasionally a sharp whistle was heard, but no special significance to this sound was observed".

At Gg. Api eggs and young were found without exception on the barren soil. So far as we could establish the birds did not use any nesting-material.

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At Gg. Api eggs and young were found without exception on the barren soil. So far as we could establish the birds did not use any nesting-material.

During my three weeks stay at Gg. Api I have not been able to ascertain at what age the young become fully fledged. However, considering certain observations on the growth of *Sula dactylatra*, I am inclined to assume that this will be at the age of 10 or 12 weeks.

In many cases flying young birds are still fed by the parents. In feeding, the young booby thrusts its head into the wide opened beak of the parent and gets its food from throat and crop. After this the old birds retire to a spot out of reach of the young, probably to escape the begging of the young.

At the appearance of the adult bird, the young runs or flits to meet its parent, stoops down flapping its wings, swaying head and neck, in the meantime uttering a squeak, touching intermittently the beak of the older bird and snatching the food from beak and throat of the adult bird. The feeding of the not fully fledged young generally occurs at the nesting place which is coloured chalky-white by the excrements of the birds. When the young had moved away from the nest, it did not take the adult birds a long time to find them, after their return to the empty nesting places. The feeding of bigger young often takes place at considerable distance from the nest.

Concerning the feeding of very young birds, I do not have any particulars. Dr. FISHER (vide BENT l.c. p. 195) remarks: "The young one inserts its head fairly into the throat of the parent, in a decidedly gruesome matter, and catches the disgorged food. In fact the young one's head went so far into the parent's throat that I became solicitous for its safety".

The young which I saw fishing near the island, caught their prey while floating with submerged head and neck. In some stomachs I found parts of fishes e.g. those of flying fish and squids. Of the squids we found only the dark parts of the beak.

Young birds, showing a transitional feathering between that of full-fledged young and the adult birds were rare on Gg. Api; I only observed 2 of them. Considering the large number of young birds which were not yet or hardly able to fly I was rather surprised to find so few birds in transitional feathering. The presence of so many young birds and eggs makes it extremely unlikely that human intervention may have caused this lack. I am unable to present an explanation for this curious fact.

Big young birds, fully able to fly, are obviously unwilling to do so. They always tried to outrun us, and were sometimes easily caught by hand. The older birds perched at level spots, seemed also disinclined to take wing. Rising from the flat ground is obviously rather difficult; as a rule they try to find a higher starting point, from where they swerve down. If they fail to do so, they run flutteringly and finally take wing for escape. Several times I observed that the seed of the kneedeep grass *Cenchrus inflexus* stuck to the feathers of the fluttering *Sula dactylatra*. H.

***Phaeton rubricauda westralis* MATH.**

*Phaeton rubricauda westralis* MATHEWS, Austr. Avium Record I, 1912, p. 88, (West Australia).

Cat. Nos. Btzg. Mus.	Sex	Culmen	Bill from gape	Wing	Tail from base of central feathers.
9100	(♀) pullus	23	36,5	—	—
9101	♀ pullus	31,5	47	—	—
9102	♂ pullus	44,5	61	—	—
9103	♀ juv.	48,5	70	190	—
9104	♀ juv.	54,5	75	242	—
9105	♂ ad.	55	82	334	390
9106	♂ ad.	59	84,5	320	398
9107	♀ ad.	61	88	310	307

The numbers 9100 and 9101 are nestlings in white down covering. In living nestlings HOGERWERF stated the down to be pearl-grey. Perhaps the colour fades in dry skins. Number 9101 has traces of grey down on tail and wings. Number 9100 still has an egg-tooth.

Iris dark brown, bill dark grey to black; shank flesh-coloured; sole dark grey, orbital skin greyish blue.

Number 9102 is an older nestling, already with black and white streaked feathers on wings and back of the juvenile plumage. In the tail two black central feathers are just beginning to develop. Colours of bare parts as in the others. Number 9103 has entirely white underparts, with a slight pinky reflection at belly, breast feathers with black central spots. Upperside black and white streaked. Neck, shoulders, rump and throat have dark grey down. Before the eye a black spot, not continued behind the eye, as in the adult animals. Forehead and cheeks white. The two central tail feathers jut out from the tail for about  $\frac{3}{4}$  inch and are white with black tips and black quill. Colours of bare parts just like those of the birds last mentioned, but base of lower mandible light grey. The bird had not yet left the nest.

Number 9104 already entirely feathered. The plumage resembles that of Number 9103, but has no remnant of down-covering. The markings on the breast have been reduced to some black bars. The quills of both central feathers have broken off, so that nothing can be said about their length. Iris dark brown, upper mandible black with bluish grey base, lower mandible black with flesh-coloured base. Shank light bluish grey; sole for the greater part dark grey. The three other specimens are adults and were found breeding. Central rectrices in number 9105 are about equally long. The longest of the two is the newest. In the two other birds only one tail feather has been developed, the other

tail feather has scarcely begun to grow. In one case the left feather is the youngest, in the other case it is the right feather.

In this series there is nothing disproving the theory of a completely regular alternative moult as contrasted with an irregular moult, as shown by CHASEN for part of his material of *Phaeton lepturus fulvus* of Christmas Island (Bull. Raffl. Mus. 8, 1933, p. 79). CHASEN himself did not find this irregular moult in *Ph. rubricauda*. This does not imply of course that such irregularities do not occur in *Ph. rubricauda*, for such an inference the series of Christmas Island and the one in question are both too small. The length of the wings of the adults corresponds to that of Christmas Island. Only the adult ♀ has a strikingly short wing. CHASEN (l.c. p. 77) points to the fact that winglength is not a suitable feature to distinguish *Ph. rubricauda westralis* from the typical form. The bills of the Gg. Api birds, however, are very short and therefore belong to the subspecies *westralis*, whose short bill is the most typical mark of identification.

v. B.

#### The Eggs.

The egg belongs to the most striking of all the types found on Gg. Api. The fairly coarse shell is bright white. In most cases this colour could hardly be observed as it is entirely covered by specks and dots which diverge a great deal in colour. Bright to dark lavender to purple seems to be the most common colour, but we also found eggs with a bright to dark gray and a brownish gray marking. The type of the marking too is not very regular. Ordinarily the dots are small, closely spaced and regularly distributed over the surface of the shell, but in other eggs the shell is coarsely dotted and the dots are concentrated at the blunt pole of the egg or at both poles. One egg was found that was almost purely white. At the blunt pole a few dirty purple spots appeared. These large spots seemed to be superficial as they could be removed by moistening the shell and scratching it, which was not the case with the small spots. A few specimens give the impression as if the colour was applied by a coarse brush in longitudinal direction. Generally the eggs show similarity with those of some birds of prey.

In 22 eggs the length varied from 47 - 68.5 mm and the width from 42 - 47 mm. The largest egg measured 68.5:47 mm. **H.**

#### Biology.

The tropic bird is also a common appearance in the bird life of Gg. Api. Occasionally one may observe one or two specimens at a time returning from sea during daytime; they are most numerous in the morning hours or in the late afternoon.

Their hidden life-habits however, makes an estimation of their number extremely difficult. During its stay at the island the bird hides in cavities of the rocks where it lives lost to view.

Never we observed *Phaeton* fishing near Gg. Api. From an examination of the stomach-contents of some of the collected birds and observations on the



feeding of the young it appeared that the diet of this species too consists nearly exclusively of flying fish and squids.

CORREIA (vide MURPHY: Bull. Am. Mus. N.H. I. 1924 p. 257), comments on the foraging of *Phaeton aetherus* as follows: "The juncos dive deep for the fish upon which they feed, and they remain several seconds under water, finally emerging with a fish crosswise in the beak or half swallowed".

Writing about *Phaeton lepturus catesbyi* the same author remarks (Nat. Geograph. Mag. 74, 1938, p. 250): "They feed by hurtling like arrows into the ocean a fact commemorated by their generic name, which they take from the illfated son of Apollo who fell from his badly managed chariot into the deep. Squids appear to make up the bulk of the tropic birds' diet".

Returning from the fishing grounds, generally solitary or in couples, the Gg. Api-birds mostly disappeared from view as soon as they reached the island.

These homing birds hurtle down right into the caves or in the immediate neighbourhood. In the latter case they shuffle along to the nest using the small legs or their wings. Rarely a bird is found lingering beyond the shelter. As a fact *Phaeton* seems rather in a hurry to hide in the cave at once; their inability to walk on the small legs or to take wing from a level surface may explain their cautiousness. The white feathering, moreover, is rather conspicuous to enemies hovering about.

One often can hear the thud of the alighting birds, even when the birds arrive at some distance. The very short and rather weak legs seem absolutely insufficient to break the fall of the rather heavy body.

To this point CORREIA, (vide MURPHY Bull. Am. Mus. N.H. I, 1924, p. 257) states about *Ph. aetherus*: "The feet are small and weak even in adults, and the "juncos" neither walk nor stand up. On the contrary they rest with their breasts on the ground, and when they progress over the short distances between the nest-chamber and the jumping-off place, they push along on their bellies".

NEWTON (vide BENT, U.S. Nat. Mus. Bull. 121, 1922 p. 191), mentions the fact that *Ph. rubricauda* ascends with great difficulty from a flat surface: ".....; in fact, like all birds which have their legs placed so far behind, they can not rise off a flat surface but require a drop of a few feet to give them an impetus".

Frequently we observed these birds flying along the slopes and poising before different shelters, a behaviour resembling the hovering of birds of prey. Not rarely several birds at the same time behaved in that way.

In this community-flying some more acts have been observed which seem to bear connection with the mating. Every day a number of tropic birds, varying from 5 till 10 were observed circling along the steep western slopes and above the craterpit, emitting a cry that sounded like: "uk-uk-uk-wow...uk-uk-wow" or "ûwûk-ûwûk-wow", intermittent with the cry "kecup—kecup—kecup" or "kecup—keeee". Flying round, the tail, pointed down obliquely, was wagged

vigourously. Next moment the bird assumed, heavily beating its wings, a vertical position apparently without moving from its place.

CORREIA (vide MURPHY, Bull. Am. Mus. N.H. I. 1924 p. 257) made similar, however slightly diverging, observations on *Phaeton aetherus* and describes their flight as follows: "They fly straight to their respective clefts or cavities in the cliff but, instead of alighting, they poise a while in air with the feet and tail trailing, and then wheel and describe short circles very rapidly, after which they return to the nest-site and poise once more".

ALEXANDER states (cf. MURPHY, *ibid.* p. 255): "Towards sundown these birds congregated over some favorite spot and indulged in nuptial flights, at times circling high in the air and uttering the whole while a series of harsh screeching notes that bore a striking resemblance to those of the common tern during the breeding season".

As said before, eggs and young of *Phaeton rubricauda*, never more than one in a "nest", were found without exception at places as described above. Not in a single case I observed that nesting material had been collected by the bird itself. The nest-cavities were often so deep that we only heard the breeding birds shriek when we were near the nest, walking *f.i.* overhead.

Besides holes and cavities in the mountain-slopes and among the lava blocks, the birds at Gg. Api show also a preference to inclining stones and low growing shrubs, where they can sit the whole day or the greater part of it protected for the heat.

BEEBE also states the breeding between lava-blocks of *Phaeton* at the Isle of Daphne.

In the rare cases where the nests were exposed to sunshine, we supposed, that the birds were "mistaken" in their choice of the nesting place and the egg was laid on a dark day when the bird could not take into account the bad consequences connected with their habitation. Here they were suffering from heat to such an extent that they sat in the nest gasping for breath their body shaking vehemently with convulsions to a degree as I never before saw in other birds.

The way of nesting at Gg. Api is different from that of the allied *Ph. rubricauda rotschildi* as related by MURPHY (N.G.M. 74, 1938, p. 250): "The species differs from other tropic birds in that it nests on the ground of low islands, instead of seeking lofty niches in cliffs. In keeping with this habit it has considerable agility in rising into flight from a level surface, which it does by scurrying along foot after foot, rapidly beating its wings".

*Phaeton* does not react if one passes at a distance from the nest. If this be the case, e.g. if one treads too close to the nest, upon which the incubating bird is perched, it produces a piercing "uk - uk - uk" or "klieuw — àkieuw..... klieuw — àkieuw", thus betraying the location of the egg.

At the approach of men the tropic bird does not leave the nest but attacks as soon as danger is imminent; even when I tried to snatch the egg away, the

parent did not budge and remained at its post. I am under the impression that in such cases *Phaeton* holds on to the clutch, for I saw the bird stand on the defensive, waddling in the nesting cavity with the brood firmly gripped. The egg may only be obtained by expelling the bird by force or by keeping the beak tightly shut. After removing the clutch, I observed several times that the birds remained at their nests, sometimes for one more day.

The territory, in which no intruder is allowed to enter, the hole or entrance to the nesting-cavity, is violently defended, even against birds of the same species. If another *Phaeton*, in search of a hide-out, attempts to enter another bird's nest-hole, it is involved at once in a fight in which bills as well as wings are acting fiercely. The birds shuffle along the ground with vertically outstretched wings like swans on the water, shrieking loudly, "ukukuk—kleeuw", "kleeuw - akeeuw", or "keee". The trespassing bird as a rule retraces its flight almost immediately in search of another hiding place. Even a young and an adult *Phaeton* were observed fighting in this way.

CORREIA comments upon this behaviour in the following way (vide MURPHY Bull. Am. Mus. N.H. I. 1924 p. 257): "They seem to be suspicious one of another. A bird which has alighted makes loud outcries and attempts to peck any other bird which shows that it would like to descend near the same place. Should the approaching bird actually perch, the other flees from his post". The latter was never observed by us.

At first I believed that a similar "kind" reception was bestowed upon the mate of the breeding bird too. Later I was able to review this opinion as I actually observed a most peaceful conduct of the partners, changing guard.

I also differ from CORREIA, where he writes (MURPHY Ibid. pag. 257): "The male "juncos" also appear to be very jealous of their mates. If a strange male approaches a niche in which a female is brooding, the mate of the sitting bird promptly takes the invader to account, with ear-splitting calls".

Such a conduct has never been observed by me, in almost every case I only found one breeding bird in the nest-hole.

The egg is incubated by both sexes equally. I was not able to tell which is the male or the female.

In changing guard the birds perched in the entrance, or the nest-hole, bills almost touching and shrieking as if an attack was forthcoming.

The young are cherished about a fortnight after hatching and just like the egg defended fiercely against intruders. However, on several occasions I observed how the small young were left alone for rather a long time.

The bigger ones lie in the nest unprotected and quite helpless for the greater part of the day and perhaps whole days. No trace of the older birds is then to be observed.

Feeding the young resembles somewhat the method in use by the herons, e.g. the aigrettes. I could not find out, however, if, like in the case of aigrettes, *Phaeton*, when feeding very young birds, spills the food on the nest, before the hungry off-spring.

Once, I actually saw a chick of only a few days old, snap at the bill of the parent and taking the food from it. In order to facilitate this, the adult bird inclined the head a little so as to enable the young to catch the food.

The chicks will take hold of the beak of the adult in such a way that the tip of the beak disappears into the bill of the young. In the case of halfgrown birds, the beak of the parent enters almost entirely into the throat of the young, where the food is disgorged. The begging sounds like "aie-weeee-weeee-weeee..... aie-weeee-weeee-weeee".

Once I saw a circa 14 days old young spilling a fish about 20 cm long. However, I could not observe the fish being swallowed by the chick, as the beak of the adult bird was plugged down so deeply into the throat of the young, that the bases of the bills were touching. Though I watched the feeding very closely, I could not see from the outside how the young bird managed to swallow this large prey.

With regard to this species I also ascertained as with *Sula leucogaster* the strange fact that a fairly large number of half-grown birds had died. In contrary to the chicks of *Sula leucogaster* these dead ones were all found in the nesting-cavities and never outside. A great number of them were so big that it may be assumed that death overtook them when they were almost full fledged.

As remarked already above when speaking about *Fregata minor*, *Phaeton* much suffers from the food-robberies by the frigate-birds, through which it certainly often happens that the adult birds return to their off-spring with empty crop, but I think it improbable that in this fact may be seen the solution of the problem.

BEEBE (Galapagos, pag. 263), who reported the same for the tropic birds of the Island of Daphne, fails to give an explanation for this curious fact. He says about this matter: "Sheltered on all sides, armed with sharp, saw toothed beak, the Daphne tropic bird have absolutely nothing to fear, and yet within a few feet of the crevice lay two mummified young birds and one adult, while in a narrow niche at one side of the nesting ledge was a cold egg. The egg was easily explained, the shuffling, awkward gait of the old birds must have given it a flick which rolled it into the narrow corner. But the dead birds were a puzzle, and the only explanation was family jars-tragedies of jealousy".

Rather interesting in connection with the facts stated above seem the observations of Mr. R. M. LOCKLEY (Nat. Geogr. Mag. 1938, p. 252) on *Puffinus puffinus*, found by him at the island of Skokholm, some miles out of the Pembrokeshire coast of Wales. The author says, that though the young of these birds in the beginning are fostered day and night by the adults, soon the care slackens and that when the definite feathering appears they are fed only once a night and on moonlight nights were neglected completely (this petrel is said to prey only at dark nights and to keep quiet during the day).

After nine weeks, when nevertheless, the young still were in a fairly good condition, they were deserted altogether. The author traced this fact in a very clever way. In one case observed by him the young after the desertion of the

parents, remained cowered in the nest-hole for 6 consecutive nights. In the seventh night it moved away and, during the following days, sat flapping its wings before the hole but not yet able to take wing. A marked decline in bodily condition was apparent.

The author does not tell if this young bird ever reached the shore but at the end of his tale he relates that the young "blunder downwards to the cliff and flutter to the sea", where they succeed in finding their food and escaping their enemies by diving under water. No mention is made in the said paper about the occurrence of dead young, but it seems probable that birds will fall victim to this Spartan education.

Perhaps *Phaeton rubricauda* behaves in a similar manner and the found mummies might be of young birds which failed to find their way to the feeding grounds.

Moreover, it is remarkable that I never saw a flying young tropic bird at Gg. Api in the juvenile feathering. Considering the great number of sturdy chickens in the holes it is not likely that not a single one fled the nest.

It may be that soon after leaving the island they travel a long way from the volcano and do not return there for a time.

Similar conditions have been reported by NEWTON (BENT l.c. pag. 192) from the breeding grounds of the red tailed tropic bird at Mauritius. NEWTON remarked on that score: "There were to be found about as many young as eggs, some of the former almost as large as their mothers, and nearly able to fly, but I did not see a single immature bird that had started in life on its own account, though I have no doubt many had already done so". **H.**

#### *Anous stolidus pileatus* (SCOPOLI).

*Sterna pileata* SCOPOLI, Del. Flor. et Faun. Insubr. fasc. 2. 1786, p. 92, (no locality = the Philippines ex SONNERAT).

#### Material:

Cat. Nos.	Sex	Culmen	Bill from gape	Wing	Tail	Colour
Btzg. Mus.						Pullus
9245	(♀) pullus	13	20,5	—	—	brown
9246	(♂) pullus	14,5	23,5	—	—	white
9247	? pullus	13,5	21,5	—	—	white
9248	♂ pullus	16	26,5	—	—	white
9249	? pullus	16	26,5	—	—	brown
9250	(♀) pullus	18,5	30	—	—	brown
9251	(♀) pullus	16,5	28	—	—	white
9252	♀ pullus	18	29	—	—	white
9253	(♀) pullus	19,5	30	—	—	brown
9254	(♂) pullus	17,5	29	—	—	white
9255	♀ pullus	20	30,5	—	—	brown
9256	♂ pullus	21	33	—	—	white

Cat. Nos.	Sex	Culmen	Bill from gape	Wing	Tail	Colour
Btztg. Mus.						Pullus
9257	(♀) pullus	21	33	—	—	brown
9258	(♀) pullus	22,5	34,5	—	—	brown
9259	♀ pullus	23,5	37	—	—	white
9260	♂ pullus	28	42	—	—	?
9261	♀ pullus	26	41	—	—	?
9262	♀ pullus	26	41	—	—	?
9263	♂ juv.	32	50	230	139	—
9264	♂ juv.	33	53	239	146	—
9265	♂ ad.	40,5	56	274	176	—
9266	♀ ad.	38	56	276	174	—
9267	♀ ad.	42	58,5	279	173	—
9268	♀ ad.	39	54	264	167	—

Of this species Mr. HOGERWERF collected a marvellous series of young birds of all ages from the very young nestlings in down to the adults. Especially the young ones are very interesting, showing a distinct dimorphism. In SAUNDERS (Cat. Birds. Brit. Mus. Vol. 25, 1896, p. 140) I found that the young ones of this species are not uniform. He gives the following description: ".....has the forehead and crown dull white, lores blackish, upper surface mousebrown, nape and throat darkest, lower parts paler. Another, only just hatched, is nearly uniform sooty brown".

One form of the young Gg. Api birds is like the first description of SAUNDERS. Not one of them is "uniform sooty brown", whereas most other descriptions of young birds mention this very colour sometimes adding "paling to sooty white on the abdomen" (STUART BAKER, Fauna Brit. Ind., Birds, Vol. VI sec. ed. p. 146) or "soon acquiring a white line above the lores". (ROBINSON & CHASEN, Birds Malay Pen. Vol. III p. 107). Besides this form there is another type of young in Gg. Api. This type is practically purely white, only down on shoulders, back and tibia with greyish brown tops, which causes the upperside to have a spotted aspect.

This white phase is also mentioned by BENT (Bull. U.S. Nat. Mus. 113, p. 307) but unfortunately he gives no further informations. As far as I know this white phase was not yet reported for Indo-Australian Noddies. How far dimorphism is typical of certain breeding-colonies is naturally an open question, but it is scarcely to be supposed that such a strikingly light type should have been overlooked in the breeding-colonies that have been examined in this part of the world. Any connection with age or sex does not exist, as may at once be seen from the table and pl. 33 fig. 1.

All nestlings in down covering have iris dark brown, bill black to greyish black; legs dark grey to dark brownish grey; the juvenile covering is rather uniform brown with blackish brown quill- and tailfeathers. Very remarkable is the change of colour of the head. All young birds have a white forehead

and in the first feather covering it remains white to greyish white. An exception to this rule is number 9258, a young one, partly in feathers and a feathered head with brown forehead with slight white spots and marked with a white line above the lores. Only Number 9264, one of the two fullgrown but still immature specimens in our collection, also has such a marking of the head, the other, number 9263, has a white forehead with a darkbrown spot at the base of the upper mandible. All other nestlings, partly in down and partly in feather covering, have a white forehead speckled more or less distinctly with brown. In number 9261 the upper part of the head is even entirely white with a little brown on the crown. Number 9260, nearly as old as number 9261, has a little brown spot on the base of the upper mandible.

Even in half feathered nestlings in down, the lores are distinctly black.

DELACOUR & JABOUILLE (Trav. Serv. Oceanogr. Indochine 3e Mem., 1930, p. 15) also emphasize this development of a white forehead in young birds to brown with white eye line in immatures and then pearlcoloured greyish in adults, while I did not find it stated anywhere else. The colours of the bare parts are alike in all the birds, both in juveniles and in adults, viz., iris brown; bill black; legs dark brownish grey. The measurements of the wings of Gg. Api birds are somewhat shorter than those of adults from the Paracel Islands given by DELACOUR and JABOUILLE (l.c.) and from several localities in the collection of the Raffles Museum, given by CHASEN (Bull. Raffl. Museum 8, 1933, p. 63). Average length of tail, however, larger.

An adult ♂ of Kebatoe cliff (S. of Billiton) in the collection of the Buitenzorg Museum has a wing of 282 mm, tail 156 mm, an adult ♀ of the Tabbotaha Reef in the Soeloe Sea has a winglength of 269 mm, tail 156 mm. **v. B.**

### The Eggs.

Without exception I found in the nest of this bird only one egg at the time. The dull or almost dull shell is white to cream-coloured and covered with a number of irregular primary and secondary spots and dots, often concentrated at the blunt poles, seldom at other places. In some cases small lines may be seen between those dots. The secondary dots are bright to dark ash-coloured while the primary irregular dots vary from bright to dark maroon. In a few cases, even from a dark amber to black. The dirty spots on some of the eggs possibly appeared after the eggs have been laid. They vary considerably in size as well as in pattern. In 24 eggs the length varied from 46 - 53.5 mm, and the width from 32.5 - 37.5 mm. The largest egg measured 53.5 - 37.5 mm.

**H.**

### Biology.

The Noddy may be considered the most common bird of the island. It seems not particular about habitat for I observed the bird living all over the volcano. It nests among the lava blocks at the shore where the spray of the ocean dashes against the nesting birds, as well as in the higher zones just

about the fuming solfatara devoid of all vegetation because of the high temperature and the composition of the soil. Once I found some nests in a dark cave which I visited in search of bats and swifts, where no other living creature could be traced than this very *Anous*.

As a rule the gregarious birds were nesting together in small groups. At first sight *Anous* resembles more a gull than a tern. We drew at once a comparison with the black-headed gull *Larus ridibundus* of the temperate zone, with which *Anous* displays a striking resemblance in appearance and behaviour. Perched among the boulders or solfatara-slopes or flying in small flocks over the sea, the birds presented more likeness to this gull and even to certain kinds of pigeons than to terns.

CHAPMAN (BENT, U.S. Nat. Mus. Bull. 113 p. 308) made a similar comparison. He writes: "As the only tern with a rounded, instead of forked tail, the noddy might be expected to differ in flight from other members of its family. In fact it suggested, when in the air, a light bodied, long-winged, long-tailed pigeon".

We figure that on Gg. Api a constant total of several hundreds of these birds can be seen day by day and as we never saw them stray far away, we venture to say that the feeding grounds, contrary to that of the larger oceanic birds, were lying near the volcano. In fact I watched them fishing in that neighbourhood. According to BENT (i.e., p. 308), WATSON mentions that as a rule *Anous* forages at a distance of 9 or 10 knots from the breeding grounds and rarely turns away a distance of 15 miles or more out of the coast.

DELACOUR & JABOUILLE (Trav. Serv. Océanogr. Indo-Chine 1930, 3e Mém. p. 15) mention that the birds live at high sea and feed upon molluscs and floating dead fish.

About the feeding-habits WATSON observed (vide BENT, i.e. p. 307): "In a locality where marine-forms are so abundant as in this favored Gulf region, the terns collect their food with little difficulty. They feed upon small fish of different kinds, which are present in great abundance. Examination of the stomach contents of both young noddies and sooties showed the presence of representatives of the two families of fish *Carangidae* and *Clupeidae*.

To my great surprise I found that the birds never swim nor dive. As a matter of fact, they never touch the water except when drinking or bathing. The bird drinks the seawater as it skims the surface of the water with open beak. Bathing they perform in much the same way, never coming to a stop in the water nor completely immersing the body; usually the breast and head are the only parts dipped into the water.

The birds fish by following schools of minnows which are being attacked by larger fish. The minnow in its efforts to escape, jumps out of the water and skims the surface for a short distance. The terns pick of these minnows as they hop up above and over the surface of the water. The rapidity and accuracy of visual-motor adjustment in this reaction is wonderful".

Contrary to this observation, AUDUBON (vide BENT, i.e. p. 308) remarks



that *Anous* "swims with considerable buoyancy and grace, and at times immerses its head to seize on a fish".

During my twenty-days stay at Gg. Api I did not even a single time see a swimming or bathing *Anous*.

In the stomachs of young as well as of adult birds examined by us at Gg. Api, we found rests of fish, mostly flying fish and squids, sometimes pebbles and a few down-feathers which may be swallowed by the birds when pluming.

Marauding of other species of terns as mentioned by DELACOUR & JABOUILLE (l.c. p. 17), was never observed by us.

On this behalf these authors remark: ".....c'est ainsi que les sterns sont poursuivies par les Niais (*Anous*) qui les forcent a dégorger les poissons qu'ils viennent d'avaler, que les Niais eux-mêmes sont victimes des Fous, lesquels sont a leur tour persécutés par les *Frégates*".

The "salutation-ceremony" on the nest or elsewhere, consists of a series of bows with wide-opened beak. I got the impression that the tongue was turned up high in the lower bill. When stooping downwards *Anous* persisted in this attitude with beak pointed to the webbed feet as if surprised by a sudden discovery which held its interest in such a degree as if the bird had forgotten all about the salutation. During this ceremony a low, unconsiderable and hoarse sound was produced.

Besides this "bowing-ceremony" another sequel of actions was performed which may be characterized as "crowing ceremony". Here the head and throat were raised obliquely and a soft "kra-kra-kra" or "kurr-kurr-kurr" was heard.

The nest-places vary widely. Along the sea-shore where vegetation is scarce upon and between the lavablocks of the slopes, a large number of eggs is laid upon the bare rocks. Higher up the mountain, along the old lava-bed, numerous birds lay their eggs into the rich vegetation of grass, herbs and shrubs of the species *Cenchrus inflexus*, *Ipomoea pes caprae*, *Trema virgata* and *Caesalpinia crista*.

Also in the *Pisonia* wood some breeding birds were found, sometimes at a considerable elevation above the ground, moreover in *Ficus*-trees and on the leave-bases of coconut palms and *Pandanus*! As has been mentioned above numerous clutches were found on the barren hot solfatara-fields and even in a dark cave along the West-side of the volcano.

The same inconstancy existed in nestbuilding. Often I found the eggs deposited upon the rocks or the barren soil, devoid of nesting material. In contrast with this, a great many nests composed of dry leaves among which those of *Pandanus* and seaweed, reminded us of the ponderous nests of the black headed gulls, to be found floating in the European marshes and bogs. However, such nests were not found on the level solfatara-fields; on the contrary there the eggs were scattered over the barren hot crater-field where the stones were covered with a white hue in consequence of the sulphurous vapours. Therefore I ventured the suggestion that large nests are built perhaps in order to prevent the eggs from rolling away, but this assumption proved not to hold for all cases, because

large buildings were also found in such places where the egg would be perfectly safe without a nest.

In the trees and shrubs the clutches ordinarily were deposited on big nests, but in *Pandanus* and in the coconut-palms they were laid as a rule without any material in the leaf-bases.

Elsewhere too, this tern displays no regularity in the choice of nesting-places and nest-building as pointed out by CHASEN. To this point he observes (Bull. Raffl. Mus. 8, 1933 p. 64): "The breeding habits of the Noddy are as variable in Malaysia as elsewhere. Sometimes as in the Keeling Atollon, it makes a nest: at other times the egg is placed on the bare rock".

In a short communication about a trip to the island Kebatoo, near Bililiton, KUIPER (De Trop. Natuur 1937, p. 67/68) mentions *Anous stolidus pileatus* to nest there exclusively on the ground, while *Anous minutus worcesteri* only was found nesting in trees and shrubs. A fairly good photograph of a brooding Little Noddy in a shrub accompanies the text.

WORCESTER (Philipp. Journ. Sc. VI, 1911 p. 175) observes: "There were numerous Noddy terns, *Anous stolidus* (LINNAEUS), on the island and they were nesting on the ground among the pursely plants. We did not find any of them nesting on the bare sand".

DELACOUR & JABOUILLE write (l.c. p. 15): "Leur nid est fait d'herbes, d'algues, de plantes marines, de carcasses de poissons ramassés sur le bord de la mer: ses matériaux sont simplement posés les uns sur les autres, sans entrelace, et forment au centre une dépression qui contient l'oeuf unique".

About nesting habits of *Anous s. stolidus* breeding in America, PEARSON (Book of Birds, Vol. I Washington, p. 319) tells: "Of all the American terns only the noddy has the habit of building its nest in bushes and low trees. Some noddies are exceptions to this rule, however. In some places they enter crevices in rocks to lay their eggs or even use the open ground for this purpose. The nests are substantial structures of twigs, grass, seaweed and similar materials".

WATSON (vide BENT, l.c. p. 304) reported that some nests are occupied anew every year and therefore attain an enormous size. I got the impression that in many cases the same occurs at Gg. Api, because I observed several old nests which seem to have been built up of various layers of nest material. The same author also mentions the stealing of nest material by *A. stolidus*.

BENT (l.c., p. 303/304) writes that the female bird is fed by her mate during the time of nestbuilding, but as soon as incubation has been started, no more feeding takes place.

I am not able to confirm this statement, which, however, does not exclude the possibility that on Gg. Api these birds act in the same way.

It is likely that here a greater number of eggs perish than elsewhere, probably as a result of the extreme heat of the solfatara-fields. Exact data on the temperature are not at hand but in my shelter erected between the nests and young I hardly could stand the heat and I had to move my feet in heavy hobnailed shoes constantly. The vapours from the soil condensed upon my

camera-lenses and the photograph-cases lying on the floor, which in a few minutes became so hot that I could hardly handle them.

The clutch is hatched by male and female equally. The time of incubation is reported to be 35 or 36 days (BENT, l.c. p. 305). The mode of defence of nest or breeding-territory differs considerably and seems more to be dependent on the individuality of the different birds than to the degree of incubation of the clutch. Sometimes the birds took wing when we approached the nest and still kept at a considerable distance; on the other hand we could not rarely draw quite close to the nest and even caress head and wings of the occupant. Once I took up a chick, while the adult stepped upon my hand. The mate of this bird, however, was so shy under the same circumstances that it left the nest when we were yet at a distance of 10 meters or more. Shrieking, it flew at us, swooped down at our heads, and returned immediately to attack us in the back. This one and also other birds touched our head several times.

In the *Pisonia* wood it happened several times that quite unexpectedly an *Anous* swooped down and attacked us shriekingly. In one case we were able to catch the rash bird with the bare hand. The sound produced during such attacks is a loud "akèggg-akèggg" or a harsh "kraaaa-kraaaa".

This dissimilarity in behaviour was also noticed by WATSON (BENT l.c., p. 304): "After the egg is laid a marked change appears in the behaviour of both the male and the female. The birds will now attack even a human intruder, and their defence of the nest against their own kind becomes even more strict than before. Oftentimes the birds will sit on the egg and allow themselves to be caught, striking viciously all the while with their long, keen, pointed beaks. Individuals vary greatly in this respect".

Probably the young birds are able to fly at an age of about 6 weeks. Before that time they stay at or near the nest. If they wandered from home, as was the case when they were disturbed by our approach, and lost their way home between the big lava blocks, they were, nevertheless, fed by the adults and flourished just like the other specimens. A similar observation made by WATSON (BENT l.c., p. 305) may be quoted here: "In many cases these young birds cannot get back into the nest. Under these circumstances they remain near the nest-locality, and the parents on returning first alight on or near the nest and later hop to the ground and feed the young bird. It is interesting to speculate upon the method of recognition between parent and young. There can be no doubt at least of an accurate functional recognition. Since the Noddy is always silent when contented, the evidence is good that recognition occurs wholly in terms of vision. Whether recognition of young (or of mate by mate) would take place outside of the nest locality is a problem which ought to be solved".

In the feeding process the young bird snatches the food from the beak of the adult after the food has been brought into the lower bill and throat. In the cases examined by me, the food consisted of fry and squids. **H.**

*Sterna anaetheta anaetheta* SCOP.

*Sterna anaethetus* SCOPOLI. Del. Flor. et Faun. Insubr. 1786, p. 92 (Panay Island, Philippines).

*Material:*

Cat. Nos.	Sex	Culmen	Bill from gape	Wing	Tail
9290	? pullus	—	—	—	—
9291	? pullus	—	—	—	—
9292	♀ pullus	27	41	—	—
9293	♂ pullus	28,5	43	—	—
9294	♀ adult	41,5	53,5	270	215
9295	♂ adult	41,5	54	274	203
9296	♂ adult	41,5	52	271	193
9297	♂ adult	43	51,5	265	205
9298	♀ adult	42	53	273	198
9299	♀ adult	41,5	52	267	202
9300	♀ adult	40	50	262	205

The numbers 9290 and 9291 are nestlings in down. Down coverts are very dark brownish grey with pale yellow brown tops and grey base. The nestlings are yellowish grey on the belly. Iris darkbrown, bill deep grey to black, legs deep grey.

Number 9292 a much older pullus, already partly in feathers. Throat and forehead still in speckled down, crown black with greyish white stripes. Quill-feathers brownish black, rest of feather covering brownish black with pale reddish brown tops. Colour of bare parts as in the preceding specimens.

Number 9293 almost fledged and entirely in feather covering.

Throat, cheeks and the whole of the underparts white. Upperside of head and lores dark greyish brown with light stripes, superciliary stripes and forehead grey with somewhat darker specks, neck and shoulders grey but no light margins on the feathers. The rest almost uniform dark brownish grey with some traces of the pale reddish brown marking of number 9292.

All the other birds are full-grown, in breeding plumage with dark brown iris, black bill and black to deep grey legs. The measurements of wings of the Gg. Api birds are larger than stated by STUART BAKER for British India (Fauna British India VI, p. 141), but they tally with those mentioned by MEISSE for Sangiang (Journ. f. Ornith. 1930, p. 193 - 194). Nor can I find any differences between a series of adult birds of Java belonging to the collection of Dr. M. BARTELS, some birds of Billiton and Ceram in the Museum Buitenzorg and the birds of Gg. Api. Some specimens of Malacca (Coll. Raffles Museum Singapore) are much lighter, but have probably faded. Number 9293 is remarkable for lacking the light margins on the shoulder feathers. A somewhat younger

pullus of Java in the collection of Dr. BARTELS is much lighter, the head being more distinctly marked and also much lighter. A somewhat older specimen of Benkoelen in the collection of the Buitenzorg Museum is also lighter with distinctly marked shoulders, but bears a greater resemblance to the marking of the head of the Gg. Api bird. If there is a constant difference in the juvenile plumage of this species between the western and the eastern part of the Archipelago, is a question which had to be left unsettled, owing to the want of material which I had at my disposal. For the present we shall have to accept that *Sterna anaetheta* is represented in the Indian Archipelago by one single subspecies. v. B.

#### The Eggs.

The egg is very pretty. The dull or light gleaming shell shows on a light to dark cream coloured background a number of spots of various shape and size. All the eggs examined by me exhibit beside dark primary dots, a number of lighter secondary speckles.

In general the marking is evenly divided over the entire shell and generally speaking the spots do not converge, with the exception of a few eggs where I noticed a concentration of most spots round the blunt pole of the egg forming there a little circle.

The secondary spots vary from light to a dark ashgray, while the primary speckles have a light to darkbrown chestnut hue, sometimes varying to the colour of amber or drawing to black. Though the colour of these eggs resembles those of *Anous stolidus*, yet one may tell them apart, because they vary not only in size but also in markings, the latter being usually more concentrated than those found on the clutch of *Anous*.

Some eggs are "flamed", making the impression as if they have been "smeared" with a paint-brush. The egg portrayed on pl. 31 fig. 3, right corner below, owes its dark covering probably to influences from the outside, i.e. from the solfatara field, where I actually found it.

In 20 eggs the length varied from 42 - 51 mm and the width from 31.5 - 35.5 mm; the largest egg measured 51:35, the widest 45:35,5 mm. H.

#### Biology.

The number of this dark-winged, rapid flighted tern was considerably smaller than that of *Anous stolidus*, even taking in consideration that many specimens were hidden among the lavablocks or kept perched on the nest or in the cavities.

During our stay the birds were almost always flying in couples, while in breeding we did not observe a definite inclination to the formation of colonies.

Contrary to *Anous*, which apparently feels itself at home in any surrounding, *Sterna anaetheta* gives the impression to be extremely particular about its habitat. At Gg. Api life concentrated in a part of the old lava bed, which was bare of all vegetation.

The birds appeared to be rather shy and easily startled. In no way they could be approached. At our approach they uttered a plaintive sound "wouweee-wouweee" or "wouweee—krrr" or "kèkè—krrr", circling wildly around us but carefully avoided to come too near. The quietly perching birds uttered a soft cooing sound like "kurr - kurr - kurr" or a plaintive "uwwww—uwwww".

As remarked before, this tern does not breed in colonies but in some cases several couples were found breeding in such surroundings which elsewhere were not frequented at all.

At Gg. Api they usually were nesting between *Anous stolidus* and like *Phaeton rubricauda* on the bare floor of cliffs and in cavities without using any nesting material, often so deep that on no account the clutch, consisting of a single egg, could be detected. Only a few times we found the eggs lying uncovered between the rocks.

The entrance to the nest is often rather intricate. So we sometimes were able to catch a bird as it tried to escape, when disturbed by our walking overhead, and could not free itself in time from the narrow mouth of the cavity.

One nest was found in a cavity in a steep slope, that in about horizontal direction had a depth of more than a meter.

Only a few times I found the egg not in a hole, but only between the stones. That *Sterna anaetheta* not always shows such a marked preference for cavities as nesting places, has been observed by the author at a breeding colony near Bawean (Java-sea) where all eggs were deposited on a coral reef and on level ridges, though the conditions for hole breeding also existed.

It took some time and a lot of trouble to discover the young of this species. Then it was another problem to snatch the fluffy balls from between the rocks.

The bigger specimens were scarcely visible too, obviously profiting of the great safety offered by the favourable nest-site chosen by the adults. Only twice we were able to collect such birds and these were the only occasions to get a closer view of them. From the fact that one of these almost full-fledged young was found in a nesting cavity it may perhaps be concluded that the young birds probably keep to the nest till they are fully able to fly, which may be the case at an age of about six weeks. Not a single flying young bird could be observed.

Owing to the lack of young birds and because all stomachs of the collected adult specimens were empty, no data could be obtained about feeding habits and the nature of the food, but it seems probable that the latter resembles the diet of all other birds at Gg. Api. Observations by WETMORE, point in this direction. This author, according to BENT (U.S. Nat. Mus. Bull. 113, p. 289), noted the following: "Of five stomachs examined one was entirely empty. Fish remains were present in all the other stomachs and amounted to 70%, one species was identified as a filefish (*Alutera* sp.) Mollusks (25%) were represented by a gastropod and a cephalopod (*Spirula australis*) the latter one of the few of that order bearing a shell, that exist to-day. Miscellaneous matter (5%) consisted of a moth and a small echinoderm. Fish and marine mollusks

form the large bulk of the food, and under present conditions the birds are to be considered harmless, as the fish eaten are not of economic importance".

BENT citing AUDUBON (l.c. p. 285) remarks: "This species rarely alights on the water, where it seems incommoded by its long tail".

And: ".....that it never dives headlong and perpendicularly, as the smaller species are wont to do, but passes over its prey in a curved line and picks it up".

I did not succeed in observing specimens of this tern swimming or even bathing. H.

### *Sterna fuscata nubilosa* SPARRM.

*Sterna nubilosa* SPARRMAN Mus. Carls. fasc. 3, 1788, No. 63 (Finland, errore = "India Orientalis", according to SUNDEVALL).

#### Material:

Cat. Nos.	Sex	Culmen	Bill from gape	Wing	Tail
Btzg. Mus.					
9269	♀ juv.	31,5	47	270	105
9270	♂ juv.	34	48	275	113
9271	♂ juv.	34	46,5	287	117
9272	♀ juv.	33	45	292	128
9273	♀ juv./ad.	38	51	(282)	158
9274	♂ ad.	41	55	(285)	166
9275	♀ ad.	39	52	(281)	(155)
9276	♀ ad.	40	55	277	(137)
9277	♂ ad.	42	58	280	165
9278	♂ ad.	41	58,5	282	168
9279	♀ ad.	42	53,5	290	168
9280	♀ ad.	40	54	285	(162)
9281	♀ ad.	41,5	53	(283)	(158)
9282	♀ ad.	40	55,5	280	164
9283	(♀ ad.)	42	53,5	294	165
9284	♂ ad.	41,5	53,5	283	177
9285	♂ ad.	42	55	293	175

The specimens 9269 - 9272 are in blackish brown juvenile plumage, but already fledged. The feathers of back, tail, wing coverts and under secondaries with white points. A white spot on belly. Iris deep brown, bill and legs black.

Number 9273 already in adult covering, but shoulderfeathers have white tops. For the rest the plumage resembles that of numbers 9274 and 9275. These birds have a white striped crown and lores, which is typical of the "winter" plumage.

Number 9281 has traces of these stripes, but has, besides this, pale tops on the shoulder feathers. Probably this is a full grown young bird. The ovary already rather well developed. Wings of these last four birds in moulting.

All the other adults still in brooding covering with dark crown and lores. Two of these, ♀ ♀ with well developed ovaries have dark spots on throat. Bill black; iris deep brown; legs black or very deep grey. The "Rassenkreis" *Sterna fuscata* urgently needs revising. I followed the division of J. L. PETERS in his "Checklist of Birds of the World", which in his own words is only "tentative". As material of comparison I had the disposal of a small series of *Sterna fuscata serrata* WAGLER of Lord Howe Island in the collection of the Australian Museum at Sydney. Two adults in this series are larger (Culmen 44 - 46); bill from gape 58 - 60; wings 296 - 300; tail (192 - 196). The juvenile specimens of *serrata* have a lighter coloured breast while the ventral spot is less distinct.

v. B.

### The Eggs.

During my visit to Gg. Api I found no clutches of these terns. From the literature on the subject we learn that the clutch usually consists of only one egg. DELACOUR & JABOUILLE (Trav. Serv. Océanogr. Indochine, 3e Mém. 1930, p. 11) give the following measurements of two eggs of *S. fuscata infuscata*: 47:37 and 55:34 mm.

H.

### Biology.

The number of this lively, sociable tern amounted to four or five hundred. Although morphologically it closely resembles *Sterna anaetheta*, in biological respect it differs widely from this species. While the latter tern kepted at the western slopes of Gg. Api, between the lavablocks, *Sterna fuscata* lived exclusively at the solfatara fields and on the crater bottom on the bare places between the *Paspalum* vegetation. On each of the three big solfatara-fields near the crater, devoid of any vegetation, we regularly could observe a number of specimens.

As a rule this species proved to be not too shy and repeatedly we succeeded in approaching the perching birds to within a distance of some meters.

Therefore my observations do not agree with the notes of BENT (Bull. U.S. Nat. Mus. 121, 1922, p. 287). He writes: "The bridled tern so closely resembles its near relative, the sooty tern, that it can hardly be distinguished from it in life by the casual observer".

Often the alarm-cry of a single bird was enough to startle the whole flock and after first being given by a single bird, was taken over by the flying flock while it steered for the sea. This cry sounded like a harsh and shrill "krr—krrr" or "awèhwèhwèh—awèhwèhwèh". Not rarely the other "rookeries" followed the first flock and a number of *Anous stolidus*, highly disturbed by the pandemonium, and not trusting themselves any longer on the ground, joined in flight. These manoeuvres happened at our approach as well as when we kept far away from the resting-places. Often we heard the alarm at moonlight nights, a fact also mentioned by BENT (l.c. p. 286). "One can hardly make himself heard in the rookeries by day and it is difficult to sleep near them at night".



During daytime the birds at the solfatara fields were chiefly occupied in trimming their feathers. Occasionally, however, a number of them were engaged in what seemed a rather curious act, which is worth mentioning.

Some 3 to 6 birds were trodding in a large circle with trailing wings and the head poised obliquely at an almost horizontal position.

Ovaria and testes of the examined birds were all in rest, and the feathering did indicate a passed breeding season. Therefore it seems difficult to connect this behaviour with mating, which seems the more improbable with a view on the presence of a number of full-fledged young birds at the island.

No eggs of *Sterna fuscata* were found at Gg. Api, but notwithstanding the fact that not a single clutch or even a small young has been found, this species too may be safely ranged among the breeding birds of Gg. Api. This I deduced from the fact that a number of mutilated juvenile birds were found at the bottom of the crater, where they were fed by the adults. It seems likely that these tumbled down at an age where they were not yet able to fly or had been hatched in the crater and were mutilated when trying to reach the open.

In this connection BEEBE suggested that at the Island of Daphne a number of *Sula nebouxi*, hatched at the bottom of a crater, were hurt in an attempt to leave this place.

The feathers of the "crater-terns" had developed normally, but it seems probable that finally they will have starved as they certainly were not able to leave the crater.

A short reference of the literature concerning the breeding of this tern at other places follows below.

WORCESTER (Philipp. Journ. Sc. VI, 1911, p. 171) mentions the breeding in great numbers of *St. fuscata* at the Phillipines. At the same time he observed eggs and big young birds.

DELACOUR & JABOUILLE (l.c. p. 11) relate that the nests without any nest-material were assembled in immense colonies in the sand, upon the bare rocks and small dunes. The eggs were often so close together that it was difficult to walk between them without treading upon the eggs.

AUDUBON (vide BENT l.c., p. 279) too, mentions the vast rookeries of this gregarious bird. Concerning this he remarked: "On landing I felt for a moment as if the birds would raise me from the ground, so thick were they all around and so quick the motion of their wings".

PEARSON (vide BENT, l.c. 319) writes about *S. fuscata*: "The eggs, usually one to a nest, are laid in slight hollows scooped in the sand. The sooty is one of the "egg-birds" of the Tropics, and thousands of its eggs are gathered for food by natives of numerous and little-known islands of the sea".

During my visit to Gg. Api the number of young was rather small. I am not able to detect the cause to which this may be attributed. As presumed for *Anous stolidus*, it probably may be caused by the great heat at the solfatara fields where this tern exclusively was found. Here, too, it seems extremely unlikely that men would have exterminated the whole amount of eggs, as a

great number of eggs and young of *Anous stolidus*, and also of other species which breed on the ground, were present. Moreover, a single looting of the nesting grounds, will not affect the tern-colonies in this way, for, as a rule, those birds produce new eggs and the incubation is started again.

The wrecking of quantities of eggs apart from the influence of solfatara seems, however, to occur elsewhere too, as mentioned by WORCESTER (l.c. p. 171), who remarks: "Eggs were scattered around in large numbers, but many of them were bad ones, which had failed to hatch".

The disgorged food is transmitted to the young through the hardly opened beak of the parent. Data on the composition of the food are not available, as the collected birds all had an empty or nearly empty stomach and crop. In some cases I saw the young birds fed with small fish.

According to DELACOUR & JABOUILLE (l.c. p. 12) the food consists of cephalopods and crustaceans, caught at the surface of the sea.

In begging, the young is slightly clapping the tip of the bill and chirping weakly, making a squeaking sound. Repeatedly I saw several adult birds pursuing a single young, seemingly urging the food upon it. If the latter tried to escape, the adults often trod upon their benjamin in their eagerness to overtake it.

This prevalent feeding-instinct seems to point to a discordance in the numerical relation between old and young birds, and is, moreover, illustrated by the fact that during my stay at the island only about 10 young were observed.

On this point too, it is not easy to solve the problem in a satisfactory way.

H.

#### *Hypotaenidia philippensis xerophila* nov. subspec.

##### Material:

Cat. Nos.	Btztg. Mus.	Sex	Culmen	Wing	Tail
12364	(Type)	♀ ad.	26	132	49
12365		♀ ad./juv.	27	123	55
12366		♂ ad. (±)	29	131	56

Type: ♀ ad. Cat. Number 12364 Mus. Btztg. Gg. Api, 9 Aug. 1938; leg. A. HOGERWERF. Terra typica: Gg. Api.

*Diagnosis:* This subspecies is especially characterized by the very small measurements. Colours resemble those of *H. philippensis australis* PELZELN fairly well, but they are brighter. Besides the throat is lighter, almost white, even the rust-coloured brown of the nape is deeper, while the orange brown coloured bar of the breast is retained also in the adult covering. Over this bar the black and white marking of the underparts is continued for about 1 cm. Iris red. Bill: upper mandible deep grey; under mandible flesh-coloured; legs light brownish grey to light grey.

The type had a swollen ovary; largest egg about  $\frac{1}{2}$  cm in section. The two paratypes are not yet full-grown. In number 12365 the orange brown bar on the breast with a narrow stripe of black and white feathers. Under this bar a broad grey stripe. In number 12366 this stripe has disappeared except for some little spots.

For comparison there follow some measurements of *H. p. australis* PELZELN of Australia, *H. p. chandleri* (MATH.) of Celebes and *H. p. wilkinsoni* (MATH.) of Flores.

*australis*.

		Sex	Culmen	Wing	Tail
Austr. Museum	30113	♂ juv./ad.	28	141	71
" "	30112	♀ juv./ad.	29	139	74
" "	16785	? ± ad.	39	146	(53)
" "	30111	♂ ad.	34	152	76

*chandleri*.

		Sex	Culmen	Wing	Tail
Mus. Btzg.	4704	♀ ad.	30	138	66
" "	stuffed specimen	? ad.	29	139	66
" "	13567	♂ ad.	30	138	73

*wilkinsoni*.

		Sex	Culmen	Wing	Tail
Zool. Mus. Berlin	30.189	? ad.	29	139	64
" "	30.1179	♀ ad.	29	145	73

In the diagnosis of *H. p. wilkinsoni* (Bds. Austr. I, 1911, p. 198) MATHEWS gives the following measurements: Culmen 32 - 33, wing 155 - 157. I am in doubt of the subspecific difference between *chandleri* and *wilkinsoni*, but owing to the want of material at my disposal I cannot take a definitive conclusion.

The new race is a typical dwarf-form, that perhaps arose on Gg. Api under influence of the extremely unfavourable circumstances. v. B.

***Halcyon sancta sancta* VIG. & HORSF.**

*Halcyon sanctus* VIGORS and HORSFIELD Trans. Linn. Soc. 15, 1827, p. 206 (Australia).

*Material:*

Cat. Nos.	Btzg. Mus.	Sex	Culmen	Wing	Tail
9301		♂ juv.	25	87	60
9302		♂	35	87	62
9303		♀	37	88	62

Three, not yet or not entirely matured specimens are concerned. Number 9301, a juvenile bird with an entirely yellowish brown belly, has very short bill. Iris deep brown; bill black with light flesh-coloured base of lower mandible; legs grey. Contents of stomach: pulverized rests of insects.

Migrant from Australia.

v. B.

**Coracina novaehollandiae melanops** (LATH.).*Corvus melanops* LATHAM, Ind. Orn. Suppl. 1801, p. 24, (N.S. Wales).*Material:*

Cat. Nos.	Btztg.	Mus.	Sex	Culmen	Wing	Tail
8947			♀	23	177,5	147

The only specimen, collected of this species, is a ♀ in juvenile covering. Wings still have distinct traces of the cream coloured first covering (vide STRESEMANN: Nov. Zool. XXI, 1914, p. 123 - 124). Iris dark brown; bill black with grey base of lower mandible; legs very deep blackish grey. Ovary very small. Stomach empty.

Migrant from Australia.

v. B.

**Zosterops palpebrosa lettiensis** FINSCH.*Zosterops lettiensis* FINSCH, Notes Leyden Museum, Vol. 20, 1898 - 1899 p. 136 (Letti).*Material:*

Cat. Nos.	Btztg.	Mus.	Sex	Culmen	Wing	Tail
9097			♂	12	60,5	51
9098			♂	11,4	58	48
9099			♀	11,4	57	51

One of the ♂♂ distinctly shows the yellow longitudinal stripe on the abdomen, mentioned by FINSCH in his original description of this subspecies. The other two specimens lack this stripe, just as the three specimens of Wetar (coll. SCHÄDLER: Rijks Museum Nat. Hist. Leiden, Number 3, 5, 6). The wings and the culmen of birds from Wetar are somewhat smaller than those of Gg. Api, viz. wings: 56; 56; 56,5; culmen 10,7; 11,4; 11,4.

In his original description FINSCH gives 60 mm for wing, but his description is only based on one single bird.

Iris light brown; bill: upper mandible black; lower mandible bluish grey; legs bluish grey. Contents of stomach little green fruit-stones. In his revision (Mitt. Zool. Mus. Berlin 17, 2, 1931.) STRESEMANN says that *lettiensis* belongs to the "Rassenkreis" *Zosterops citrinella*. Recently the same author, however, proved, that the "Rassenkreis" in question should be united with *Zosterops palpebrosa* (Journ. f. Ornith. 87, 1939, p. 160).

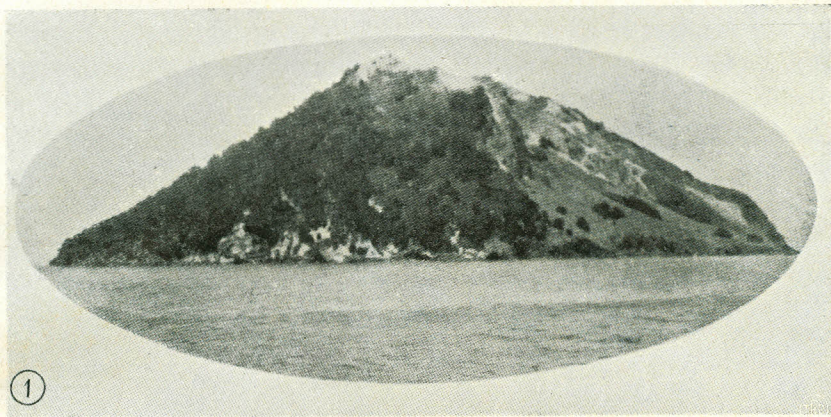
v. B.

## POSTSCRIPT.

The second author expresses his thanks to Miss Dr. J. RUINEN who assisted at the translation of his part of the present paper.

Readers may be interested in the fact that MURPHY gives an explanation of the word booby, as follows: "The name booby comes from the Spanish b o b o, meaning a dunce, and the lethargic behaviour and stupid expression of the bird make the name seem appropriate". (Nat. Geogr. Mag. LXXIV, no. 2, Washington, Aug. 1938).

H.



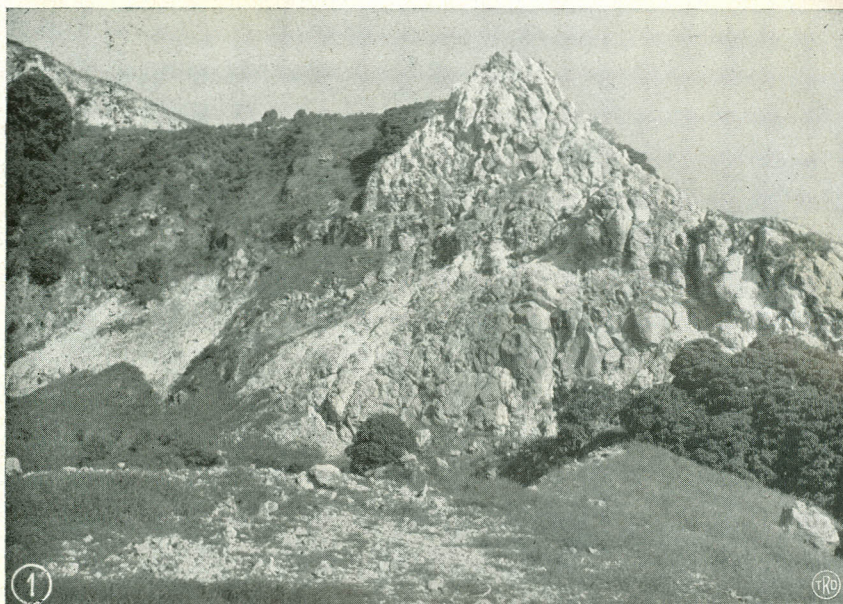
*Photo Dr. Ph. F. Kuenen.*



A. C. V. VAN BEMMEL & A. HOGERWERF:  
The Birds of Goenoeng Api.

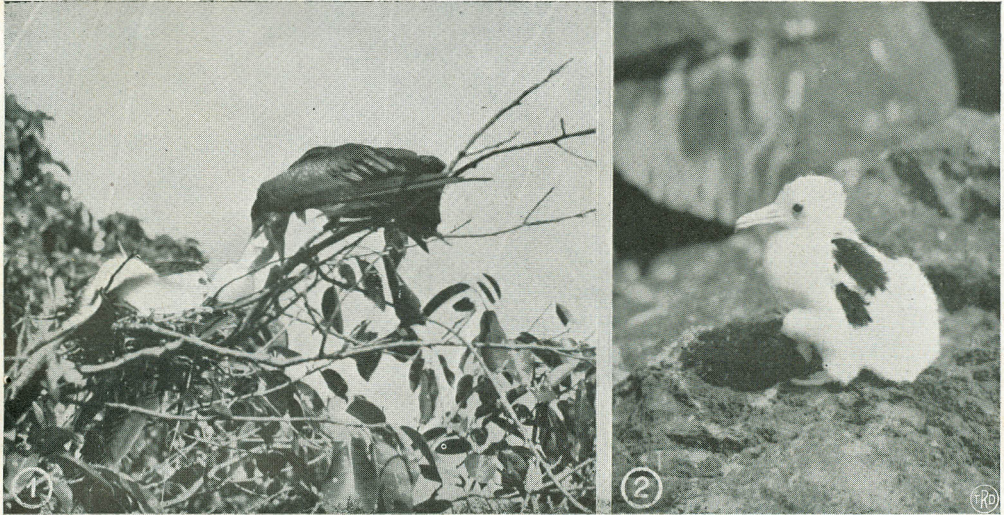
Fig. 1. Goenoeng Api, seen from the West. — Fig. 2. Part of the inhospitable West side of the volcano.

[Photographs on pls. 17 - 29 by A. Hoogerwerf, and on pls. 30 - 34 by F. Huysmans jun.].



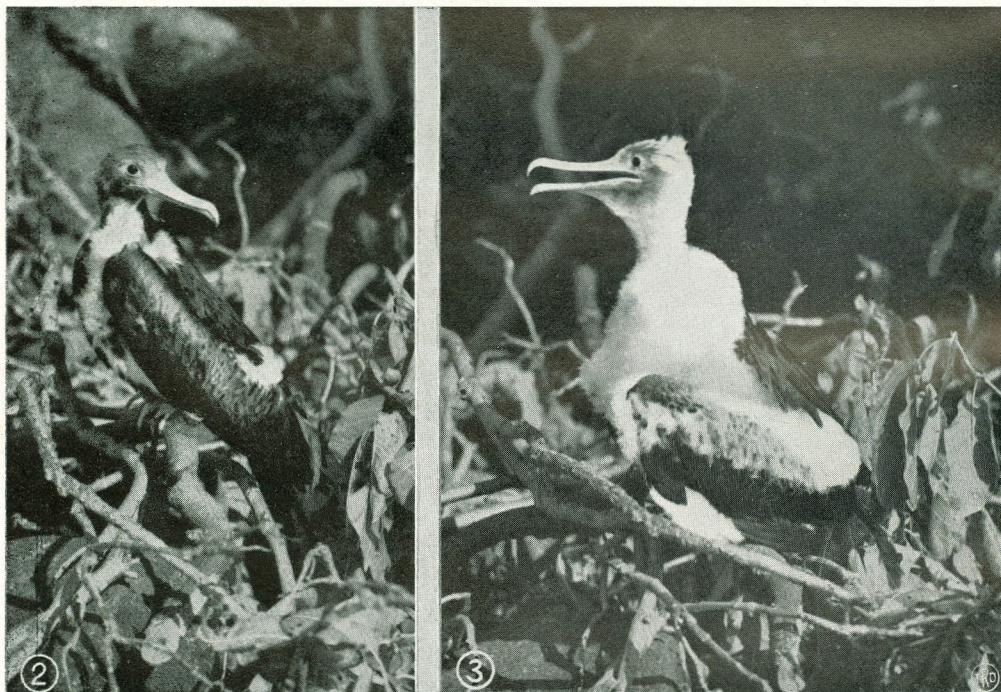
A. C. V. VAN BEMMEL & A. HOGERWERF:  
The Birds of Goenoeng Api.

Fig. 1. One of the highest points of Gg. Api. Left in the centre a solfatara-field along the craterwall with resting *Sterna fuscata*. — Fig. 2. "Rising directly from the Ocean bottom, 4000 meters deep". Steep slope, partly grown with dense *Pisonia*-complexes.



A. C. V. VAN BEMMEL & A. HOOPERWERF:  
The Birds of Goenoeng Api.

Fig. 1. *Fregata m. minor* feeding its young. — Fig. 2. Small young of the frigate-bird, placed on a lava-block by the author. — Fig. 3. Breeding female of *Fregata m. minor* in a partly leafless *Ficus*.



A. C. V. VAN BEMMEL & A. HOOGERWERF:  
The Birds of Goenoeng Api.

Fig. 1. Male of *Fregata m. minor* with inflated breast-pouch in a *Pisonia* on the future nest-site. — Fig. 2-3. Young of *Fregata m. minor*; the right one is about 4 weeks, the left bird circa 7 weeks old.





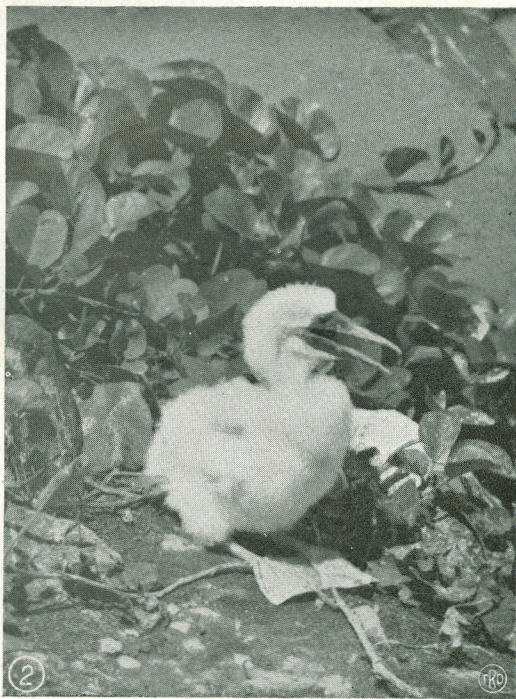
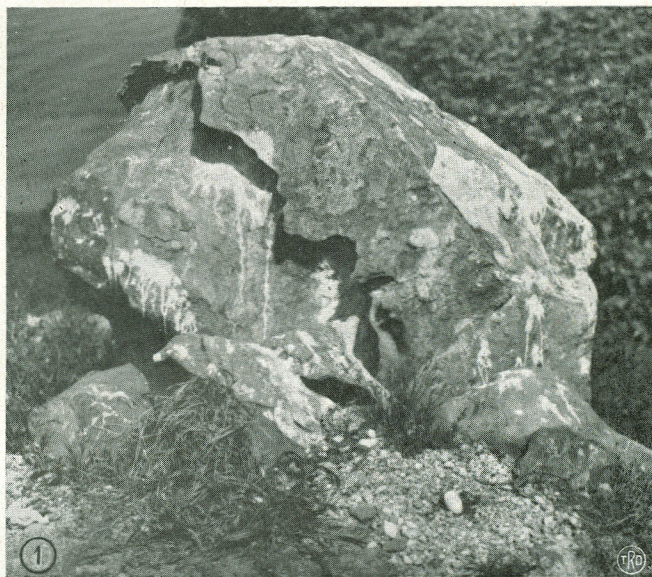
A. C. V. VAN BEMMEL & A. HOGERWERF:  
The Birds of Goenoeng Api.

Fig. 1. Breeding *Sula sula rubripes*; the bird in the foreground is still in the juvenile stage. — Fig. 2. The same nests; the mate of the "juvenile" bird of fig. 1 was a specimen in adult feathering. In the right corner a young frigate bird.



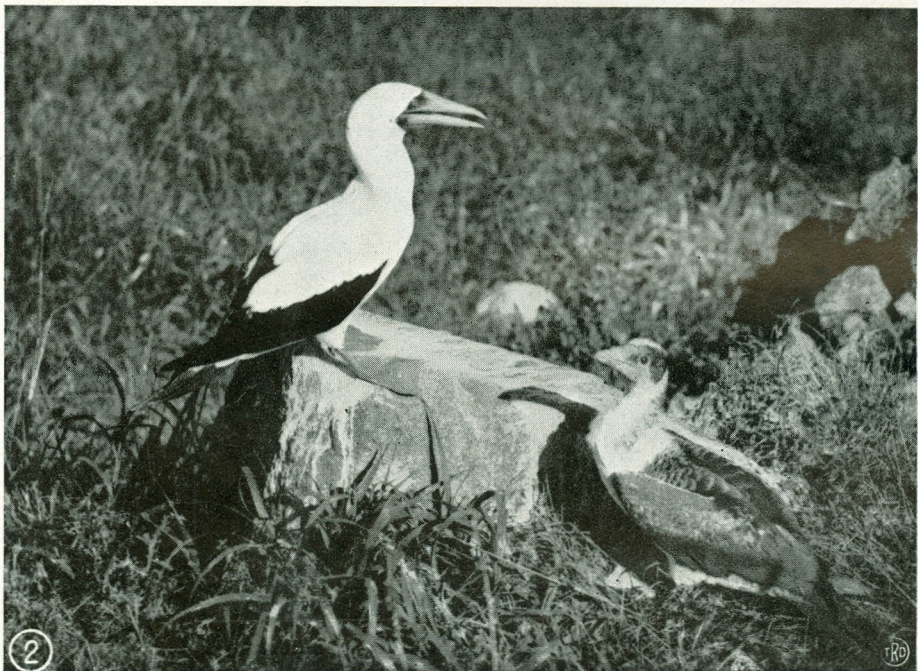
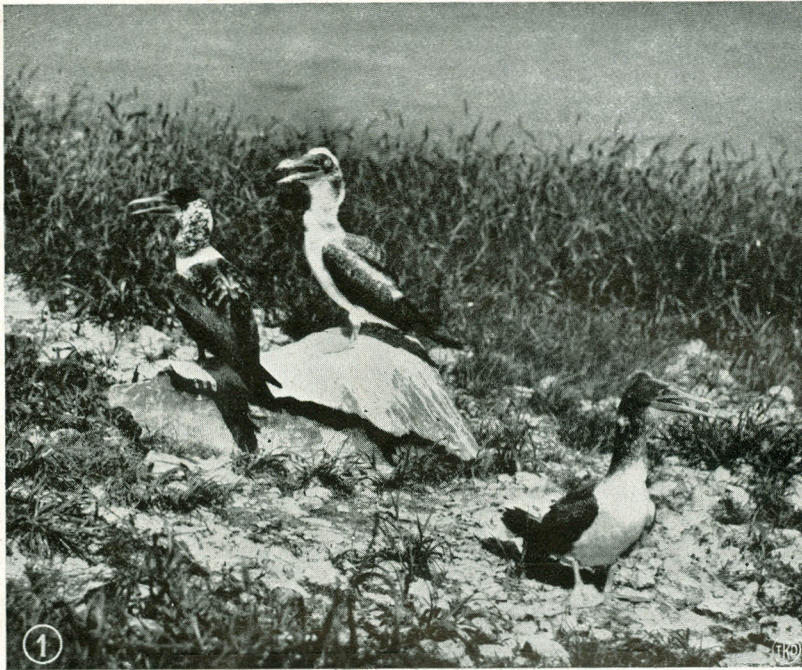
A. C. V. VAN BEMMEL & A. HOGERWERF:  
The Birds of Goenoeng Api.

Fig. 1. Nest of *Sula sula rubripes* in a *Pisonia*-tree. — Fig. 2. Small young of the red-footed booby, placed on a lava-block by the author. — Fig. 3. Nearly full-fledged young of the same species.



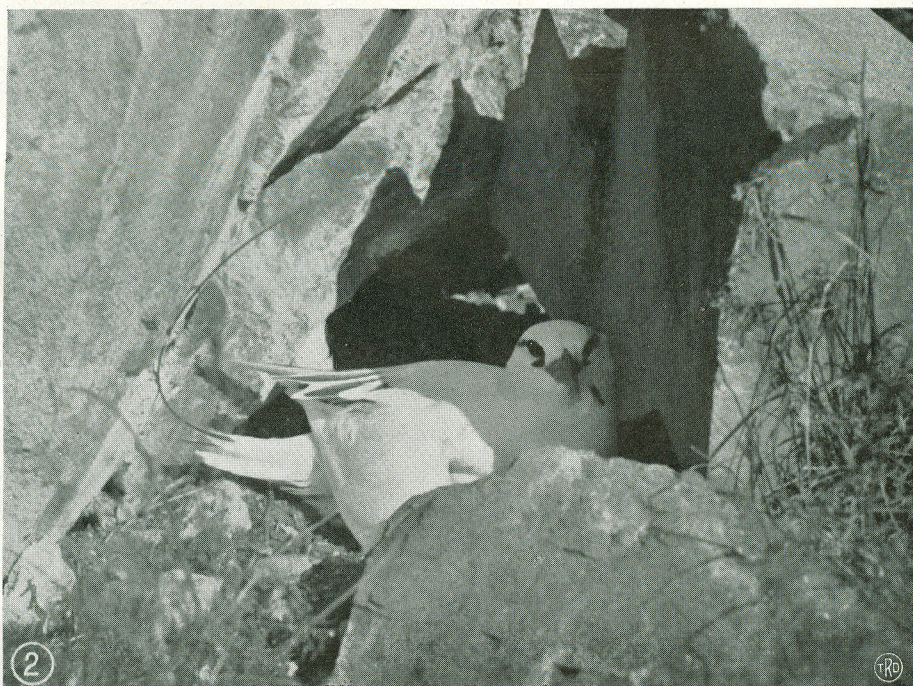
A. C. V. VAN BEMMEL & A. HOOGWERF:  
The Birds of Goenoeng Api.

Fig. 1. The egg of *Sula dactylatra* amidst a lot of small pebbles, at the foot of a weather-beaten lava-block. — Fig. 2. Young *Sula dactylatra* in dawn at the nest-site amidst *Ipomoea pes caprae*.



A. C. V. VAN BEMMEL & A. HOGERWERF:  
The Birds of Goenoeng Api.

Fig. 1. Two wholly and one nearly full-fledged young of *Sula dactylatra bedouti*. —  
Fig. 2. Adult *Sula dactylatra*, just returned to its young and before feeding started.



A. C. V. VAN BEMMEL & A. HOOGERWERF:  
The Birds of Goenoeng Api.

Fig. 1. Nearly full-fledged young of *Phaeton rubricauda westralis*, placed on a lava-block next to the nest-hole. — Fig. 2. One of the rare cases when the nest was exposed to sunshine part of the day.



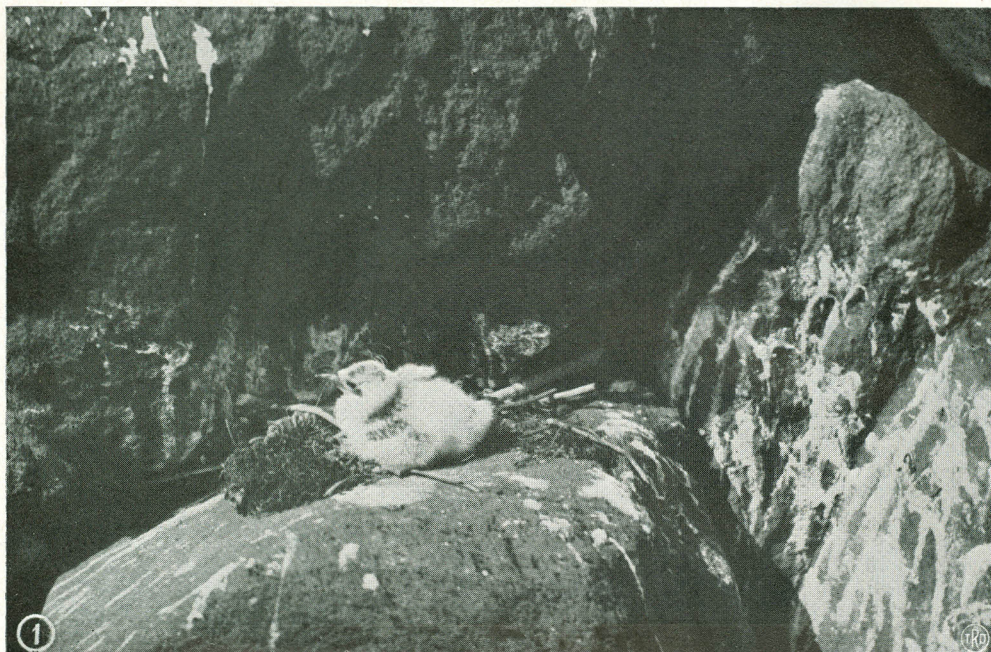
A. C. V. VAN BEMMEL & A. HOOGERWERF:  
The Birds of Goengoeng Api.

Fig. 1. *Sula leucogaster plotus*; adult feathering not yet fully developed. — Fig. 2. *Anous stolidus pileatus* with small chick near the place where it was hatched.



A. C. V. VAN BEMMEL & A. HOGERWERF:  
The Birds of Goenoeng Api.

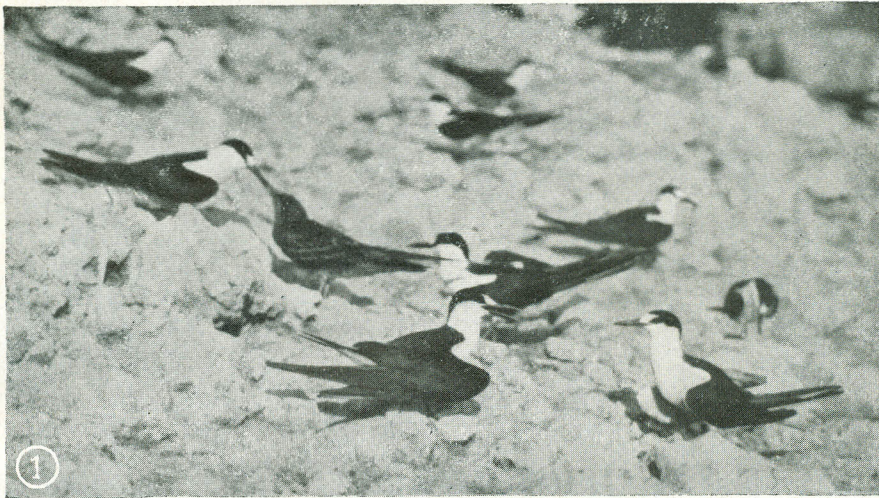
Fig. 1. Tree-nest of *Anous stolidus* with small young in the white phase. — Fig. 2. A similar chicken on a lava-block.



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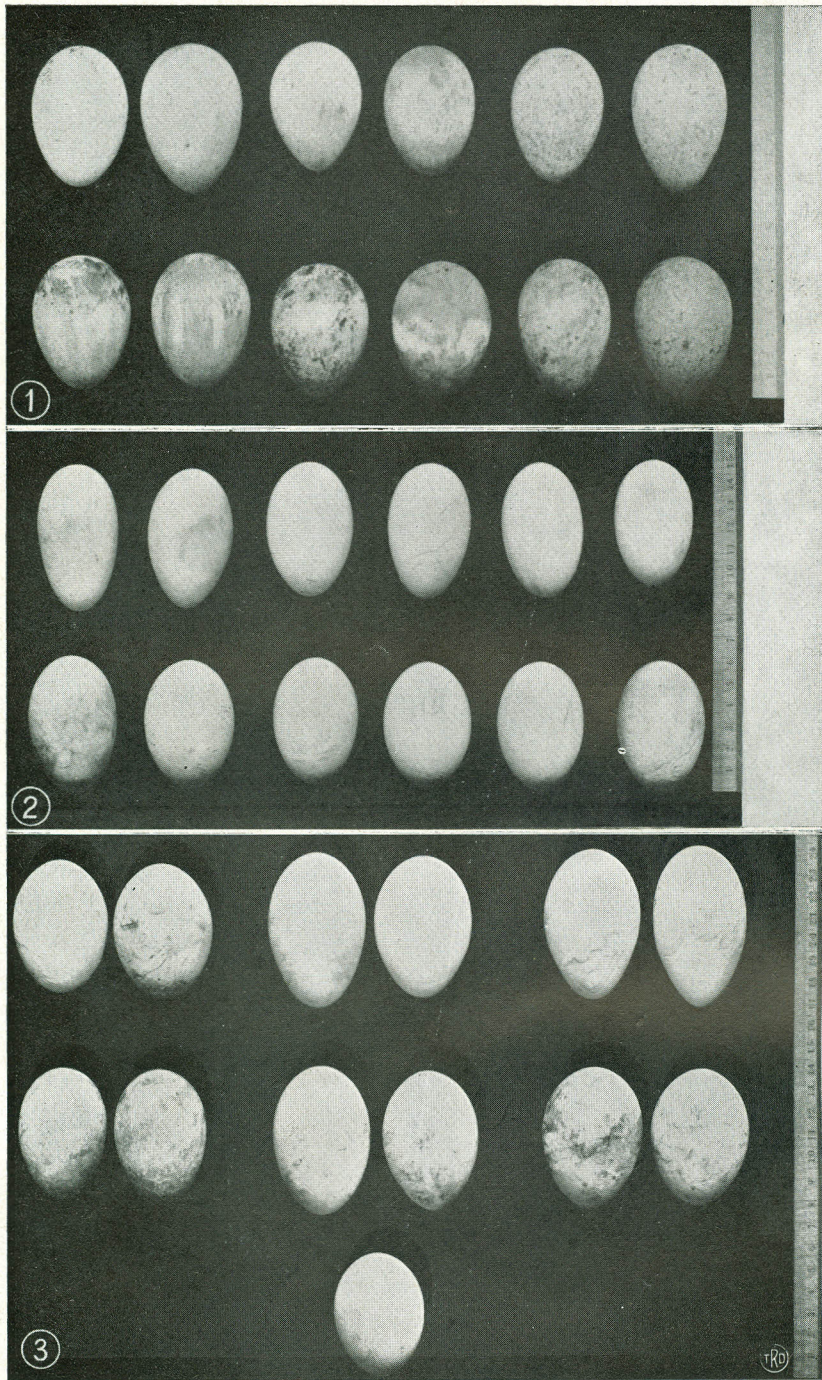
Fig. 1. When the young of *Anous stolidus* grows, the feathering becomes darker. —  
Fig. 2. Tree-nest of the Noddy with young in the brown phase. — Fig. 3. The Noddy  
feeding its young.





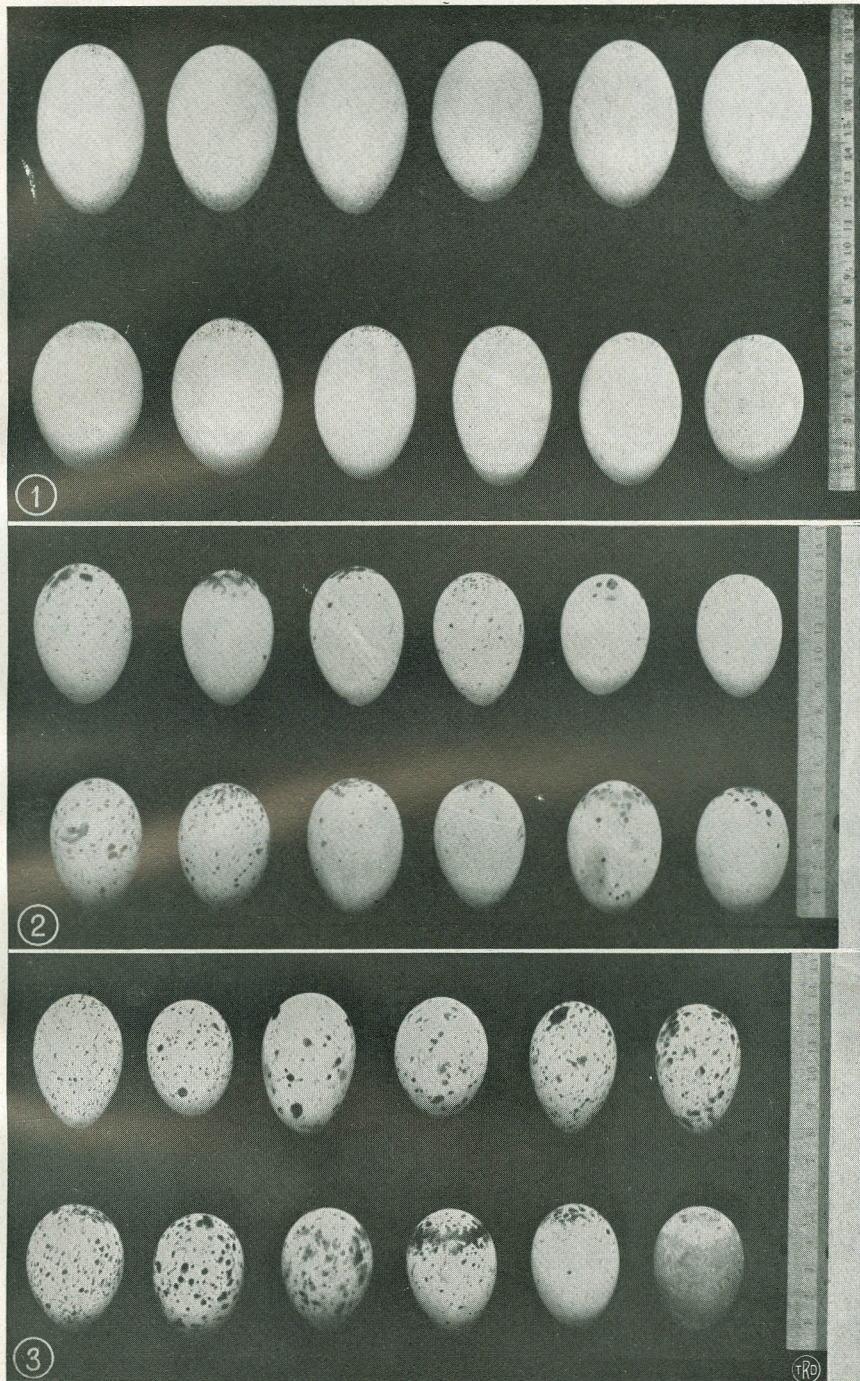
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Fig. 1. *Sterna fuscata nubilosa*, feeding. — Fig. 2. Colony of the same species on a solfatara-field, in the neighbourhood of the crater. In the centre a „begging” young.



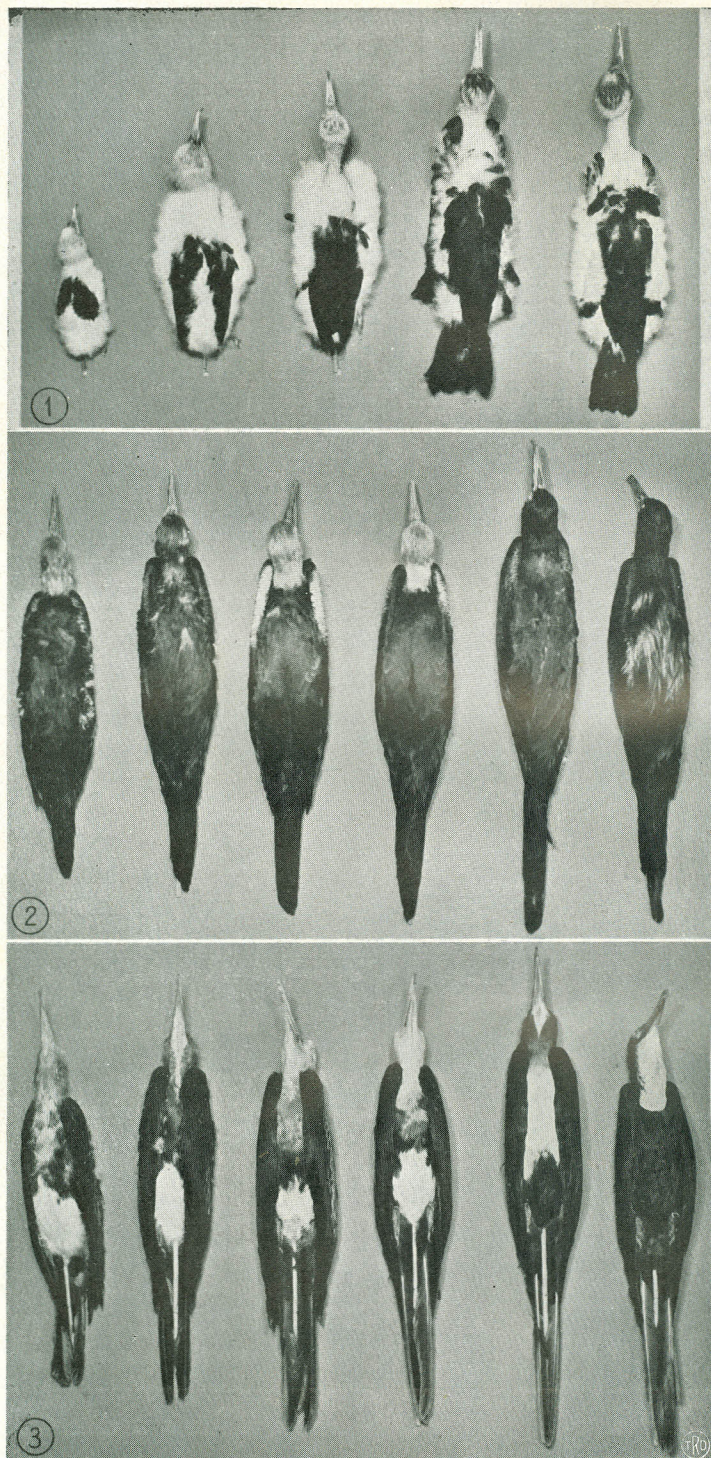
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Fig. 1. Twelve of the most divergent clutches of *Phaeton rubricauda westralis*. —  
Fig. 2. Idem of *Sula sula rubripes*. — Fig. 3. Seven clutches of *Sula dactylatra bedouti*.



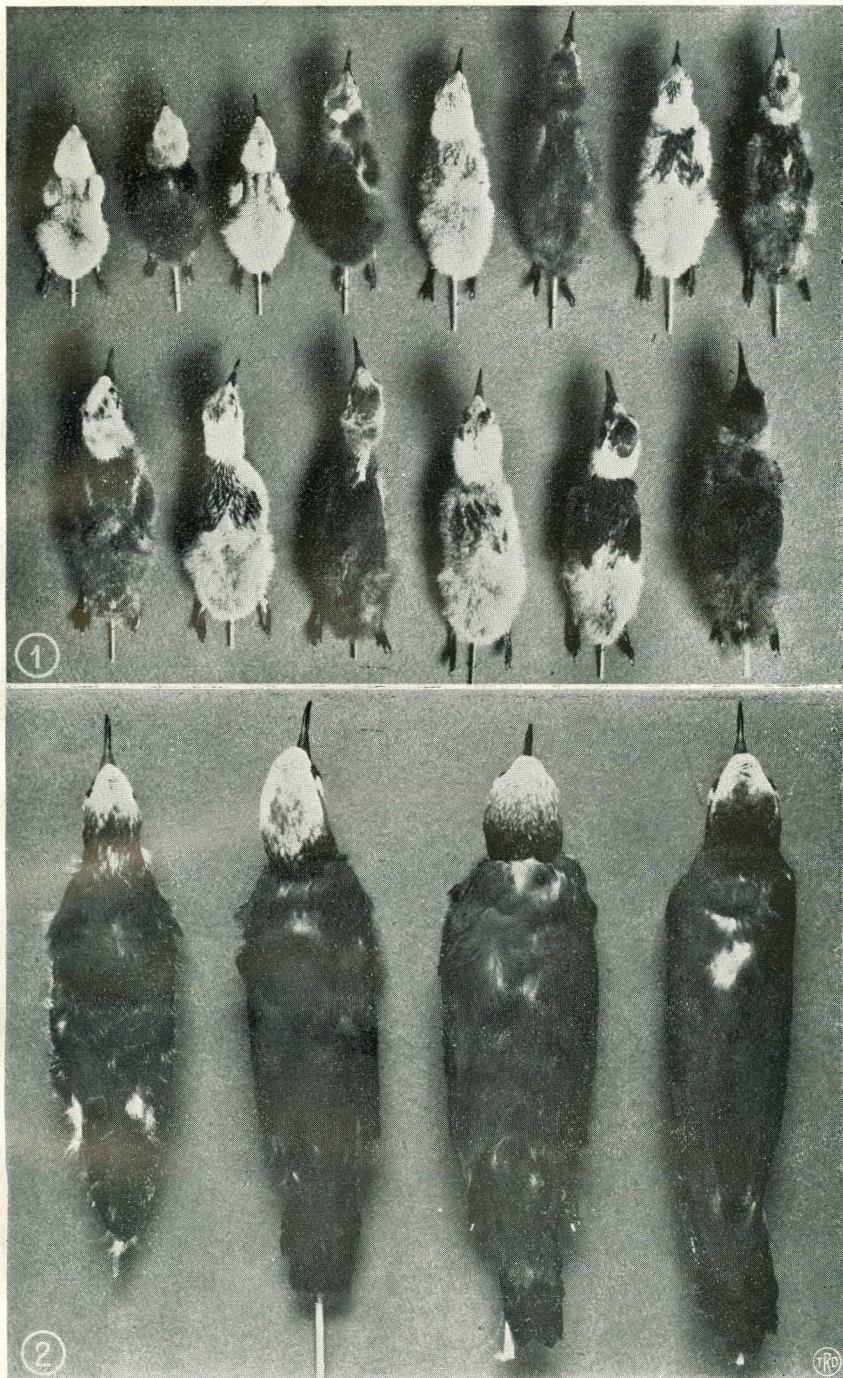
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Fig. 1. Twelve of the most divergent clutches of *Fregata m. minor*. — Fig. 2. Idem of *Anous stolidus pileatus*. — Fig. 3. Idem of *Sterna anaetheta anaetheta*.



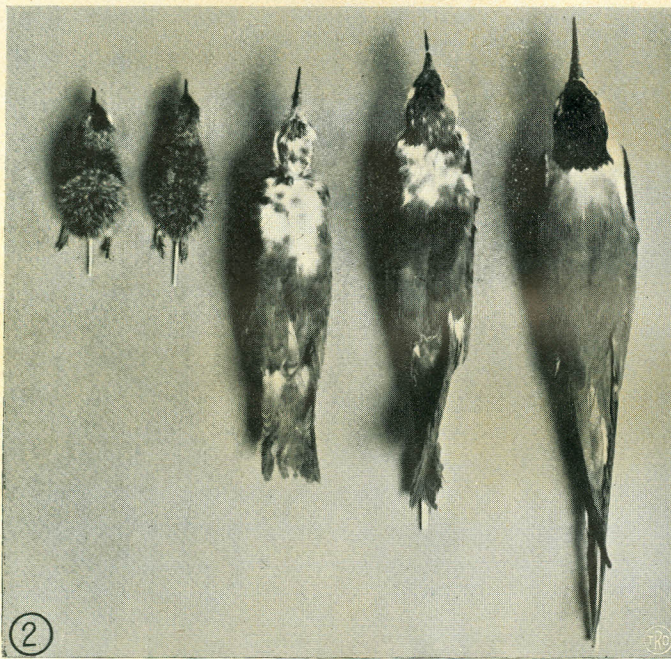
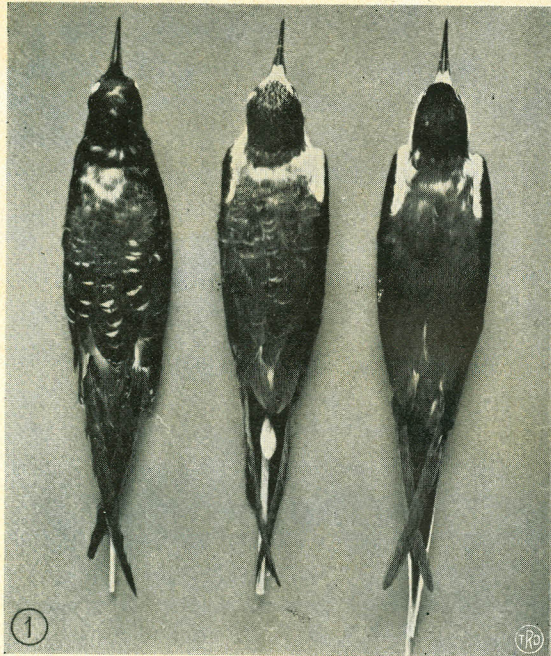
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*Fregata m. minor*. — Fig. 1, left to right: Young of ca 7, 18, and 25 days, and two of 5 weeks. — Fig. 2 & 3, left to right: Young of ca 7, 9 and 12 weeks, one young of probably more than a year old, one adult ♀ and one adult ♂.



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*Anous stolidus pileatus*. — Fig. 1. Chicks in different phases of an age of 2 to 10 days.  
— Fig. 2, left to right: Young of about 3 and 4, and two of 5 weeks old.



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*Sterna fuscata nubilosa*. — Fig. 1, left to right: Full-fledged young, young in the transitional feathering, and adult bird. — Fig. 2, left to right: Chicks of about 3 or 4 days, young of 3 and 5 weeks, and one adult bird.