

Notes on the Eggs of New Zealand Paryphantidae, With Description of a New Subgenus.

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[Read before Wellington Branch, October 26, 1944; received by the Editor,
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DURING the past few years I have been successful in accumulating a full collection of shells of the New Zealand species of the *Paryphantidae*, and, in the process, have acquired quite a good range of their eggs. Of the latter, most have not previously been described, and as they are of interest, I have compiled a list of measurements and other data concerning the eggs of the various species and sub-species available.

It may be noted that the eggs are not as easily procured as some people imagine. Their finding entails a lot of hard work in searching amongst leaf mould, or, as an alternative, they may be obtained by shutting up live captive snails in damp moss in the hope that they will lay. Although the latter method is uncertain, it is the way by which most of the specimens have been obtained. If the captives do not lay in a few days, or at the most, in say a fortnight, it is practically certain that no eggs will be obtained from them, and the collector often shuts up snails to no purpose. In odd cases, where laying has occurred after some time in captivity, the eggs are generally not normal, owing no doubt to uncongenial conditions. The usual laying period is late October, November, and early December, but in one case—i.e., *spedeni*, new-laid eggs have been taken in March.

The eggs are generally deposited in leaf mould. As I have not obtained many in natural conditions, there are few records of the numbers usually laid together. Mrs. I. Worthy informs me that she has found eggs of *Paryphanta busbyi* at Kaeo in nests of 3, 5, 8 and 10. *Rhytida* eggs are found in larger numbers, viz: *R. dunni* 8, 9, 15, 17, 19 (Mrs. Worthy); *R. greenwoodi* 9, 14, 22, 25, 26; *R. patula*, 3 to 9; *Schizoglossa*: 4, 9, 14, but generally about 9. *Waimui*: Unfortunately I omitted to take an exact count of those I found, but Mr. R. A. Prouse, of Levin, has found them in nests of 4, 5, 9 and 13.

Paryphanta eggs are all large in relation to the size of the shell and animal, but the most remarkable case is that of *P. spedeni*, a snail which reaches a maximum size of 40 mm. and produces an egg up to the amazing size of 11.5 mm., or .2875 of its parent's major shell dimension—truly this species is the "kiwi" of the family. Shape of the eggs is seldom constant; most are oval, and in one species, *unicolorata*, they occasionally are completely round.

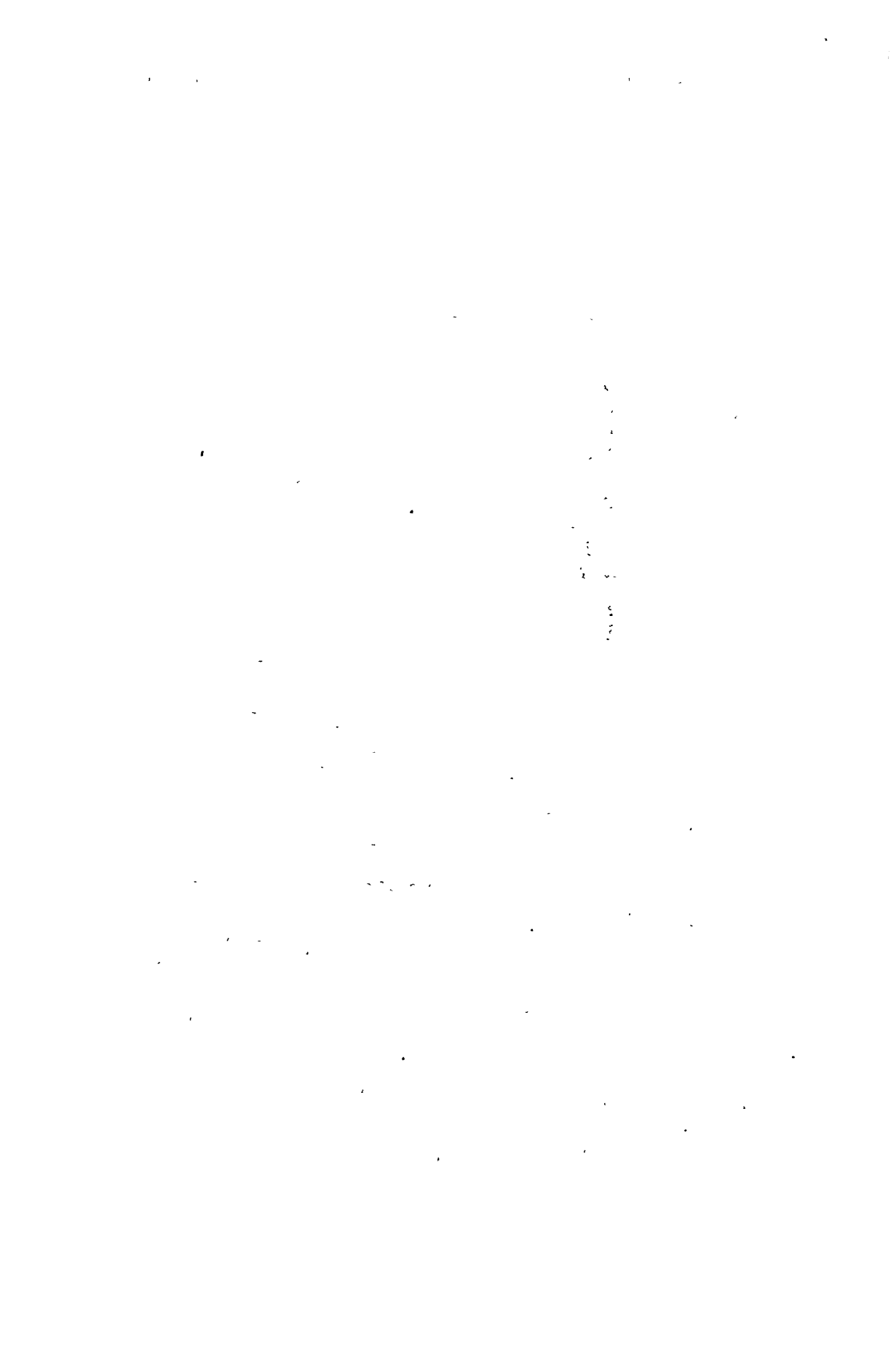
The genera *Waimuia*, *Rhytida* and *Schizoglossa* have eggs with a calcareous surface which lacks cuticle, and *Paryphanta busbyi* alone among its New Zealand congeners has a similar white limy egg,

EGG MEASUREMENTS (in millimetres).

<i>Rhytida greenwoodi</i>	Patumahoe	—/10/43		3.25 x 2.75, 3 x 2.8, 2.75 x 2.5, 3.5 x 2.75
" "	Levin	—/ 9/44	R.A.P.	5 x 4, 4 x 3, 3.75 x 3.
" "	H.W. Maungatua R.	—/ 1/41	C.F.	4.75 x 4, 4.75 x 3.75, 4.75 x 3.5.
" <i>dunniac</i>	Cornwallis	21/ 1/39		3.5 x 2.75, 3.25 x 3, 3.75 x 3.
" "	Kaeo	—/10/43	I.W. & A.C.O'C.	4.5 x 3.75, 4 x 3.5, 4 x 3.5, 4.75 x 3.5, 4.25 x 3.5, 4.5 x 3.75, 4 x 3.75
" <i>australis</i>	Stewart Is.	11/ 5/41	J.H.S.	2.75 x 2.25, 2.75 x 2, 2.75 x 2.25.
" <i>meesoni</i>	Manaroa	—/10/44	W.H. & R.G.	2.75 x 2.5, 2.75 x 2.25, 2.5 x 2.25, 2.5 x 2, 2.25 x 2.
" <i>patula</i>	Lake Kanieri	29/10/40		2.75 x 2.5, 3 x 2.25, 2.5 x 2, 3 x 2.5, 3 x 2.25, 3 x 2.25.
" " ?	Maruia Springs	28/12/38	R.C.	4 x 3.5, 4 x 3.25, 4.25 x 3.
<i>Paryphanta bushyi</i>	Taranga		A.W.B.P.	14 x 10.75.
	Hokianga District		A.W.B.P.	13 x 9.5, 12 x 9, 12 x 10.5, 11.5 x 0.5, 12 x 10, 11.25 x 9.25.
	Onetea.		A.W.B.P.	12 x 9.75, 12 x 9, 10.5 x 9.5.
<i>Powelliphanta hochstetteri</i>	Takaka Hill	10/ 2/41		12 x 10.
" <i>h. anatokiensis</i>	Anatoki Forks	6/11/38		9.5 x 7, 8.5 x 6, 12 x 10.5, 12 x 10, 12.5 x 10.5.
" <i>h. obscura</i>	D'Urville Is.	21/10/42		10 x 8, 11 x 9, 10 x 8, 9.25 x 7.75, 10 x 8.5, 9.75 x 8.25, 9.5 x 7.75.
" <i>h. consobrina</i> (red variety)	Eli Bay Ridge	6/10/44		9 x 7.75, 8.25 x 6.75.
" <i>h. bicolor</i>	Blumine Is.	31/10/40		10.75 x 9, 10.75 x 9.
" <i>h. obscura</i> x <i>bicolor</i> (hybrid)	Mt. Kiwi	—/10/39	H.W.H.	10.25 x 9, 9.25 x 8, 10 x 8.75, 9.5 x 8, 9 x 8.
" <i>ignaria</i>	St. Helens	6/11/40		10 x 8.25, 9 x 7.75, 9 x 8, 8.75 x 7.75.
" <i>annectens</i>	Oparara	8/11/40		9 x 8, 9 x 8.5, 9 x 8.5, 9 x 8.
" <i>mouatae</i>	Goulard Downs	1/11/39		10.5 x 8.5, 10.5 x 8.5.
" <i>superba</i>	Mt. Bock	10/11/41		14 x 12.
" <i>unicolorata</i>	Seddonville	5/11/40		8.75 x 8.25, 8.5 x 8, 8.5 x 7.75, 9 x 7.5, 8 x 7.25, 7.5 x 6.5, 8 x 7.5, 8 x 7, 8.25 x 7.25, 7.25 x 7.25, 7 x 7.
" <i>gagei</i>	Near Rewanui	4/11/40	E.S.G.	8.5 x 7.75.
" <i>fletcheri</i>	Mt. Tuhua	30/10/40	E.S.G.	7.75 x 6.5.
" <i>rossiana</i>	Mt. Greenland	1/11/40	A.R.	8 x 6.75, 6.5 x 5.75, 8 x 6.75, 8 x 6.75, 8.25 x 6.75.
" <i>spedeni</i>	Mataura Range	12/ 3/39		11.5 x 9, 11 x 9, 9 x 7.75.
" <i>gilliesi</i>	Mt. Burnett	—/ 1/42	A.R.	9 x 8, 9.75 x 8, 10 x 8.
" <i>g. brunnea</i>	Paturau R.	—/ 3/41	H.S.	8 x 7, 7.75 x 6.5, 7 x 6, 7.5 x 6.75, 7 x 6.5, 7 x 6, 7.25 x 6.
" <i>g. kahurangica</i>	Kahurangi Pt.	27/10/39		8 x 7.8 x 7.5, 9 x 7.5, 7.5 x 6.5.
" <i>g. ?</i>	White Pine Creek	9/ 7/44	R.A.P.	8 x 7.25, 8 x 7.
" <i>g. subfusca</i>	Kaihoka	4/11/39		9 x 7.5, 7.75 x 6.75, 7.5 x 6.5, 8 x 6.75, 7.75 x 6.75.
" <i>compta</i>	The Castles	6/11/41		10 x 7, 10.25 x 7.75, 10.75 x 8.
" <i>jamsoni</i>	Goulard Downs	12/ 3/38	A.R.	9.5 x 8.
" <i>fallax</i>	Onekaka	27/ 2/44		9 x 7.5, 9 x 5.
" <i>traversi</i>	Near Levin	—/11/37		10 x 8.75, 9.5 x 8.5, 10 x 8, 10 x 8.75.
" <i>traversi</i>	Near Ohau R.	—/12/43		11 x 9, 10.75 x 9, 10 x 8.75.
" <i>t. tararuaensis</i>	Kahinu	1/ 1/41		10 x 8.25, 11 x 8.25, 9.25 x 8, 10.5 x 8.5, 10 x 8.5, 10.5 x 9, 11 x 8.5.
<i>Wainuia urnula</i>	Rimutakas	29/ 9/40		5 x 4, 5 x 4, 5 x 4, 5 x 3.75, 4.5 x 3.5.
" "	Korokoro	—/ 5/43		5.25 x 4.25.
" <i>edwardi</i> ?	Mt. Fife	—/ 5/38	R.A.F.	5 x 3.75.
<i>Schizoglossa novoseelandica</i>	Mt. Egmont	—/12/40	R.C.	4 x 3.
" "	Taorua	23/ 4/43		4.5 x 3.5, 4.5 x 3.75, 4 x 3.25, 4.5 x 3.5.
" "	Whangarei Heads	—/ 1/38	R.K.D.	4.25 x 3.5, 4.5 x 3.5, 4.25 x 3.5.

All the above, except where enumerated, were collected by the writer.

C.F., C. A. Fleming; I.W., Mrs. I. Worthy; R.C., R. Cumber; J.H.S., J. H. Sorensen; A.W.B.P., A. W. B. Powell; R.K.D., R. K. Dell; H.W.H., late H. W. Harvey; E.S.G., E. S. Gourlay; A.R., A. Richardson; H.S., H. Scrimgeour; R.A.F., R. A. Falla; R.G., Miss R. Guzzwell; W.H., W. I. R. Harvey; R.A.P., R. A. Prouse.



without cuticle (Pl. 5; Fig. 4). All other New Zealand *Paryphanta* species have eggs with a glossy membranous cuticle (Pl. 6, Fig. 8), which, when the egg is new laid, is always of a pale buff colour, but which after preservation very seldom keeps its colour. They are very hard to preserve, especially when not treated. The best method of treatment is to puncture a small hole in the side, place in methylated spirits for, say 24 hours, then dry out slowly in a cool place. Never dry out quickly, or in a hot room, as the percentage of breakages then would be very high. Even when treated as above, quite a number will break. After treatment the eggs alter in colour to brown or palish green.

Eggs found in leaf mould, which are not known to be freshly laid, are nearly always either dark brown or badly stained, an effect possibly due to development of the embryo, and to contact with the leaf mould.

The difference in egg structure between *Paryphanta busbyi* and the more southern members of the genus is paralleled by differences in shell shape, structure and colour. In his first paper on the family, Powell (1930, p. 32) stated:—

“ The species of *Paryphanta* in New Zealand are covered by two groups, occupying two distinct areas of distribution separated by a gap of about 300 miles. The northern area is represented by *P. busbyi*, a shell having a uniformly dark greenish-black coating of conchin, while the southern area is represented by seven distinct species and three sub-species, all differing from the northern *busbyi* in being variously coloured and banded.”

The number of species and sub-species, of course, has been much added to since the above was written.

The Australian and Tasmanian species of *Paryphanta* (i.e., *Victaphanta* and *Melavitrina* (Iredale, 1933) agree with *Paryphanta busbyi* in shell colour, in radula characters, and it is likely that they have the same type of egg, while in New Zealand, the genus *Wainuia* has comparable shell colouration. It would appear that the production of limy eggs without cuticle, and the possession of a uniformly dark coloured conchin coating to the shell are primitive features shared by *Wainuia*, *P. busbyi* and the Australian species [*V. atramentaria* (Shuttleworth, 1853), *V. compacta* (Cox and Hedley, 1912), *M. milligani* (Pfeiffer, 1854)], and that the variously complicated colour patterns, and cuticled eggs of the *hochstetteri-lignaria-gilliesi* series are specialised characters. To give taxonomic recognition to these differences, which are accompanied by anatomical differences (Murdoch, 1904), the two groups may therefore be separated sub-generally.

Genus PARYPHANTA Albers, 1850.

Sub-genus POWELLIPHANTA nov.

Shell generally similar to *Paryphanta* Albers, but with the last whorl pulled in closer to the preceding whorl, and with a colour pattern of concentric or radially arranged bands, usually of

alternating and contrasting colours. More important is the paucity of lime compared with conchin in the shell.

Egg always with cuticle, pale buff when laid.

Distribution: North Island of New Zealand, in and south of the Ruahine Range (possibly once as far north as East Cape) and South Island.

Type: *Helix hochstetteri* Pfeiffer, Mal. Bl., viii, 146, 1862 (see Pl. 6, Figs. 5-8).

Powelliphanta will include all New Zealand species previously included in *Paryphanta* except the type of that genus, *P. busbyi* (Gray, 1840) which is confined to the North Auckland Peninsula.

(For list, see Powell, 1938, pp. 140, 141.)

The sub-genus is named in recognition of the great service rendered to the study of the family by Mr A. W. B. Powell.

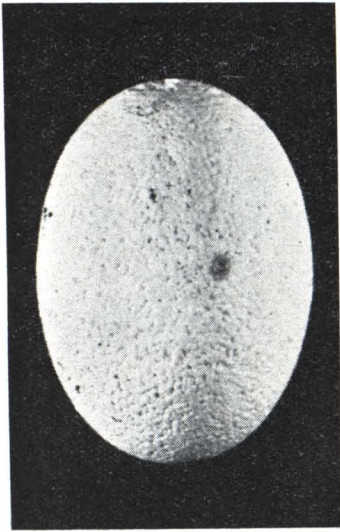
P. busbyi (Pl. 5) has a very thick coating of conchin, as well as an inner limy shell, and specimens are not infrequently found in North Auckland Pleistocene dune deposits which have weathered down to a strong, limy shell even when all the conchin has gone. All other New Zealand Paryphantas have a flexible shell composed chiefly of conchin with a much reduced limy layer, so that they generally collapse soon after death. *Powelliphanta* is known in a sub-fossil condition only in limestone caves where replacement of conchin by lime has apparently occurred. Empty, "dead" shells of some species of *Powelliphanta*, which are mostly conchin with practically no inner limy shell, such as *gagei*, *fletcheri*, *rossiana* and *spedeni*, are sometimes so collapsed and distorted when found that they appear worthless as specimens. They can usually be restored, however, by soaking in very hot water, but on no account must they be lifted out until the water is absolutely cold. In most cases, if this is done, it will be found that the shape has been brought back without any alteration in colour. On no account must any of the other coloured species be treated in this way, otherwise the colour will be spoilt.

ACKNOWLEDGMENTS.

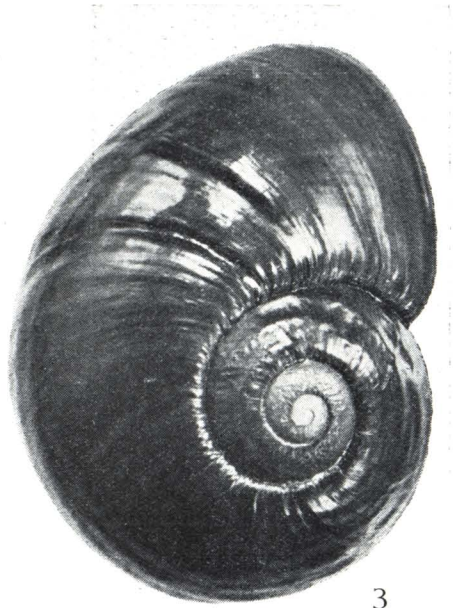
The writer is indebted to Mr. J. T. Salmon for the fine photographic illustrations accompanying this paper, and to the various collectors who have generously provided material as acknowledged in the table.

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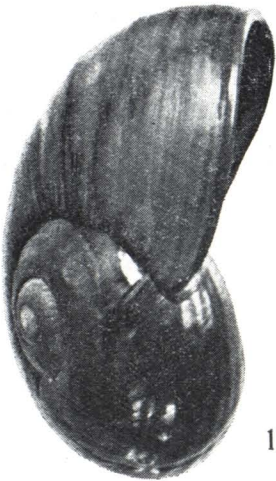
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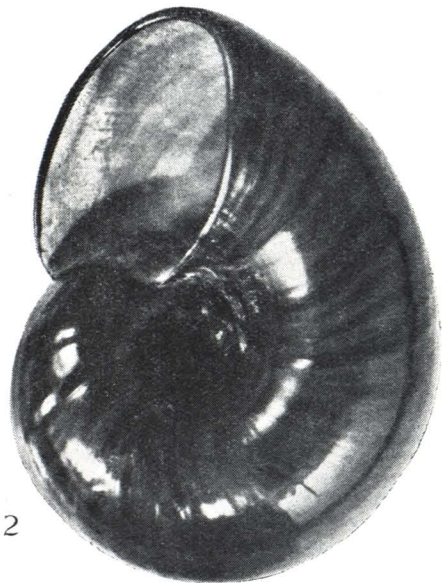
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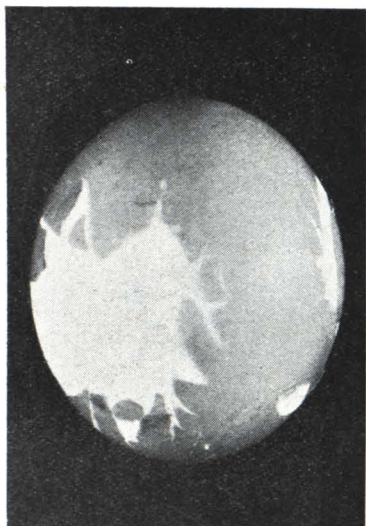


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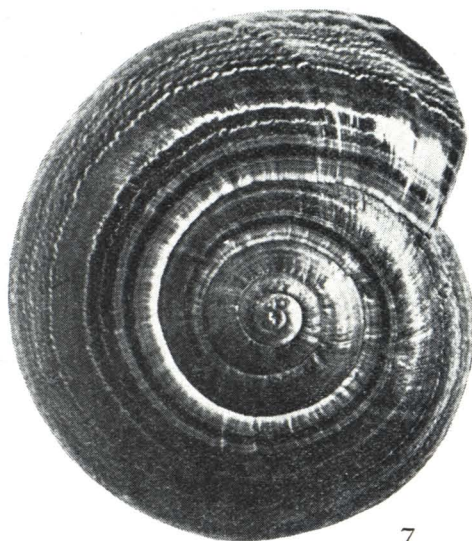
Photo: J. T. Salmon.

FIGS. 1-3.—*Paryphanta (Paryphanta) busbyi* (Gray), genotype. $\times 1$.
FIG. 4.—Egg of *P. busbyi*. $\times 4$.

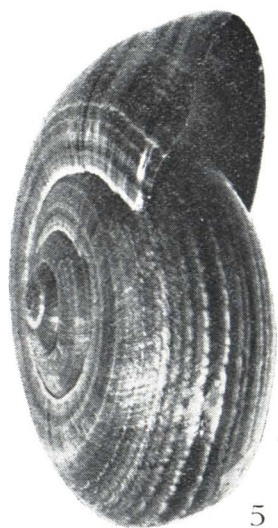
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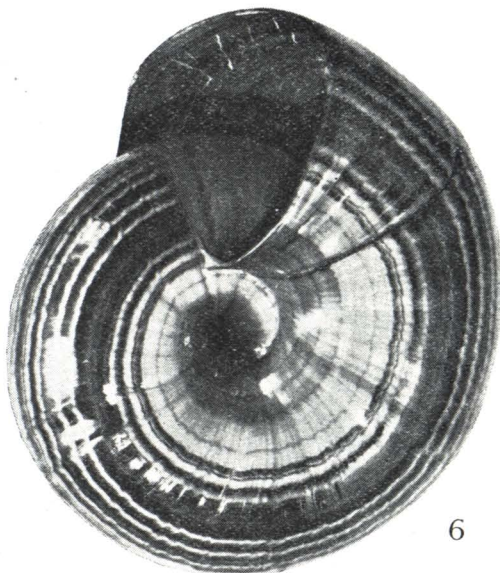
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Photo: J. T. Salmon.

FIGS. 5-7.—*Pauphanta* (*Powelliphanta*) *hochstetteri* (Pfeiffer), subgenotype.
× 1.

FIG. 8.—Egg of *P. hochstetteri*. × 4.

Dental Caries: A Study of Regional Variations In New Zealand.

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INTRODUCTION.

THIS study was undertaken primarily to ascertain whether there was, in fact, any regional variation in the incidence and degree of dental caries in New Zealand, as has frequently been surmised from clinical observation. Analysis of the statistical evidence assembled did actually disclose certain significant variations as between different localities, and, in particular, between certain types of localities. Further statistical analyses were made, this time applied to various factors which seemed to offer promising fields for study in relation to their association with dental caries—rickets, occupational environment, infant feeding and child care, relative susceptibility of the sexes. Incidental reference is made to certain other factors that are receiving prominence to-day as possible factors in the etiology of dental caries.

The writer was fortunate in having the facilities of the New Zealand Department of Health at his disposal, and in having the ready co-operation of other Government departments. The willing assistance that was forthcoming from these and other sources is gratefully acknowledged.

BASIS AND PURPOSE OF THE INVESTIGATION.

The study is based on the dental and, in a proportion of cases, the medical examination of 1,475 children of school-entrance age (5-6 years) in 25 different localities, which were chosen for their diversity geographically, climatically, physically and economically.

Stated briefly, the objects of this study are:

- (i) Primarily to ascertain to what extent regional variations occur in regard to the incidence and degree of dental caries in New Zealand, and
- (ii) To study, statistically, the effect of some environmental factors, both extrinsic and intrinsic, on such regional variations as are shown to exist.

As with all such studies, the ultimate object is to gather and sift the available material in the hope that some contribution, however small, may be made to our knowledge of the cause and prevention of dental caries.

THE METHOD ADOPTED.

Twenty-five centres were selected for study, extending from Whangarei in the north to Invercargill in the south. The localities were chosen as being representative of all parts of the Dominion, including farming, industrial, fruit growing and coal mining areas,