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ANTARCTIC MITE POPULATIONS AND NEGATIVE ARTHROPOD SURVEYS[1]

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Abstract: Notes are given on relative populations of the prostigmatic mites *Stereotydeus mollis* Wom. & Str. and *Nanorchestes antarcticus* Str., and on eggs of the former. The latter mite, only 0.25 mm long when mature, is much more numerous than the former, and appears to have a wide distribution. In addition, notes are given on previously uninvestigated areas which proved negative for arthropods, and on negative searches for spiders and water mites.

This report, from Bishop Museum's project on the U. S. Antarctic Research Program, includes data from the 1962–63 and 1963–64 summer seasons. The data is the result of field work carried out by us (Gressitt both seasons; Fearon 1962–63; Rennell 1963–64), and by O. R. Wilkes and J. C. L. M. Mather in 1962–63 and Alister Spain (partial report) in 1963–64. Some of the Berlese funneling and field supervision was carried out by K. A. J. Wise. Field and laboratory work done by Wise and Spain will be reported later. Gressitt and Rennell were largely occupied with surveys in previously uninvestigated far southern

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or interior mountain ranges. These investigations proved negative for arthropods proper, but Tardigrada were found at one locality. The mite population counts were largely made by Gressitt, partly with the help of Rennell and Spain. The mite egg studies were started by Fearon and Gressitt and continued by Fearon.

The significant feature of the detailed mite population samplings is that previously a very inadequate picture of the population situation had been obtained because the sampling had been done mainly with the naked eye. Since the dominant free-living mite (*Nanorchestes antarcticus* Strandtmann) of the south Victoria Land—Ross Island area, and perhaps of most arthropod inhabited areas of Antarctica, is only 0.25 mm long when mature, it had been almost totally overlooked in previous surveys. Another factor is that most ice-free areas in Antarctica suitable for arthropods consist of coarse gravel or rocks with any soil often frozen into the permafrost. This latter often reaches to the surface or nearly so in the areas extensively studied. Thus it has been easier to search by eye in the field than to transport large quantities of rocks for running through Berlese funnels, for flotation sampling or for examination under the microscope. The presence of abundant sand in the biologically rich area on the south side of the terminus of Blue Glacier (77°51′S) made possible effective use of the flotation method. This was used after close examination of the rocks in the field with a hand lens. Such a sampling of a one square meter area required about two hours time in the field plus a few hours work later in the laboratory, whither several kilograms of sand were carefully carried in plastic bags. Thus it was proven that *Nanorchestes* is far more abundant than *Stereotydeus*. This is true not merely in the sandy area by Blue Glacier, as evidenced by the survey on the rocky slopes of Observation Hill, Ross I., and by examination of rocks in the field by hand lens at Flatiron, Granite Harbor and at some other points. *Nanorchestes* now appears to be the most widespread antarctic free-living mite, being known all the way from the Shackleton Glacier (Wise 1964) to Campbell I. (Strandtmann 1964).

In regard to the negative areas, considerable microclimatological data was accumulated during the search in the Heritage and Sentinel Ranges (Ellsworth Mts), Jones Mts, and Queen Maud Mts. This data is only very briefly summarized, or omitted, here. However, it will later be analyzed in the light of possible adverse factors preventing the existence of arthropods. Nevertheless, in the meantime, it must be borne in mind that there was more extensive glaciation of Antarctica during the Pleistocene and that the obstacles to dispersal and ready establishment are such that not enough time may have elapsed to permit occupation of isolated inland habitats. Even in the south Victoria Land area there are many locations seemingly appropriate which are not occupied by arthropods (Janetschek 1963).

MITE POPULATION SAMPLING

In order to obtain a preliminary idea of the occurrence and relative representation of mite populations in the McMurdo Sound area of Antarctica, some population counts were made in December 1963. Two samplings were done at Blue Glacier and one on Observation Hill, Ross I. In each case a one meter square quadrat was sampled, and counts were made of the different species of mites. The numbers under each stone were separately recorded, with indication of size and color of stone, to more precisely determine the niches of the mites. Temperature of air and soil was recorded, and particularly of the niches of

the mites. The presence (and numbers) or absence of Collembola in the same quadrats was also noted. Samples of sand or soil from beneath the stones were taken to determine to what extent the mites occurred in the sand as well as under the stones. Neighboring vegetation was noted.

The only free-living mites so far positively recorded from the S. Victoria Land—Ross Island area and southward are trombidiform mites (Prostigmata). One uncertain record of an oribatid mite (Wallwork 1962) from the Pass between McMurdo and Scott stations on Ross I., undoubtedly concerns one taken in an air-borne trapping net maintained at that spot during the period when the specimen was taken. The mites treated here are:

Penthalodidae: *Stereotydeus mollis* Womersley & Strandtmann 1963="large mite"
Pachygnathidae: *Nanorchestes antarcticus* Strandtmann 1963="small mite"

Blue Glacier: At the lower end of Blue Glacier (77°51'S), south side, near the west coast of McMurdo Sound (S. Victoria Land), two quadrat counts were made on 18. XII. 1963 by Gressitt. The first produced only mites, and the second produced mites with only a few collembolans. The surroundings have the most extensive growth of moss observed by us in the general area, or this far south in Antarctica. Lichens, however, are almost lacking. Algae are present, as well as Fungi Imperfecti.

Quadrat 1: This square meter plot was about 4 meters above sea-level, 150 meters from the coast, in a stream bed of glacier and snow melt consisting of rocks in sand, the rocks fairly dense. The area averaged about 18 cm above the level of water of a pond in the stream. The stream was covered with ice and snow for about half its length, but at this point was uncovered, and was flowing. The count was made between 10: 00 and 12: 20. The undersides of the stones were damp and the sand was damp. Permafrost was not apparent near the surface. The sky was overcast with very weak sun; wind varied from 2 to 7 knots. Temperatures recorded were as follows:

Time:	10 : 00	11 : 00	11 : 20	13 : 30
air 1 m above ground	−1.7°C			
upper surface of stones	+2.7°C		+5.0°C	+6.2°C
under surface of stones	+2.2°C			
sand 1 cm deep	+2.2°C			
sand 2 cm deep		+2.7°C	+3.9°C	+5.6°C

The data in Table 1 show that 85% of the stones had mites on their under surfaces and 50% of the stones had both species of mites (nearly 2/3 of the inhabited stones). Also that all dark stones were inhabited, and that most of the large stones possessed both types of mites. The large mites totaled 33 in number and the small mites 50. It is estimated that barely 2/3 of the mites were noticed on the rocks, with a lower proportion of the small mites. Thus *Nanorchestes* was well ahead of the large mite in numbers. This does not take into consideration mites in the sand.

Quadrat 2: This square meter plot (same date) was about 20 meters above sea-level, 250 meters farther up the same stream, and about 60 meters from the edge of Blue Glacier. It was in a sandy part of the stream bed with no water running on the surface at the time. There were fewer stones as far as volume was concerned, but more small stones, and the sand was deeper. Also, the majority of the stones were dark, instead of the

Table 1. Record of mites from quadrat 1, Blue Glacier. Population of each rock recorded separately. *Stereotydeus mollis* (large) and *Nanorchestes antarcticus* (small).

Type of stone:	Large, dark	Small, dark	Large, pale	Small, pale
	4 : 3	2 : 3	4 : 2	*6 : 2
	2 : 7	1 egg : 1	2 : 1	*1 : 4
	1 : 0	0 : 1	2 : 2	1 : 0
	1 : 0	0 : 3	2 : 1	*0 : 0
		0 : 4	1 : 4	0 : 0(x2)
		0 : 5	2 : 2	
			2 : 1	
			*0 : 1	
			0 : 3	
			0 : 0	
Totals	8 : 10	2 : 17	15 : 17	8 : 6

* Stones not entirely pale, partly dark.
The first figure of each pair represents the large mites; the second figure the small mites.
Large stones are those more than 8 cm in length and breadth, or equivalent size.

reverse as in quadrat 1. The sand was quite damp. There were snow-fields on the moraine slopes above the bed, away from the glacier, and some moraine ridges. The sampling was made between 14 : 00 and 16 : 30. During this period the sun shone moderately, there was 7/8 cumulus and stratus cloud cover, and wind was from 5 to 8 knots. Temperatures recorded during the early part of the period were:

air 1 m above ground	−0.6°C (in sun)
upper surface of stones	+6.1°C
under black rock	+7.2°C
under pale rock	+7.2°C
sand 1 cm deep	+7.8°C
sand 2 cm deep	+7.2−7.8°C

The data in Table 2 show that a higher proportion of dark stones had mites, that most of the stones without mites were very small or went very deep (were vertical rather than horizontal), and that less than 1/2 of the stones with mites had both species of mites. The large mites totaled 25 and the small mites 43. Additional mites of both species were retrieved from sand beneath the rocks, by flotation in the laboratory. Some of these may have fallen off the stones when they were lifted from the sand. It appears safe to say that there were at least five times as many *Nanorchestes* as larger mites in this quadrat.

One-half of the Collembola (*Gomphiocephalus hodgsoni*) in this quadrat were quite young individuals, and were pale brown.

Sand flotation (Blue Glacier quadrat 2): By flotation and careful examination in the laboratory, a large number of mites was extracted from about 4 kg of sand taken from quadrat 2. The count resulted as follows:

Table 2. Record of mites (and springtails) from quadrat 2, Blue Glacier, 18.XII.1963. (Records as in Table 1, but figures in parentheses are eggs of large mites)

Type of stone:	Large, dark	Small, dark	Large, pale	Small, pale
	*2(+1) : 2 (4 Coll'a)	1 : 2	*1 : 1	1(+2) : 3+ (1 Coll'a)
	3(+3) : 1	2(+1) : 2	*0(+3) : 1	1 : 0
	#0(+2) : 2	*1 : 2	1 : 1	0(+1) : 0
	2 : 2	0(+3) : 0	1 : 0 (5 Coll'a)	0(+1) : 0
	1(+3) : 1	0(+1) : 0		0 : 2
	3 : 2	0(+1) : 0	0 : 0	=0 : 1
	3(+3) : 0	0 : 9(flat)	@0 : 0	0 : 0(x2)
	@1 : 0	0 : 4		=0 : 0(x2)
	@1 : 0	0 : 0		
	*0 : 4	=0 : 0(x5)		
	@*0 : 1			
	@0 : 0(x2)			
Total adult mites	16 : 15	4 : 19	3 : 3	2 : 6

* Stones somewhat intermediate in color. # Very large stones.
@ Stones going deep. = Very small stones. + Rough stone.

	From sand	Rock census	Totals
Stereotydeus mollis Wom. & Str.	41	25	66
Nanorchestes antarcticus Str.	348	43	391
Gomphiocephalus hodgsoni Carp.	14	10	24
Tardigrada	20		20

Quadrat 3 (Observation Hill): This quadrat was at alt. 90 m on the west side of Observation Hill (77°56'S, 166°41'E), Hut Point Peninsula, SW Ross I. The square meter plot was just below the edge of a melting snow field, and largely lay in the line of flow of the temporarily flowing melt water among the rocks. The survey was made between 15 : 30 and 17 : 00 on 20. XII. 1963. Gressitt and Rennell made the mite counts and Spain took the telethermometer and other weather records. Some of the stones in the area were wet, some dry, and some frozen together. The area was largely of gravel and stones of mixed sizes and shapes, with very little sand. The larger stones were mostly dark in color. Permafrost was 5 cm below the surface. Vegetation consisted of limited green algal growth on rocks and sand, and some limited black lichen growth on some of the rocks. This spot is the same locality as Dr Janetschek's location #1 on Observation Hill. Microclimatological data was as follows:

Air temperature 1 m above ground	+2.3°C
Temperature on upper surface of rocks	+13.0
" " top of flat black rock	+12.2
" " underside of flat black rock	+11.7
" " underside of pale rock	+7.3
" 1 cm deep	+7.2
" 5 cm deep	+2.4
Relative humidity 37%	Sunny, nearly 8/8. Wind SW, 4–5 knots

Table 3. Record of mites and mite eggs from meter quadrat on Observation Hill, 20.XII.1963.

Type of rock:	Large, black	Small, black	Large, pale	Small, pale
	8 : 1	2 : 0(x2)	2 : 0	7 : 1
	6 : 0	1 : 0(x2)	1 : 0(x5)	1 : 0(x2)
	4 : 0	0 : 1	1 : 16	0 : 20
	3 : 0	0 : 2	1 : 2	0 : 27
	2 : 0	*0 : 0(x3)	1 : 1	0(1) : 3
	0 : 3(x4)	0 : 0(x31)	0 : 1(x2)	0 : 8
	0 : 2(x2)	=0 : 0(x32)	0 : 0(x19)	0 : 6
	1 : 0(x2)			0 : 1(x3)
	@0 : 1			0(1) : 0
	0(3) : 0			*0 : 0
	@0 : 0			0 : 0(x30)
	0 : 0(x17)			=0 : 0(x46)
Total mites	25 : 17	6 : 3	10 : 21	9 : 68

@ Vertical stones = Very small stones * Intermediate color
See Table 1 for other explanations.

Flotation: Sand and fine gravel from the Observation Hill quadrat was taken to the laboratory and processed by flotation and microscopic examination of the surface film. No Collembola and no Tardigrada were found. The results are tabulated with the above totals, indicating nearly thrice as many small mites as large ones:

	From sand	Rock census	Totals
Stereotydeus mollis Wom. & Str.	2	50	52
Nanorchestes antarcticus Str.	34	109	143

HATCHING OF MITE EGGS

Preliminary studies were made of hatching of eggs of the free-living prostigmatic mite *Stereotydeus mollis* Womersley & Strandtmann. The other local mite, *Nanorchestes antarcticus* Str., is ovoviviparous. A stone bearing 14 mite eggs laid in a small crevice on its underside was collected from Observation Hill, Ross I. on 29. I. 1963 and taken to the laboratory. A map indicating the position of each egg on the stone was drawn, and the stone was placed in a large covered petri dish with a piece of moistened filter paper. The petri dish was kept in a refrigerator at +4°C. After 8 days no hatching had taken place. The petri dish was then placed in an outside opening steel cupboard on the northern side of the biological storeroom. On 16. II. 1963 three mites had hatched from the eggs. These were put into petri dishes with *Penicillium* sp. cultured from Cape Royds soil. On 19. II. 1963 the unhatched eggs were preserved. The hatched mites were kept alive until 28. II. 1963 when they were preserved.

Observations were incomplete as the date when the eggs were laid is not known. However certain conclusions may be drawn. 1. Mite egg took at least 19 days to hatch. 2. Minimum temperatures during that time did not fall below −3.1°C. Possibly the higher maximum temperatures of the steel cupboard speeded up development. 3. Hatched mites could be kept alive for 9 days possibly feeding on *Penicillium* sp. Future observation of hatching of mite eggs should include determination of time of egg laying as well as detailed study of

other physical conditions, such as relative humidity, which might influence the development or hatching of the eggs.

Daily maximum-minimum temperatures were recorded in the steel cupboard between 7. II. 1963 and 16. II. 1963:

Date	Maximum	Minimum
29. I. 1963–7. II. 1963	+4.0	−0.4
7. II. 1963	+6.7	−0.4
9. II. 1963	+5.2	−1.4
10. II. 1963	+8.9	−0.2
11. II. 1963	+8.5	−1.4
12. II. 1963	+6.6	−1.6
13. II. 1963	+7.9	−3.1
14. II. 1963	+5.1	−1.7
15. II. 1963	+8.2	−2.1
16. II. 1963	+7.3	−1.9

INVESTIGATIONS FOR SPIDERS AND AQUATIC MITES, MCMURDO SOUND AREA AND CAPE HALLETT

From November 1962 to January 1963 the McMurdo Sound area was investigated by O. R. Wilkes especially for spiders and aquatic mites, as well as searches by all other Bishop Museum personnel in earlier seasons and in the 1963–64 season.

Previously an adult male spider of the family Erigonidae had been collected at Marble Point (south Victoria Land) on the west coast of McMurdo Sound, in an aerial net (Yoshimoto, Gressitt & Mitchell 1962). Dr R. R. Forster had advised (pers. comm.) that an adult male spider (family Attidae) sent to him, had apparently come out of a bag of moss and lichens from Cape Hallett (north Victoria Land Coast) although there was no certainty that the spider itself had been collected at Hallett. Further, Dalenius & Wilson (1958) had recorded and figured "spider's threads" in Western Dronning Maud Land, at the same time recognizing the possibility of the threads being fungal mycelia. Murray (1910) had recorded "mites of several kinds" in lake vegetation and the "skins of small mites" taken in several lakes about Cape Royds, Ross I., during the 1907–09 expedition. Since then mites have been taken about the edges of meltwater pools and streams but it was not known if any true aquatic mites existed in Antarctica.

Visual searches for spiders or webs were carried out, particularly about Marble Pt, while soil and moss samples were examined and processed by Berlese funnel and flotation methods. Meltwater pools and ponds were searched and swept with hand nets for water-mites while damp algae on pond shores were examined and processed.

Areas searched were, on Hut Pt Peninsula above Scott Base, Ross I.; Victoria Land: Marble Pt; Gneiss Pt, Marble Pt area; Cape Geology and Flatiron, Granite Hbr; L. Péwé; Wright Valley; L. Bonney, Taylor Valley; Beaufort I., McMurdo Sound.

A few of the larger trombidiform mites were extracted from dry algae from the dry area of a pond (Granite Harbor: Flatiron; 16. XII. 1963), some 5 meters from the edge

of the existing pond which was largely melted at the time. However, the site of this sample was only a short distance from rocks forming the normally observed environment of these mites (as well as springtails). It seems fairly safe to assume that these mites do not inhabit ponds. They are sometimes found under rocks in temporary melt streams.

A number of individuals of the small mite were taken under stones on the natural dam of the above pond. This is considerably above the existing water level, and not far from the area of quadrat studies made by A. Spain, 1963–64.

Only the known species of terrestrial Collembola and mites were found or extracted from samples. No specimens or signs of spiders or water-mites were discovered and none were found elsewhere in south Victoria Land during the 1962–63 and 1963–64 seasons. In view of these facts and the fact that "ballooning", with aerial drift, is a characteristic of adults as well as young of the family Erigonidae, it would seem that the above-mentioned record of a spider net-trapped at Marble Pt is a real indication of the possibility of faunal introduction into Antarctica through wind dispersal.

During a one-day search by J. C. L. M. Mather on Seabee Hook, Cape Hallett, on 14. II. 1963, no sign of spiders was seen and none were extracted from 8 bags of moss and soil taken back to New Zealand for processing in Berlese funnels.

QUEEN MAUD MOUNTAINS

These mountains, part of the trans-antarctic mountains, are very nearly the southernmost mountains in the world. They are situated south of the south end of the Ross Ice Shelf and about 100 km NW of Mt Weaver and Mt Haws, the southernmost mountains. The southern Queen Mauds are less than 400 km from the South Pole, and reach to 86°10′ S near 157°40′W. Field work was done by Gressitt 8–12. XII. 1963 on the southernmost ridges and cliff bottoms in company with the Ohio State University geological expedition (Dr Goldthwait, Wm. Long *et al*). Camp was near the edge of the snowfield (opposite edge of polar ice plateau) at the upper end of the Amundson Glacier at 2100 m alt. Searching was done on several ridges and outcrops, including Porky Gulch, Roaring Valley and nearby areas, mostly from 2150 to 2300 m alt.

Almost no ice-melt was observed even in warm sun in protected niches. Some ponds seen had apparently not thawed at the edges for about 200 years. No sign of any types of plant growth or animals was seen. Gravel, sand, melted pond-ice and other materials were taken back to the McMurdo bio-lab for examination and processing but no living matter was found. Apparently the area is too high, too cold and, in particular too dry, to permit plants or animals to exist, although they might occur on the northern slopes of the ridges or a little farther down the Amundson Glacier.

Evaporation rate was very rapid. Humidity was insufficient to measure. Sand was found to be dry under thin stones which warmed enough to melt snow at times of maximum temperature. Many areas visited proved to consist of thinly scattered moraine on solid glacier ice.

The mean annual temperature in the campsite area is −37°C (−35°F). In the 5 weeks since the camp had been established on 5 November, highest temperature recorded was −7.6°C (18°F), and one day maximum temperature did not reach −17.8°C (0°F).

The rocks of the area are largely granite and dolerite, with some mud-shale, coal-shale,

gneiss and sandstone. Fossil plants occur in the sandstone and worm-tracks in the mud-shale.

ELLSWORTH MOUNTAINS (HERITAGE AND SENTINEL RANGES)

The Ellsworth Mts stretch in the area of 77–80°30'S and 79–89°W. Rennell spent 20. XI–18. XII. 1963 and 23. XII. 1963–2. II. 1964 in the Ellsworth Mts with the University of Minnesota team (C. Craddock, R. Rutford *et al*). Results were negative as far as arthropods were concerned. Rennell worked at several localities besides the following areas here briefly described.

Inferno (Heritage). 79°23'+S, 84°18'+W. 28. XII. 1963. Telethermometer sites 1 & 2.

1) East-facing, exposed to south wind; gray weathered phyllite; permafrost 12–15 cm deep; melt water stream near site: alt. 650± m.

2) Exposed to north, but sheltered by low ridge and from south and west by rock outcrops: soil finely powdered phyllite: alt. 750± m.

		Site 1	Site 2
Temperature range (24 hr):	Free air	−10.2 to 0.0°C	−10.8 to +0.9°C
	Under flat stones	−2.8 to +11.7°C	−6.7 to +18.0°C
	1 cm deep	−4.3 to +8.8°C	−5.0 to +13.9°C
	2 〃 〃	−4.0 to +8.5°C	−2.8 to +11.6°C
	10 〃 〃	−0.7 to +2.0°C	−1.6 to +2.0°C
Atmosphere:		Shady; thick Cs; wind S–E, 0–10 kts	Shady; wind S–NE, 0–3 kts

Meyer Hills (Heritage). 79°46'+S, 81°0'+W. Alt. 500± m. 1. I. 1964. Sites 1–3.

Three sites with different exposures (1, E; 2, N; 3, W) near unfrozen lake; area largely quartzite; in some areas weathered to a fine soil; algae grow as gray scum on rocks on bottom of lake.

		Site 1	Site 2
Temperature range (7 hr):	Free air	−4.0 to +5.0°C	−4.1 to +8.0°C
	Under flat stones	−0.1 to +15.5°C	+1.0 to +17.8°C
	1 cm deep	−1.4 to +9.2°C	−1.0 to +15.7°C
	2 〃 〃	−1.3 to +14.6°C	+1.3 to +15.1°C
	10 〃 〃	+2.7 to +6.9°C	+4.0 to +6.6°C
Atmosphere:		Sunny; 2/8 Ci; wind NW-N, 0–3 kts	Sunny; NW-NNE, 0–5 kts

NW Heritage (R 103). 79°25'±S, 85°40'±W. Alt. 800± m. 10. I. 1964.

Site on north-facing moraine; level; pebbles and rocks; traces of soil; melt-water streams common.

Temperature (10: 58−12: 50):	Free air	−3.9 to +3.0°C
	Under 1 cm thick flat stone	+9.0 to +11.6°C
	1 cm deep	+9.9 to +10.2°C
	2 〃 〃	+9.9 to +10.6°C
	10 〃 〃	+3.7 to +4.8°C
Atmosphere:	Sunny; clear; wind N-E, 0–3 kts.	

East Sentinels (R 114). 77°37′S, 85°26′W. Alt. 1000± m. 14. I. 1964.

Site on north-facing 20° slope in large flat area; 200 m above ice plateau; slope of black soil and flakes of phyllite; stones small, some wind-polished; moisture present at 5–10 cm below surface; permafrost at 15 cm.

Temperature (10 : 10–13 : 22) :	Free air	+0.2 to +6.8°C
	Under 1 cm thick flat black stone	+30.7 to +33.3°C
	1 cm deep	+30.8 to +32.9°C
	2 〃 〃	+21.0 to +23.1°C
	10 〃 〃	+10.1 to +13.7°C
Atmosphere :	Sunny; 1/8 Ci; wind N-ENE, 0–2 kts.	

JONES MOUNTAINS

Rennell visited these mountains (73°20′–73°35′S, 93°30′S–94°45′W) on 6. II. 1964, also with the University of Minnesota team. The locality investigated was at 73°31′S, 94°25′W; alt. 730 m. Results were negative for insects and mites. A young petrel examined lacked ectoparasites. Moss samples (#4, #5) were positive for Tardigrada, Rotifera and Nematoda (latter submitted to W. C. Clark). Moss samples were later propagated in pure culture by E. Schofield.

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