Benthic Zonation in Antarctica, as Displayed by Marine Annelids (Polychaeta) Based on Published and New Records, from Intertidal to Hadal Depths

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Abstract: A historical summary of polychaetous annelids from Antarctica shows that 457 species have been named to 1965; 65.7 per cent are endemic; about 10 per cent occur in circum-Antarctic seas, and fewer than 10 per cent are cosmopolitan. Nineteen areas are recognized from which samples have been taken in recent expeditions of the United States of America. About 200 useful samples come from shelf to abyssal depths. New faunas are recognized; one occurs in intertidal and shallow depths of the Antarctic Peninsula; others are in deep slope and abyssal depths surrounding the continent.

Antarctica, covering the south polar region, is a large continent measuring about 6800 by 4000 km and has a coastline of approximately 20,000 km. Its ice-covered surface extends well over the steep-sloped fringe of the continent, as floating ice shelves and tongues of glaciers. The southernmost extensions of the ocean are in two great embayments—the Ross and Weddell Seas, at about 78° S latitude, or about 1200 km from the South Pole. Difficulty in reaching the continent through the frozen shelves hampered surface exploration of the shelflands, far beyond the years when exploration was at its height, in the 1820's to 1850's. Expeditions at that time were chiefly concerned in exploring the Antarctic seas for the richly rewarding whale and seal fisheries. These earliest Antarctic explorations were often privately financed and seldom interested in biological work, so that few polychaete records have been documented; they were only incidental to the major task of farming the sea. Area-wise, however, these expeditions were interesting in that their routes nearly encircled the continent.

As early as 1837 the French ZÉLÉE dipped up a sample of seawater, at 60° S, 1° W, which contained a pelagic polychaete that was deposited in the Paris Museum. Much later, 1865, it was described as *Tomopteris carpenteri*. It turned out to be not only the largest of all known tomopterids, but also the only truly Antarctic one.

Somewhat later the British EREBUS and TERROR, 1838–43, explored the waters around Victoria Land, in 160° E, and took samples from shallow depths; six species of polychaetes were described by BAIRD, 1865.

The first named polychaetes from south of 50° S latitude were taken by

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the Swedish Frigate EUGENIE. During its voyage around the world it penetrated south to Kerguelen and passed through the Strait of Magellan. The ship's doctor, J. G. H. KINBERG, who was also one of its scientists, took samples in shallow water of the Strait. Some polychaetes were named as early as 1855, making them the first marine annelids named from latitudes south of 50° S. Although KINBERG had little other claim to zoological literature, since he published only preliminary accounts of these samples, he will be remembered for having named the first seven of the most abundant polychaetes in the Magellan area; the type locality of 12 species was Buket (meaning little bouquet); later changed to Bucket.

A significant contribution to polychaete literature was made when the British CHALLENGER, 1873–76 (sta. 149–158) penetrated south to 62° S, in the vicinity of Queen Mary Land. MCINTOSH (1885) named 62 species from latitudes south of 50°; 20 came from abyssal depths. The German GAZELLE, 1874–76, went south as far as Kerguelen and Magellan; 21 species were named by GRUBE (1877). The French mission to Cape Horn, 1882–83, in the ROMANCHE, resulted in the discovery of 47 species named by FAUVEL (1941), and six spirorbids by CAULLERY and MESNIL (1897).

German zoologists, W. MICHAELSEN and associates, were in the Ushuaia area in October, 1892, in the Falklands in 1893, and the deepest samples came from Smyth Channel and South Georgia in 56 to 62 fms. EHLERS (1897) named 85 species of polychaetes of which 32 were new, and in EHLERS (1901) their numbers were increased to 137 species, all from the Magellan area.

The Belgian Antarctic Expedition in the BELGICA, 1897–99, penetrated south to the Bellingshausen Sea, at 71.5° S. The zoologist, EMILE RACOVITZA accompanied the expedition and made many interesting observations. Polychaetes with 46 species, were named by FAUVEL (1936); unfortunately, this study regarded about 30 per cent of the species as cosmopolitan or European forms, —a distributional pattern which has not been borne out by subsequent studies, for the affinities of Antarctic species are not with the Mediterranean Sea.

A significant study was that of the German VALDIVIA, under the direction of KARL CHUN, 1898–1900, when a transect was extended from Madagascar south toward Enderby Land, at 50° E. The polychaetes with 46 species, were studied by EHLERS (1912). The British SOUTHERN CROSS (1898–1900), penetrated to Cape Adare in Victoria Land, and west to the Ross Sea; WILLEY (1902) reported on 16 species of polychaetes. The German GAUSS, 1901–03, returned with one of the greatest hauls of invertebrates ever brought back from Antarctic waters. EHLERS (1913 and 1917) reported on 206 species, of which 80 were Antarctic forms.

One of the most profitable in terms of scientific reports, resulted from the Swedish ANTARCTIC expedition, in 1901–04, under Dr. OTTO NORDENSKJOLD. Although the ship was crushed by ice and wrecked in the northwest part of the Weddell Sea, its members were rescued by an Argentine ship, and many of the valuable collections had already been sent to Sweden. One hundred sixty-six

species of polychaetes were named in ten separate reports.

The British National Antarctic Expedition in the DISCOVERY, 1901–04, wintered at Hut Point, McMurdo Sound in the Ross Sea. EHLERS (1912) named 46 species of which 11 were new, and STUMMER-TRAUNFELS (1908) named the first and only myzostomes (parasites of echinoderms) which have ever been recorded from Antarctica. The Scottish National Antarctic Expedition, in the SCOTIA, 1902–04, explored the Falkland Islands, the South Orkneys and the Weddell quadrant. RAMSAY (1914) named some nereids and PIXELL (1913) some serpulids. The Falklands were also the site of shallow water collecting by R. VALLENTIN, 1898–99; a few polychaetes were named by FAUVEL (1916) and PRATT (1898, 1901).

Two French expeditions, the first in the FRANÇAIS, 1903–05, and the second in the POURQUOI PAS?, under the French physician, JEAN B. CHARCOT, explored the Palmer Archipelago, south to 70° S latitude and northward to southwestern South America. GRAVIER (1907, 1911) named 51 species of polychaetes, of which 14 were new. The British TERRA NOVA, 1910–13, collected in the Ross Sea. These collections, together with those of the Australian Antarctic Expedition, 1911–14, in the AURORA, which explored along the Adélie Coast, were studied by BENHAM (1927), who recorded 128 species. Three Norwegian Antarctic Expeditions in 1929 to 1931, explored areas in South Georgia and Bouvetøya, south to 62° to 68° S latitude. Depths ranged to 750 meters. AUGENER (1932) named 80 benthic, and STØP-BOWITZ (1949) eight pelagic polychaetes.

The joint efforts of Britain, Australia and New Zealand, as the BANZARE Expedition, 1929–31, resulted in the description of 143 species by MONRO (1939). The British ships, DISCOVERY I and II, and the WILLIAM SCORESBY, 1926–27, and 1931–33, resulted in the recovery of 220 benthic polychaetes in 128 genera, of which 29 species were new, in addition to 25 pelagic species in 17 genera (MONRO, 1930). This was followed by MONRO (1936) with 159 species of which eight species and six varieties were new. TEBBLE (1960) later redescribed the pelagic polychaetes of the DISCOVERY. These results are summarized in HARTMAN (1964–66).

Three Soviet Antarctic expeditions to the eastern quadrant (1955, 1958, 1959), in the OB were summarized by USCHAKOV (1956–58) in "Benthic Operations of the OB" who reported: "The most striking feature of the bottom fauna of the Antarctic coast is the enormous variety and the great degree of endemism. Despite the broad polar circumpolar distribution of most Antarctic species, it is possible to point out specific features of fauna from Indian, Atlantic and Pacific sectors of the Antarctic". At depths of about 700 to 800 m, over the coastal region of this quadrant there was found a predominant epifauna of sponges with large numbers of echinoderms.

A more complete list of Antarctic expeditions, for which polychaetes may have been taken and remain unpublished, may be found in the Geographic Names of Antarctica, Gazetteer no. 14, 1956 (U. S. Board on Geographic Names).

Since 1959 this vast polar land and its surrounding seas with an area of

about 54 million square km have been the subject of intensive studies by more than 12 nations, through the IGY cooperative study begun in 1956–59. Five of these nations (Australia, Argentina, Chile, New Zealand and South Africa) bound the Antarctic Ocean; others include Belgium, France, Japan, Norway, the United Kingdom, United States, Soviet Socialist Republic, and more recently Denmark, Czechoslovakia and Poland. Ships of many nations are now exploring the most inaccessible parts of the continent and surrounding seas, in all depths. As a result, much physical, oceanographical, meteorological and biological data is available. The Scientific Committee for Antarctic Research (SCAR) organized in 1958, early formulated objectives and coordinated the various scientific programs, greatly strengthening the effectiveness of individual efforts, and insuring free exchange of knowledge. The promise of rewarding results in the Antarctic programs is indicated by the fact that all original participating members have shown continued interest to conduct activities at various levels of research.

Advances in cartography have made possible the mapping of sea bottoms surrounding the continent, without which a project to plot the distributions of benthic animals would be quite meaningless. The detailed maps show that Antarctica is completely bounded by the Antarctic Ocean, which makes wide communication, at great depths, with the three major oceans — the Atlantic, Pacific and Indian oceans. At its northern limits the Antarctic Ocean is strongly characterized by two temperature convergences; the Antarctic Convergence at 50° to 60° S, with a surface temperature which rises, within a hundred miles, from near freezing to 2° to 4° C and the Subantarctic Convergence, at about 40° S, which has temperatures that rise, within a similar short distance, to 8° to 10° C. These temperature differences may be barriers to migrations of pelagic organisms, including possible larval forms of benthic species. Based on many measurements, it is now known that temperature and salinity of surface, and perhaps deep waters, remain unchanged over long periods of time. The Antarctic continent, near the ice edge has a temperature at about $-1°$ C; surface water of the sea is about 0° C; offshore surface waters are about 1° to 2° C in winter and rise to 4° to 5° C in summer. Deep water has a temperature of 0° to 2° C, and bottom water is at 0° C; the deepest parts of the Weddell Sea may sink to $-0.4°$ C.

Only about 0.3 per cent of Antarctic surface water lies above the thermocline, or region of rapid temperature change, the remainder is in temperature at or below freezing. The pycnocline, where density increases, lies just below the surface. The effects of these two processes on Antarctic sea life are poorly known, but may be expected to be profound on benthic organisms at various levels.

Antarctica is a vast treeless continent which covers the earth from the pole to about 75° S latitude. This is entirely land and solid ice, supporting a flora which is almost limited to sparse growths of bryophytes and lichens, and some green and blue-green algae. The presence of impressive rookeries along the margin of the continent, may contribute measurable amounts of nutrients to

the long-shore sea bottoms. Although the shores of Antarctica have usually been characterized as nearly devoid of life, due to the effects of ice-bound and sheer coastlines, coarse sediments of ice-rafted sandstones, detritus and ice, intensive search may prove that there are no really barren areas where the terrain is exposed. Dr. WALDO L. SCHMITT, of the USNM, who in 1962–63 made shore-stations in the Palmer Archipelago and South Shetland Islands disclosed the occurrence of a highly significant intertidal and shallow water fauna, in areas where the coastline is free of ice. The polychaetes, numbering more than 70 species, are typically shallow water forms, and have their affinities with the fauna in Juan Fernandez and southern South America; some are unknown.

In depths below the cold surface water, the amount of life increases tremendously, so that at 50 meters there are great masses of algae, sponges, bryozoans and other filter-feeding forms, together with echinoderms. These animal masses are thought, by some, to represent the most productive faunal areas known to exist. At greater depths, where muds prevail, the groups of animals comprise especially polychaetes, mollusks, and crustaceans.

Since 1962 the University of Southern California has participated in the collecting program of the USNS ELTANIN, through support of the National Science Foundation, U. S. Antarctic Program. A broad sampling program was established between 20° W longitude, in the Atlantic region, and 160° W in the Pacific Antarctic; this includes the southern Pacific Ocean between South America and New Zealand. Samples have been taken both north and south of the Antarctic Convergence within these longitudinal ranges, and most recently into the Pacific Basin. A continuous shipboard program, over three years, has resulted in the recovery of many benthic and pelagic samples. The chief objectives have been aimed at determining the species-composition of the dominant elements in the benthos. The polychaete studies are continuing in this direction, combining the results of the ELTANIN, the DEEP FREEZE cruises in the Ross Sea areas and the shallow-water collecting in the Palmer Archipelago. Studies to date verify not only the existence of great diversity at all depths, but faunal changes with latitude, longitude, depth and kinds of sediment.

The major kinds of sampling equipment used in taking the samples aboard the ELTANIN have included the Blake trawl, Otter trawl, 5–ft beam trawl, rock dredge, Menzies trawl, and quantitative bottom grabs. Efforts to take quantitative samples have usually met with failure because the sea bottoms are too rubbly or too deep to permit a fair recovery and subsequent appraisal of the kinds and amounts of animals existing in these bottoms.

More than 200 useful benthic samples have been recovered from various areas, and the numbers and kinds of animals in Antarctic seas have been greatly increased in shallowest to greatest depths. Abyssal depths, which cover vast areas, remained almost unknown; the samples from these areas have revealed a new fauna.

Before a systematic study could be made of the polychaetes of Antarctica, it was necessary to review all previous works and update the systematics. This

was done, in 2 volumes of the Antarctic Research Series, comprising the Errantia in vol. 3, and the Sedentaria in vol. 7. This includes all published records coming from areas south of 50° S latitude. Before 1965, 457 species of polychaetes were named. Of these, 165 species have each been recorded only once; an additional 78 species twice and 54 species three times, bringing the total number of sparsely recorded species to 297, or 65.7 per cent of the total number; these may be considered endemic species, until their ranges can be extended into deep bottoms of other oceans. Another 111 species or a total of 24.3 per cent have been recorded four to nine times. Only 46 species, or ten per cent have been recorded ten or more times. Forty species, or less than ten per cent, may be regarded cosmopolitan, of which about half are so-called Mediterranean species (which may reflect the training of specialists in European countries). Many so-called cosmopolitan benthic polychaetes are now considered too incompletely known. To the totals published, nearly as many more must be added, coming from collections of recent expeditions (ELTANIN; DEEP FREEZE; STATEN ISLAND cruises).

The majority of polychaetes previously known come from moderate depths, or less than 2000 m. Twenty species were named from CHALLENGER stations in depths of 1000 m or more. Intertidal, or shallow water species have come chiefly from southern South America or Subantarctic islands, including the Falklands, South Georgia, Kerguelen, and others. The polychaetes of Antarctica and in the surrounding large, abyssal depths are very incompletely known. The collections under study in the Allan Hancock Foundation are positive proof that faunal surveys will reveal a vast diversity hitherto unknown for invertebrate animals from Antarctica.

The collections taken by the ELTANIN have been especially rewarding in providing samples from deep slope and abyssal depths. The number of specimens taken runs into the thousands, and the number of unknown species is not yet assessed but will prove considerable, especially in abyssal and shallowest depths. Only intermediate depths are relatively known. Although the studied results are far from complete, it is obvious that there are highly productive abyssal depths, supporting species of bizarre kinds, and with individuals attaining sizes which rival or surpass those in slope depths. A summary of faunal composition for these areas follows:

Valparaiso transect, western Chile, is represented by 20 samples. In shallow depths, 154 to 974 m, the polychaetes are represented by about 44 species, all small, coastal forms, showing generic affinities with similar latitudes in the northern Pacific. At greater depths, to 4634 m, the polychaetes are deep-water kinds, represented by onuphids (*Hyalinoecia tubicola*, *Onuphis paucibranchis*), ampharetids, and many others; some are unknown to science, differing from any found in Antarctic samples south of the Convergence. One of the deepest is *O. paucibranchis* common to the Antarctic Basin. Individuals in shallow and moderate depths appear sparse and impoverished, perhaps due to the effects attributed to the Gunther Current. This area lies well above the 50° S latitude, which has

been arbitrarily chosen to mark the Antarctic-Subantarctic realm.

Southwestern Chile is represented by three samples, coming from depths of 146 to 957 m; two bathypelagic samples come from depths of 2981 m over 4008 m, and 2893 m. Twenty-three species of polychaetes were taken from depths to 957 m, and four pelagic species over abyssal depths; one is an unknown flabelligerid genus encased in a thick mucoid sheath. It is the first and only known pelagic flabelligerid, and reminiscent of the enigmatic north Pacific *Poeobius meseres* Fisher, for which the distribution is in similar north latitudes. This was taken only in a limited area off southwestern Chile into Subantarctic latitude. The benthic species off southwestern Chile show affinities with the central Chile and Magellanic areas.

Tierra del Fuego is represented by seven useful samples coming from depth of 80 to 641 m. At least 44 species are represented, of which 32, or more than 75 per cent, are representatives of the Magellanic fauna. Typical genera include *Chaetopterus*, with peak numbers in 80 to 128 m, *Chloeia*, *Sphaerosyllis*, *Salmacina*, and others, not known from Antarctic samples. Unusual numbers of specimens occur in *Eunereis patagonica*, a tubicolous nereid associated with algal bottoms. *Phyllocomus crocea* is an unusual ampharetid, having affinities with ampharetids in the south Atlantic. Two sabellarians, *Idanthyrsus armatus* and *Sabellaria*, a sabellid, *Potamilla antarctica* and a serpulid *Serpula narconensis*, attain their greatest development in this latitude.

Strait of Magellan, on the **Patagonian Shelf,** is one of the best known for its polychaete fauna. This shelf measures about 600 by 250 miles, has rubbly volcanic debris from which samples are taken with difficulty. Six samples were taken in 81 to 485 m. One hundred sixteen species of polychaetes have been identified, of which at least 16 are so limited. *Chaetopterus*, the parchment-worm, *Maldane sarsi*, *Serpula narconensis*, *Potamilla antarctica* and an *Aphrodita* with a commensal endoproct, *Loxosomella*, show peak numbers in 485 meter depth. Other conspicuous members are *Eunereis patagonica* in 40 to 980 m. The polychaetes are best represented and diversified at the 485 m level. Pogonophorans were found entangled in the dorsal felt of *Aphrodita*.

Cape Horn, a southerly extension of the Magellanic area is represented by seven useful samples from 31 to 4008 m. Most animals were small, occurred in sparse numbers, and were representatives common to the Magellanic fauna. Noteworthy collections were those in abyssal depths, where a sample from 3806 to 3770 m contained a polynoid, *Macellicephala nationalis*, taken previously only in the North Atlantic (HAECKER, 1898, and EHLERS, 1913). An unknown species of an unusual syllid found previously in deep water of the North Atlantic (HARTMAN, 1965), and the pelagic flabelligerid, found also off southwestern Chile. Other finds included new species in other sedentary genera (*Euzonus*, capitellid, opheliids, ampharetid).

The Falkland Islands with Burdwood Bank are separated from the Patagonian Shelf by a trough of water 150 to 200 m deep. They lie beyond the limit of pack-ice and belong to the Subantarctic zone, with isotherms of 6° to 12° C.

They are under the influence of the Cape Horn Current, which carries Pacific water. Shallow bottoms are sandy. Ten useful samples were taken in 106 to 595 m. About 40 species, of which 22 were previously reported, are predominantly Magellanic. One of the best represented is a commensal polynoid *Polyeunoa laevis*, on hydrocoral, in 346 to 586 m; *Nothria iridescens*, in 578 to 595 m, widely represented in the northeast Pacific, and *Nothria conchylega*, in 247 to 293 m. A reef-building sabellarian, *Idanthyrsus armatus*, attains its greatest development in 229 to 293 m. *Chaetopterus* was represented only by fragments. Six samples, from greater depths in 845 to 3642 m, yielded more than 40 species of which most are either unknown, or occur in abyssal depths of Antarctica. Families best represented are onuphids, polynoids, maldanids, ampharetids and syllids. None of the species is common to shallower depths. One of the most characteristic abyssal Antarctic species—a large maldanid of unknown genus—occurred in greatest depths, at 3514 to 3642 m; the same species was found in all other Antarctic quadrants, at comparable depths.

A strong thermal hiatus occurs between the Falkland Islands and South Georgia to the east. A change in benthic fauna is obvious, but also due to differences in depths and sediments of the two areas.

South Georgia, an island about 168 by 32 km, with steep glaciated mountains, in 54° to 55° S, and 35° 45′ to 38° W, is completely surrounded by water to a depth of 3000 m. Its deep sediments are chiefly blue muds, which support a distinctive fauna. Eight samples, in depths of 2196 to 3239 m, yielded 26 species of polychaetes, of which perhaps more than half are new. They are representatives of *Lagisca*, *Macellicephala* (Polynoidae), Onuphidae, Maldanidae, Opheliidae, Ampharetidae, and others. Shag Rocks, near South Georgia, was sampled in 3403 to 3714 m, with three samples. The largest were an aphroditid, *Laetmonice*, onuphids of two kinds, ampharetids, and other deep water kinds, some common to South Georgia.

Drake Passage in 56° to 62° S latitude, between South America and Antarctica represents the narrowest part of the Antarctic Ocean. It is traversed by a complex current pattern which has been described by OSTRAPOFF (1965, p. 97); it consists of a fourlayered system in which the surface water to about 2400 m flows westward; intermediate water, at 2400 to 3000 m flows east, with its greatest strength at 59° S; lower water, at 3000 to 3200 m flows west, and bottom water, at 3200 to 3400 m is part of the east-flowing Antarctic circumpolar current flow. The bottom is well scoured, terrigenous sediment. Greatest concentrations of life are at about the 500 m level, where enormous sponge associations exist; they diminish rapidly to the 3000 m level. Twenty-three samples were taken from depths of 384 to 4574 m. In 384 to 1208 m polychaetes were represented by more than 12 kinds, resembling those near the Falkland Islands. Depths of 2000 to 4574 m yielded about 56 kinds, differing wholly from those in shallower depths; most are either unknown or briefly reported. Notable genera are in the polynoids, *Leanira*, *Eteone*, *Glycinde*, *Microorbinia*, *Chaetozone*, *Tharyx*, *Ilyphagus*, *Brada*, *Flabelligella*, *Pseudoscalibregma*, opheliids of three kinds, *Kesun*, ampharetids,

sabellids; some show strong affinities with deep-water genera named from the North Atlantic Ocean (HARTMAN, 1965).

The Scotia Arc in great depths connects Burdwood Bank, Shag Rocks, South Georgia and the South Shetland Islands to the Antarctic Peninsula. It encompasses the Bransfield Strait; this is one of the most productive areas of polychaetes found in Antarctica.

The **Scotia Sea**, centered at 57°30′ S, 55° W, is bounded by South Georgia, the South Orkneys and the South Sandwich Islands. Eleven useful samples came from 220 to 1400 meters. The large aphroditid, *Laetmonice producta* and many other representatives of the Antarctic fauna are best represented. Shallow water species, represented by *Haploscoloplos kerguelensis* and *Serpula narconensis*, are present to nearly 1400 m. An abyssal fauna, differing wholly from shallower bottoms, occurs below 2366 m, this is represented through four samples which yielded about ten species.

The **South Shetland Islands**, at 61° to 63° S, north of the Antarctic Peninsula, are represented by 12 samples. Six, in depths of 225 to 1437 m were richly diversified, representatives including some earlier named from these areas, and more numerous unknown kinds. Typical representatives are in *Laetmonice* (peaks in 403 m), *Pista spinifera*, *Polyeunoa laevis*, many polynoids, a giant *Trypanosyllis*, an Antarctic phyllodocid (*Austrophyllum*) and sphaerodorids. Deeper bottoms, to 4758 m, with two samples, yielded abyssal forms, numbering more than 50 species, found also in other Antarctic areas. Two tubicolous, viviparous onuphids, *Nothria notialis* and *Paronuphis antarctica*, were abundant at 1437 m, with an unknown *Anaitides* (phyllodocid) which occurred in peak numbers. Ampharetids and sabellids, in 1437 m; opheliids in 2763 m, and many other kinds, usually as single individuals, but like those from other abyssal depths of the Antarctic Ocean.

Bransfield Strait, between the South Shetland Islands and the Antarctic Peninsula, is a narrow body of water about 60 miles wide and 200 miles long, centering at 63° S, 59° W. The bottoms are mixed, glacial terrigenous sediments. It has previously remained almost unknown for its polychaete fauna except for *Nothria notialis* (Monro). Twenty-four samples, from depths of 73 to 2562 m, yielded more than 101 species, of which most represent either new species or genera, and all are new records. A conspicuous population of the large *Laetmonice producta*, with individuals attaining sizes of 12 to 14 cm long by 4 to 5 cm wide, containing arm fragments of a large ophiuroid in the alimentary tract, are conspicuous at depths to 770 meters. At 73 m the southernmost *Chaetopterus* were encountered. Peak numbers of an ampharetid, *Neosabellides elongatus*, *Pista spinifera*, *Flabelligera*, and polynoids of numerous kinds, were found. The commensal polynoid, *Polyeunoa laevis* with hydrocoral, was most abundant in 210 to 220 m together with *Phyllocomus crocea*, a characteristic Magellanic form in 265 m. The viviparous *Paronuphis antarctica* and another onuphid, *Rhamphobrachium ehlersi*, were most conspicuous in 220 m to 240 m. *Streblosoma antarctica*, with *Pista mirabilis* and *P. corrientis* and *P. spinifera*, together with many other kinds, were best represented. *Serpula narconensis*, another Magellanic species, has its deepest

southernmost limit in the Strait in 884 m.

The **South Orkney Islands**, including two larger and several smaller ice-covered mountainous islands, in 60° to 70° S, and 44° to 46° W, were sampled with various kinds of trawls; 27 useful samples came from 234 to 5274 m. More than 100 species, of which many are either new species or also genera, are represented. A shallow sample, from 298 to 302 m, yielded 28 species and 160 specimens, which have affinities with adjacent areas. The sample contained a giant *Eulagisca gigantea*, measuring 190 mm long and 70 mm wide with setae, and more than 100 inhabited tubes of *Paronuphis antarctica*; these were accompanied by other moderate to large individuals. Another sample, from 298 to 403 m, yielded 39 species in 646 specimens, of which there were peak numbers of an unknown oweniid, and *Eunoe opalina*. The polychaetes are well represented by polynoids, syllids, onuphids, paraonids, spionids, cirratulids, opheliids, maldanids, oweniids, ampharetids, and sabellids. Abyssal depths, from 2196 to 5274 m, contained animals of other kinds; the deepest, in 5259 to 5274 m with a maldanid, *Notoproctus o. antarcticus* (more than 100) and an unknown sabellid, ? *Potamethus*. The large clymenid maldanid was abundant in 4196 m. The viviparous onuphid, *Nothria notialis* was abundant in 2800 m and replaced by *Onuphis paucibranchis* in greater depths.

The Scotia Arc with its interrupted islands and rocks, supports a varied bottom fauna, which is abundant in all depths, and changes not only with depth, but latitudinally, with those of more southern islands more like that of the Antarctic fauna, and the more northern islands having greater affinities with the Magellan region.

The **Antarctic Peninsula**, south of Cape Horn and the Drake Passage, extends from 63°15′ S to 75° S, and 57° to 65° W, was most completely sampled on its western side, with nine samples in 128 to 4328 m. Several interesting lots were taken intertidally and in very shallow depths, off Anvers Island, by Dr. WALDO L. SCHMITT, Shelf depths at Anvers Island resulted in the recovery of 15 species and 200 specimens in intertidal depths, 16 species from four fms, all different from the first, 26 species from 12 to 38 fms with 20 different from previous named, and 18 species from 41 to 46 fms. Most specimens are small to minute, and some are ovigerous. The shallow water genera are like those in other parts of the Scotia Arc, except for two unknown genera. It is estimated that 60 species are represented.

Shallow depths, in 128 to 165 m, were characterized by polynoids, terebellids, ampharetids, sabellids, and the southernmost shallow depth by *Serpula narconensis*. Other species resembled those of southern parts of the Scotia Arc.

In greater depths, 128 to 632 m, polychaetes resemble those of other parts of the Scotia Arc. In greatest depths, 2782 to 4328 m, deep-water forms may be characteristic (samples have not been wholly satisfactory).

The **South Sandwich Islands**, a volcanic chain north of the Weddell Sea, are centered at 56° to 59° S and 26.5° W. Eleven samples in depths of 101 to 7686m resulted in the recovery of more than 45 species, of which a considerable

number are new. Most characteristic are an unnamed *Aglaophamus*, *Maldane* resembling *sarsi* but with a thin-instead of a thick-walled tube, and sabellids. Abyssal depths, 2531 to 7686 m, support a unique fauna, with some species not found elsewhere. An unknown myzostome, in 4643 to 4645 m, and several unknown genera of polychaetes, in 2553 to 2575 m, are indicative of the unusual fauna in these depths.

The **Weddell Sea** is a large ice-clogged sea between the Antarctic Peninsula and Coats Land, centered in about 73° S and 45° W, best known for the Filchner Ice Shelf. Its sediments are glacial debris. This was sampled in 2818 to 4557m, resulting in five useful samples. Ten species, all either in unknown genera or species, are present with about 50 specimens; a coarse actinian and large deep-water maldanid are characteristic.

Peter I Island, an ice-covered island 14 miles long and five miles wide, 68°50′S, 90°35′ W, was sampled three times, yielding four species and nine specimens of which all are perhaps unknown. Sediments are siliceous ooze.

The **Mid-Pacific Antarctic Basin**, west of Peter I Island has sediments of ooze; it is represented by 19 samples taken in 3386 to 5124 m. About 15 species are present, all from great depths, of which four appear to be so limited, the others are found also in other abyssal Antarctic stations.

The **Pacific Antarctic Ridge** was sampled three times, in clayey silts, in 3587 to 4520 m. Only a few small fragmented bits were retained, they show no unique affinities, except possibly with the Pacific Antarctic Basin.

Samples taken from the **New Zealand Plateau** and **Auckland Rise** are altogether different from Antarctic samples. They come from shallow (79 m) to abyssal (3762 m) depths.

The Ross Sea area is known with about 45 species (published records), of which 13 are so limited.

The Eastern sector of Antarctica, excluding the Ross Sea area, is known through about 135 species, of which 57 are so limited (these areas are not yet studied from ELTANIN samples).

Characteristics of Antarctic Polychaetes

The polychaetes of Antarctica, as currently known, are highly endemic; more than 60 per cent of a total of 453 species, are not known beyond Antarctic-Subantarctic seas; only 24 per cent of the total occur also in the Magellanic region, and fewer than ten per cent are cosmopolitan. This is in line with known facts of some other benthic invertebrate groups. Mollusks from the New Zealand sector of Antarctica, reported by DELL (1964, p. 259) are represented by 91 families of which 50 have a single genus, 28 other families have only one species; 56 families have three species or fewer. POWELL (1965, p. 347) regarded the Antarctic mollusks as very incompletely known. Bryozoans, ROGICK (1965, p. 402) reported 321 species of which 179 are exclusively Antarctic. Pycnogonids, by W. G. FRY (1964, p. 263) are recorded with 100 species in 14 genera, of which 90 per cent are endemic. Ophiuroids from the Ross Sea were studied by H. B. FELL

(1961, Mem. 18) with 33 species of which 17 are also Magellanic; only one is common to New Zealand.

The 453 species of Antarctic polychaetes, recorded to 1965, will be increased to well over 800 species when the newly collected samples of the ELTANIN, DEEP FREEZE and STATEN ISLAND cruises are reported. The number of species will increase chiefly in samples coming from abyssal depths and very shallow, intertidal or shelf areas of the continent.

The greatest abundance of polychaetes has come from depths of 500 to 1000 meters, where peaked numbers of some species occur. Some of these species, with their localities are:

South Georgia, in 3056 m to 3102 m: *Nicomache lumbricalis* and *Myriochele*.

Drake Passage, in 384 to 494 m: *Euphrosine notialis*, *Eunice pennata* and a laeospirid; in 641 m: *Nothria notialis*, and in 3800 m, *Ammotrypane nematoides*.

South Shetland Islands, at 403 m, with *Laetmonice*, and at 4758 m with ampharetids.

Bransfield Strait, in 73 m with *Neosabellides elongatus*; at 210 m with *Laetmonice*, polynoids, *Nothria notialis*, *Paronuphis antarctica*, *Rhamphobrachium ehlersi*, *Pista mirabilis* and *Streblosoma antarctica*. At 935 m with *Myriochele* and *Paronuphis*.

South Orkney Islands, in 400 m, with *Eunoe opalina* and *Myriochele*. In 604 m with *Paronuphis antarctica*, and at 4000 to 5000 m with an unknown large maldanid and *Notoproctus oculatus antarcticus*.

South Sandwich Islands, in 1482 m with *Maldane*, and at 7686 m with *Amphicteis gunneri antarcticus*.

The southernmost limits of some commonly regarded cosmopolitan species have been found to extend only into Subantarctic moderate depths.

References

DELL, R. K.: Zoogeography of Antarctic benthic mollusca. Premier Biol. Ant. Symp. SCAR, Paris, 259–262, 1964.

FELL, H. B.: The fauna of the Ross Sea. Ophiuroidea. N. Z. Oceanogr. Inst., Mem., No. **18**, 1–79, 19 pls., 9 textfigs., 1961.

FRY, W. G.: The pycnogonid fauna of the Antarctic continental shelf. Premier Biol. Antarct. Symp. SCAR, Paris, 263–270, 1964.

HARTMAN, O.: Polychaeta Errantia of Antarctica. Antarct. Res. Ser., **3**, 1–131, 39 pls., map, 1964.

HARTMAN, O.: Deep-water benthic polychaetous annelids off New England to Bermuda and other North Atlantic areas. Hancock Fdn Publ., Occ. Pap., No. **28**. 1–378, 52 pls., map. 1965.

HARTMAN, O.: Polychaeta myzostomidae and sedentaria of Antarctica. Antact. Res. Ser., **7**, 1–158, 46 pls., 5 charts, 1966.

OSTAPOFF, F.: Antarctic oceanography. Monogr. Biol., The Hague, **15**, 97–126, figs. 1–15, 1965.

POWELL, A. W. B.: Mollusca of Antarctic and Subantarctic seas. Monogr. Biol., The Hague, **15**. 333–380, figs. 1–6, 1965.

ROGICK, M.: Bryozoa of the Antarctic. Monogr. Biol., The Hague, **15**, 401–413, 1965.

U. S. BOARD ON GEOGRAPHIC NAMES: Geographic names of Antarctica. Gazetteer No. **14**, 332p., Washington, 1956.

USCHAKOV, P. V.: Biological results of the Soviet Antarctic Expedition (1955–58). Explorations of the fauna of the seas. Issled. Fauna Morei, 129–189, pls. 1–9, 1962.

USCHAKOV, P. V.: Quelques particularités de la bionomie benthique de l'Antarctique de l'est. Cah. Biol. Mar., **4**, 81–89, figs. 1–4, 1963.