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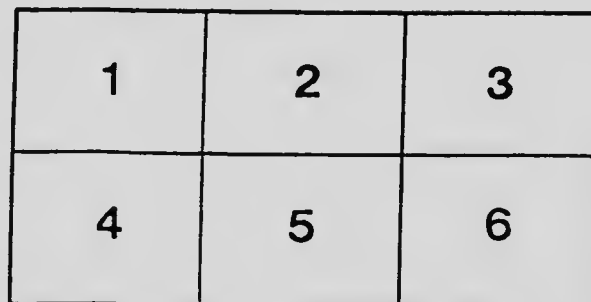
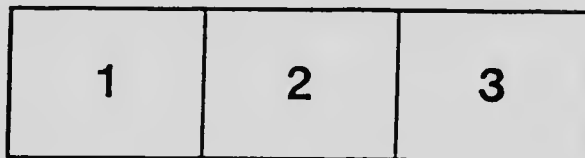
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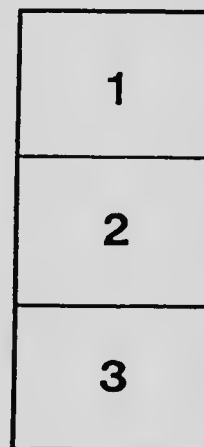
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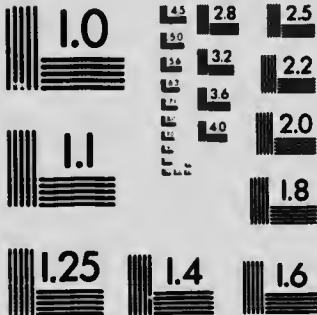
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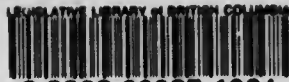
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REPORT ON THE CLAM-BEDS OF  
BRITISH COLUMBIA.

BY  
WILLIAM F. THOMPSON,  
Stanford University.

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Shell bed, Oyster Harbour.



Indian woman digging for cockles. The stick is used to feel for them.



An Indian clam digger's canoe and baskets.



## REPORT ON THE CLAM-BEDS OF BRITISH COLUMBIA.

BY WILLIAM F. THOMPSON, STANFORD UNIVERSITY.

### I. INTRODUCTION.

At present the value of the clams marketed in British Columbia is overshadowed by that of oysters, native and eastern, but they are nevertheless a valuable asset, both commercially and as an article of use by coast inhabitants or campers. The utilization of the clam-supply by the white population has barely begun, and at present but a small area is actually dug. There are three canneries operating at present—one at Sidney, one at Nanalino, and one on the Queen Charlotte Islands. The first named preserves about 2,000 cases of 48-lb. tins each season, but the yield of the other two is yet to be investigated. Beside this canning industry, clams are sold fresh almost the whole year—more when the tides are good and when the clams are supposed to be in good condition than at other times. The trade in fresh clams is confined in large part to the two large cities of Vancouver and Victoria, as in the smaller towns there is usually little profit in carrying such stock in the fish-stores. A conservative estimate of the total value of the clams marketed per year would be \$25,000.\* This is, of course, only tentative and incomplete, but serves to indicate the relative commercial value of the clam industry at present. It must be borne in mind, however, that the money value is, or will be, overshadowed by the utilization of the beds by the campers and people who desire messes for themselves. A very good example of this is the part the beds play in the social economy of the Indians.

The actual market value of clams per pound approaches that of oysters, being in some cases 3 cents. This is due in part to the fact that the clam industry is not organized as the oyster industry is, and because the greater proportion of cost accrues in handling. The irregular nature of the digging, because of the tides, also has its effect.

In the consideration of the following report, it must be borne in mind that the acreage of a clam-bed means little, because of the density of the population in some of them and the reverse in others. As a rule, two species stock their beds very abundantly—namely, *Saxidomus giganteus* and *Paphia staminea*—while the others do not. The small beds treated of are invariably those of these two species. It was deemed of much greater importance to investigate closely the area covered by the present report than to go over a great deal of territory, because the country surrounding Victoria and Vancouver is the only region in which there is taking place a rapid change in conditions of the beds—if the northern extremity of British Columbia be excluded. The beds used only by the Coast tribes in all probability need no supervision at present because of the small population using them, but where commercial methods are employed and the clams are canned or sold, there is sure to be danger of exhaustion of the beds. In the consideration of the beds as a whole, it will be necessary to investigate closely typical areas at various places along the coast, as the extent of the latter is very great, and one of these areas is most assuredly the region between Vancouver Island and the Mainland. The portions examined lie between Nanoose Harbour and Burrard Inlet on the north, and Boundary Bay and Victoria on the south, with a total of about nine square miles of beds which are productive, at least commercially, and twenty-five more which are productive to some degree. (This is, of course, simply an estimate, but fairly close.)

### II. GENERAL REMARKS ON DISTRIBUTION OF THE BEDS.

Unlike the clams on long unbroken coasts, those of the waters behind Vancouver Island are not concentrated into large areas, but are scattered as a large number of small beds save near the mouth of the Fraser. The beds are found either on the shores of the islands or in the smaller bays and harbours. This distribution is the result of the rough, rocky character of almost the whole shore-line and of the deep waters, while the waves are not able to obtain sufficient force to wear down the rocks into sand beaches. There are extensive clam-beds only

\* NOTE.—The value of the clam products for the Pacific Coast of the United States in 1908 was \$46,000; for California, including the mussel, \$11,400. (U.S. census figures.)



at Boundary Bay and around the mouth of the Fraser River, there being a total of twenty-five square miles of tidal flats in the first named. All the others are of small area, each one of several acres in extent and frequently merely long narrow stretches of bench.

As a whole, the beds form two general types. The first of these is that with a small area, densely inhabited by *Paphia staminea* and *Saxidomus giganteus*, the "little-neck" and the "butter-clam"; and the second that with the large, sparsely inhabited flats. In the latter are found mainly the cockle (*Cardium corbia*), the "atter shell" (*Schizothoerus nuttallii*), and several of the smaller species. Among the beds of the first type are the most valuable of the Province, although no one of them may be said to be very valuable in itself. They include almost all the island beds, False Narrows, Burrard Inlet, Nainina, Kulleet Bay, Cowichan Harbour, and Conox. In the second are included Boundary Bay, Fraser River Sand Heads, Chemainus River Flats, and numbers of smaller stretches. Each of these areas will be treated separately, wherever possible, but the smaller ones will have to be taken up as geographical divisions, such as the "Islands of the Gulf" and the "East Coast of Vancouver Island."

### III. SPECIES OF CLAMS FOUND IN THE REGION INVESTIGATED.

There are six species of clams which are commonly considered edible found on the tidal flats of southern British Columbia, and four species of lesser importance. Of the first six, two are considered superior to the others and utilized to the greatest degree. This variety of species is large and compares very favourably with that of other regions. As but the southern end of the coast-line was investigated, and none of the outer coast, there are at least three more species of considerable importance not yet encountered. It will be necessary in the following report to confine the general remarks on each species to a very brief résumé of the characteristics, abundance, and present utilization, as detailed treatment is outside the scope of this paper and must await a complete and final report upon the beds of the Province. For the identification of each species the plates given will suffice. The details of life-history are largely unknown for all of the species.

#### A. SAXIDOMUS GIANTEUS, Deshayes. (Plate I.)

(Common names: "Butter-clam"; "big-clam" of the Vancouver markets; and "little-neck" of certain localities.)

1. *Description*.—This species has an oval shell of  $2\frac{1}{2}$  to 3 inches in length, strong, and slightly brittle, with fine concentric ridges parallel to the edge of the shell, but without radial ridges crossing these. The foot is but moderately developed and the siphon not of large size, leaving the greatest part of the body suitable for canning.

2. *Abundance*.—This is one of the most abundant of the species found in the smaller clam-beds, ranking a close second to *Paphia staminea*, the true "little-neck." It is an inhabitant of the middle parts of the tidal areas, in the gravel beds, either exposed or sheltered, but it is also frequently found in muddy and soft-bottomed flats.

3. *Present Use*.—This species is the one most employed by the canneries at present and shares the popularity of *Paphia staminea* in the fresh-clam markets. All of the canned shell-fish of British Columbia are of this species, as far as I was able to discover. The Indians are very fond of it and dig it extensively. The shells are found in great quantity in their shell-mounds, and it is evident that it has been one of their principal foods in the past. It is one of the most delicious of the species found in the inland waters, although it is surpassed by some of those which live on the outer and exposed coasts. It is found as far south as the coast of California and is everywhere highly valued as food. When canned or cooked fresh the meat is tender. The shipping qualities (that is, the ability to withstand shipment) are very good, and the appearance of the clam is usually very attractive. It is undoubtedly at present one of the most valuable of the species found on the northern coasts of the Pacific.

#### B. PAPHIA STAMINEA, Conrad. (Plate II.)

(Common names: "Little-neck"; "small-clam"; "hard-shell"; and "sweet-clam".)

1. *Description*.—This is the smallest of the clams now utilized commercially, being from  $1\frac{1}{2}$  to 2 inches in length. It is rounded in shape, with small radiating ridges crossing the somewhat more indistinct concentric ones. The shell is easily broken and brittle. The foot is fairly large, the siphon short. It is of attractive appearance, clean, and white.

2. *Abundance*.—It is a very abundant form in the smaller beaches, living with *Saridomus giganteus* in many cases. The density of the population in its beds is second to that of none of the other western species. It is found in all gravel or firm beaches of any sort which are of comparatively small extent; also, though less abundantly, in the larger flats. The total area which is productive is large. It inhabits the lower half of the beaches.

3. *Present Use*.—As far as I am aware, this species is not made use of by the canneries, and the most extensive commercial digging is done in Burrard Inlet for the Vancouver markets. The supply is not threatened in the least, as it is one of the species most resistant to prolonged digging, and the greater number of beds are untouched as yet. The Indians appreciate it, and in their shell-mounds great quantities are found, showing their extensive use in past times. It is small, but sweet, and very delicious if properly cooked, so that there is no reason why it should not be used by the canneries, save the slightly greater expense of handling. In the opinion of the writer, it surpasses the "butter-clam" in edibility. Wherever it is found, along the whole coast of the Pacific from California to British Columbia, it is highly valued. The ability to withstand shipment is not as great as in some of the other species, yet it is sufficient to eliminate any trouble from that source. It is to be confidently anticipated that it will be one of the most valued of the species, in great part because of its suitability for marketing in a fresh condition, and because of the great concentration of the beds.

C. *CARDIUM CORBIS*, Martyn. (Plates III. and IV.)

(Common name: "Cockle.")

1. *Description*.—This is a large species, reaching  $2\frac{1}{2}$  to  $3\frac{1}{4}$  inches in length, with almost equal height and width. The valves are strongly arched, so that viewed from one end its shells appear heart-shaped. The radiating ridges on the valves are very strong, and form alternating crenulations on the edges, which fit into each other. The foot is very large and strong, somewhat pointed and finger-shaped. There are no siphon-tubes, two holes in the fused mantle edges taking their places.

2. *Abundance*.—This is one of the most widely spread of all the forms, being found wherever the tidal flats are level, low, and not too rocky, over the open beaches and the flats at the mouths of rivers. Although widely spread, the beds are never densely stocked; in fact, the species is more thinly scattered than is the "otter-shell" (*Schizothoerus nuttalli*). This is compensated for in part by the ease with which the individuals may be discovered. (See description of methods in Part IV.) The largest beds in which it was found are the following: Boundary Bay, Cowichan River Flats, Nanaimo River Flats, southern end of Fraser River; Sand Banks, and Chemainus River Flats.

3. *Use*.—The Indians are fond of this form, in great part because it requires no digging, and it forms in many places a stock portion of their diet. As far as I am aware, it is utilized regularly by no white people save as it is mixed with the other species found in the Vancouver and Victoria markets. The reason for this is hard to find, for it is certainly very good when properly cooked. The bulk of meat obtained is less in proportion to the size of the clam than in some of the other species, and the foot much larger. It is a close ally to the much-esteemed cockle on the coasts of Europe, and would find a ready welcome in the markets here. It is doubtful whether it will ever become one of the species utilized for canning purposes, unless simply to supplement the others.

D. *SCHIZOTHOERUS NUTTALLI*, Conrad. (Plate V.)

(Common names: "Otter-shell"; "summer-clam"; and, wrongly, "geoduck.")

1. *Description*.—This is the largest clam of northern waters save the geoduck, reaching an average length of 6.4 inches and a weight of  $2\frac{1}{4}$  lb. This varies greatly with the locality. It is smoother-shelled than the other species, but shows irregular, concentric, and indistinct lines of growth parallel to the edges of the shells. It is covered by a dark epidermis save on the older parts, indicating its passive life. The shell is thin and very easily broken when dug carelessly. The "neck," or siphon, is very long and never completely retracted. The foot is small and apparently of only slight use to the adult.

2. *Abundance*.—Next to *Cardium corbis*, the cockle, this is the most widely distributed of the forms studied, being found in all beaches of somewhat level character, at low-tide line, even where greatly exposed to currents or waves. Similarly to that species, it is never found densely inhabiting its beaches, but is found at most one or two to a square yard, and sometimes

one to every four or five square yards. The siphon-holes are easily discovered, however, and each clam has to be dug out separately, anyway. It is found 1 to 1½ feet below the surface.

3. *Use.*—Owing to the difficulty of digging this form, it is little used by any one; but this does not mean that it is so difficult to obtain that it is impracticable to consider it for commercial purposes, for it is possible to dig a considerable number, if so desired, at each low tide. It is considered edible, but cannot be said to possess the delicacy of the others. In my estimation, it is nearly as good as the soft-shell clam when it is properly cooked. When dried and smoked, especially the siphon, or "neck," the Indians along the whole coast of the region north of San Francisco are fond of it and put up quite a quantity for winter use. It is best during the late summer and fall, according to the Indians. There is no reason why it should not be utilized by the canneries. Its shipping qualities are very poor, owing to its thin and ill-fitting shells, which fail to retain the water in the mantle cavity. The consequent dryness and loss of weight soon kills the animal. The beds of this species are hence of no prospective value as sources of supply for the fresh-clam markets. At present there is no use to which this species is put save that of drying and immediate cooking.

E. MYA ARENARIA, Linnaeus. (Plate VI.)

(Common names: "Soft-shell"; "mud-clam"; "eastern-clam.")

1. *Description.*—This is the common mud-clam of the Atlantic coasts of Europe and America, which has been recently (?) introduced into the Pacific Coast region. It is somewhat elongated, and flattened, with smooth thin shells which do not meet because of the thick mantle edges, a large, long siphon, and rudimentary foot. It reaches a length of 5 or 6 inches, usually somewhat less.

2. *Abundance.*—It is found everywhere there is a well-protected beach, at the upper tidal levels, above the beds of *Tapes staminea* and *Saxidomus giganteus*. Where found it is relatively abundant, but not as much so as is reported of it for the Atlantic shores. It may be safely ranked among the more abundant species, however. The largest beds are at Boundary Bay, Burrard Inlet, Nanaimo, and Chemainus River Flats.

3. *Use.*—At present this species is never dug save by an occasional Chinaman working on the ranches near the beds, and is not marketed save where mixed with the other species in the markets of Vancouver. The Indians do not put it to extensive use, and their shell-mounds do not contain any of its shells. This may be due to its late introduction to this coast, and the lack of familiarity with it on the part of the Indians. It is only a matter of time, however, before it becomes valued as it is in the east and to the south. The present state of affairs illustrates the slight interest taken in clams and the neglect of valuable resources. It is the stock market clam in the markets of the Eastern cities.

F. MYTILUS EDULIS, Linnaeus. (Plate VII.)

(Common names: "Mussel"; "inland mussel.")

1. *Description.*—This is the common mussel of the more protected bays and harbours, as the waters of Puget Sound, being replaced on the outer coast by its larger and more rugged cousin, *Mytilus californianus*. The species under consideration reaches a length of 3 inches in places, but is usually about 2. The shell is thin, very black and smooth, without radiating ridges. The animal is attached invariably to some solid substance, as other shell-fish, rocks, or gravel, by fine threads, called collectively a "byssus." It is found on both the European and American coasts.

2. *Abundance.*—It is found everywhere on the rocks and beaches at nearly high-tide level, usually in great numbers. Where found abundantly, as at the First Narrows in Burrard Inlet, and False Narrows, they form masses 5 or 6 inches deep over the surface of the beach. They exist also over the rocks at high-tide levels, but only where they are not greatly exposed to waves, and give them a characteristic blue colour.

3. *Use.*—This species is used by no one save the Indians, as far as I was able to ascertain, although it is highly esteemed in Europe and even on the Californian coasts. The Indians do not seem, however, to make the use of it which they do of the species of clams. There is no reason why this species should not be as widely used as it is in other countries, save its small size and the presence of so many other species.

If not properly handled, the flesh of this species is liable to decompose and show traces of ptomaine poison. It should be marketed fresh, and from clean beds at as low a level as

possible. When canned it should be put up in glass receptacles. If these precautions are taken there is not the slightest reason to fear the use of the species.

#### G. OTHER SPECIES.

##### (a.) *MACOMA SECTA*, Conrad. (Plate VIII.)

Common name: "White-sand clam."

This is a species found at a depth of  $1\frac{1}{2}$  feet below the surface in all pure sand of the exposed parts of the larger flats, and often in the smaller ones. It may be found by the slight marks on the surface of the sand left by the water rising from its siphons. It is flat in shape, only slightly longer than deep, with one end abruptly contracted on one side, the left, giving it a "bent-nosed" appearance. On this side it lies, and the two siphons, slender, delicate white tubes, reach up from the contracted end to near the surface of the sand. The shell is white, clean, and very pretty and attractive. The foot is large, strong, and flattened, so that it is protruded somewhat like a tongue.

The flesh of this species is very delicate, and when steamed is white and very little like a clam. The alimentary canal is invariably full of sand, however, and the utilization of this form awaits a method of ridding the animal of this. It is very easy to do this with all the other sand-eating animals, and this problem should present no great trouble in this case. Experiments to this end were undertaken, but not finished because of the short space of time it was possible to stay in any one place. The clam is undoubtedly unique in its delicacy and appearance, and if rid of the sand would, in my opinion, rank very highly. It has never been dug for any purpose, and the great majority of people interviewed were unaware of its existence in the sand, save from the dead shells on the surface. It is nevertheless a very abundant and widely spread species.

##### (b.) *MACOMA NASUTA*, Conrad.

A species somewhat resembling the preceding, found in the mud-flats, however, and not of very great value. It is found in the Indian shell-mounds, but I have so far not seen it eaten by any persons whatsoever.

#### IV. ENEMIES OF THE CLAMS.

Within the scope of this report it will be possible to treat only of the most prominent of the enemies, and no attempt made to diagnose the bacterial and parasitic enemies. There are two types of destructive agencies, one including organic enemies, the other physical. Of these the latter are the most important, preventing the maturing of by far the greatest part of the young and limiting sharply the extent of the beds. The organic enemies are specific for this coast, and in part for the British Columbia portion of it.

The organic enemies include the following forms: *Corvus caurinus*, Baird, the crow; *Thais saxicola*, Valenciennes, and *Thais lamellosa*, Gmelin, small borers with spiral shells; *Polynices lewissii*, Gould, the large spiral-shelled borer, called frequently a "big-snail"; the five-rayed starfish, \* *Pisaster ochraceus*, *Pisaster confertus*, and *Pisaster sp.*; and the twenty-rayed starfish, *Pycnopodia helanthoides*.

To these enemies may be added certain ducks, on the assumption that their habits are the same as they are farther to the south. Other shell-fish strain from the water as food vast numbers of the swimming young and thus destroy them.

1. The crow, *Corvus caurinus*, is more particularly the enemy of the cockle, *Cardium corbis*. At every low tide there are great numbers of these birds walking or flying over the flats, closely inspecting the surface for anything which may be eaten. All shell-fish which are not too large to be carried are lifted in the bird's beak and dropped from a height on to a hard surface, gravel-bed or railroad-track, and thus broken. The roads and rocky beaches near clam-beds are frequently densely littered with broken shells. The cockle is peculiarly susceptible to the attacks of the crow because of its habit of thrusting itself out on to the surface of the flats. If too big to be carried off by the birds, it nevertheless is exposed to the heat of the sun, and as a usual thing becomes so weak during the low spring tides that it is unable to keep its shell closed against its enemies, and thus dies. The crow, to do justice to it, is drawn as much to the flats by the worms to be obtained as by the shell-fish.

\* Starfish identified by Dr. Walter K. Fisher, of Stanford University, California.

2. *Thais saxicola* and *T. lamellosa* (Plates IX., X., and XI.), the small borers, are particularly enemies of the mussel, *Mytilus edulis*, and great numbers of these may be found dead, pierced by the drills of these spiral-shelled forms. Other species are also attacked whenever they are near the surface and thus exposed. As these borers are but  $1\frac{1}{2}$  inches in length they are able to satisfy themselves with barnacles in a great many cases, and thus are diverted from the shell-fish. Their eggs are laid in vase-shaped capsules attached in clumps to shells, etc., and in these the young develop. They may be easily destroyed by collecting the eggs during the spring tides.

3. *Polynices lewissii*, the large "snail-shell" borer, is not as serious a pest as it is in some of the southern bays, but is nevertheless serious enough to merit attention. Its shell reaches a size of 3 or 4 inches, and it is able to attack any of the clams. Its habit is to plough along 2 or 3 inches below the surface of the bed until it comes to a clam, or it may go still deeper. It then wraps its pray in the large extensible foot, and proceeds to drill a hole through the umbo or round shoulder of the shell. That the animal does not depend on the drill exclusively is shown by the fact that the juices secreted by the foot frequently kill the clam before the hole is through the shell. In certain regions it is possible to collect clams very rapidly by taking the prey away from these "snails," which may be easily discovered by the projection of a portion of the mantle or the tip of the shell above the surface. Each of these clam enemies seems to be constantly in possession of a freshly killed clam, and it is evident that they kill great numbers of them. The eggs are laid in a cape-like form, cemented together with sand. These are usually partly buried in the mud, but may easily be collected and destroyed. This species does not attack mussels or oysters. It is unable to reach the deepest-burrowing clams.

4. The starfish named above, are not serious pests in any of the localities investigated, but are nevertheless worthy of consideration. Their method of attack is well known and needs no comment. The twenty-rayed *Pycnopodia helianthodes* is destructive to all shell-fish below low-tide line, but is unable to withstand exposure to the sun and drying, and hence cannot attack the higher forms. On the rocks the five-rayed starfish are the worst enemies of the mussels.

#### V. PRESENT METHODS OF UTILIZATION AND REGULATION OF THE CLAM-SUPPLY.

1. *General Remarks on the Use.*—The clam product of greatest value in British Columbia appears to be that of the canneries, but, of course, a great deal is utilized by Indians and marketed fresh. When canned they are shipped to cities of the interior for the great part, but Vancouver and Victoria consume much. The market can be regarded as but just opening, and there is no doubt that all that can be produced will find a ready sale. Much less than a quarter of the available shell-fish supply in the area investigated is utilized.

In common with the western United States, the natural products most easily obtained are held in slight esteem. With the greater age of the country, the relative value of these resources grows in proportion. Thus in Virginia the amount of clams marketed is but 13 per cent. of the total for the whole of the United States, but the value of the same is 20 per cent. of the total value. In the Pacific Coast States the amount is 6 per cent., but the value is only 2 per cent. of the total (1908 census). The same will be found true of all the new countries as compared with the older, and with the growth of this value, the unused species will be utilized (i.e., *Mytilus edulis*, *Mya arenaria*, *Schizothoerus nuttalli*).

During the summer months of May, June, July, and August there is a general belief that clams are not edible. This follows in part from the fact that the spawning of the various species leaves the animals in a spent condition, thin and watery. This is not true of all the species, and some of them may be considered edible all the year round.

The salmon season provides a natural close season, as then all the diggers are at the salmon-canneries. As a general thing, but few of the clams are dug during the four months previously mentioned save in Burrard Inlet.

As is stated in another part of the report, the only clam now utilized for canning is the "butter-clam" (*Saxidomus giganteus*). The fact that but the one clam is desired has proven a material factor in preventing the total depletion of some of the beds. Were it customary to can all of the other forms found in the same localities, it would be profitable to dig the beds longer than is now done, and in consequence the supply of some of the species would be much more closely culled. As it is at present, the beds are abandoned when the yield has fallen so low that it is unprofitable to dig longer, and the consequence is a period of rest and recuperation for the area.



2. *The Diggers and their Methods.*—At present the clam-diggers in British Columbia are for the most part Indians. The tribes of the Pacific Coast have in the past lived largely on clams and fish, especially salmon. Their shell-mounds are found in great abundance everywhere, and show an extensive utilization of the shell-fish long before the coming of the white man. The place they now hold is therefore natural to them, and one which they are best fitted for. As was the case before the days of canneries, many of them catch salmon during its season, and depend on clams in the interim, preserving some of each by drying. The greater number, however, labour for the salmon-packers instead of for themselves, and sell clams during the days that intervene, or follow some other pursuit. It is only just, in a way, that these resources should so serve them, for they were in the first place peculiarly their own.

The qualities demanded of them by this method of life are those of savages. They must be nomadic, capable of shifting their homes with the seasons and making them wherever convenient. Without their ability to make a portion of their living from the beach, they would not be able to work at the wages they do in the canneries, or to dig clams at the prices obtained from the canners. A white labourer would demand wages far higher in both cases, providing the labour were not continuous. In a way, then, the clams of the coast aid in providing the labour-supply for the salmon canneries. The fact that the Indians are at home on the water and that they possess canoes, enables them to make use of all the small beds of clams everywhere, as the distribution of the species at present in use demands.

The methods employed by the Indians in obtaining the shell-fish are various. At the present time the spade or the potato-fork is used to dig up the clams which bury themselves, just as is done by the white men, but formerly these were dug up by means of a short pointed stick or similar tool. This method is even yet used in the flats of Burrard Inlet, where the Indian women dig clams for the Vancouver market, a short stout blade of steel being substituted. The cockle is found in a very different fashion, for it dwells near the surface and is sparsely distributed. As it lies with its "siphonate" end near the surface, it may be detected by the appearance of the sand above it. The Indians search the tide-flats carefully for this, and feel for the clam with the point of a slender stick or wand, of such length that they do not have to squat, thrusting it into the sand until the shell of the clam is encountered. The animal is then pried up. Over the greater tide-flats many Indians can be seen every low tide wandering to and fro, engaged in thus searching for the clam. The great "otter-shell" of the flats is little dug, because of the difficulty of digging to its depth in the sand, which flows because of the water in it, but when it is desired a spade is used. The principal method of preserving the clams and mussels seems to have been by drying, as is done even now with salmon, but this process was not observed.

Beside Indians there are few diggers, save two white men who were found in Burrard Inlet. The Chinese have not interested themselves in clams, as in San Francisco, and their markets were without them at the time they were inspected. A factor not to be forgotten is the man who digs clams for his own use. At certain parts of the coasts of Washington and California the clam-beds are strong attractions for the camper and the local inhabitant, especially on Sunday. It is not likely that this will be so markedly the case in British Columbia, but it must not be ignored.

An odd use to which the clam-beds are put, especially the soft-shell and mud-clam, may be incidentally mentioned. At Boot Cove, Saturna Island, a herd of pigs was found feeding on these clams, rooting them out at low tide. I was informed that the pigs had formed a habit of doing this, and that they thus obtained much food. This is a common practice in some of the Eastern States, and affords a suggestion for the use of the beds in some of the present unutilized places.

3. *The Canneries.*—During the course of the investigation but one cannery was completely inspected, although there are three in the Province. The time was inopportune, as it was during the salmon season, and the off-season for clams, so that no actual operations were observed. There are known to be canneries at Sidney, at Nanaimo, and on the Queen Charlotte Islands. The latter was out of reach, the second was closed and the owners away, so that I was able to go through only the one at Sidney. The incomplete report will be here presented, with a description of the methods used there.

The cannery at Nanaimo was formerly conducted on a barge, which was towed from place to place as conditions demanded. I was informed that it had been located first in the San Juan Islands, then at Sidney, Chemainus, and Nanaimo in succession. The cause for each move was presumably a temporary exhaustion of the neighbouring clam-beds. Certain of the

diggers told me that it was necessary to dig in a new bed each year. This method of shifting the scene of operations is most certainly dangerous, as with the increase of demand it will simply be a case of each cannery taking all that can be obtained in any one place, with the promise of other beds to be had for the trouble of moving. In this cannery there were employed about thirty people, including some girls and boys.

The cannery at Sidney is owned and operated by the Sidney Trading Company. When running, fifteen to twenty men and women are employed intermittently. This is because of the irregular run of the low tides and a consequent variation in the amount of clams brought in. It is customary to be idle for a week or ten days, open for a similar period, and then closed again. A total of 2,000 cases of forty-eight 1-lb. tins each were put up last season between September and May. This means approximately 3,000 sacks of clams or more. The greatest part of this is obtained during March and April, and at that time employment is most nearly continuous. The clams come from numerous small beaches, and are brought from as far as Ganges Harbour and Pender Island. These are distances of twelve to twenty miles. Almost all the diggers are Indians, operating in families, with their canoes and occasionally with gasolene-launches, so that these distances are not serious obstacles to them. I was informed that there were nearly a hundred of them employed at various times. The cannery has been in operation for seven or eight years.

The methods employed in the canning of the clams are not as well developed as is the case in salmon-canning. The clams are brought in as clean as possible and thrown into the steaming-barrel. This is a barrel set on tipping-pivots and with a tap at the bottom. Into it steam is injected until the clams are cooked and have opened. The first dirty nectar is discarded, but the cleaner is saved. The open clams are then thrown into a tinned trough-like table, where the meat is taken out by hand. This is then washed in a sink by hot water to free it from sand, placed in cans, and these filled with the nectar which was saved from the steaming-barrel. The cans are then topped by hand, the tops being punctured, carried to a hot-water vat, and there the air is exhausted by heat. The hole in the top is then soldered. The cans are finally placed in a retort for two hours at 212° Fahr., shellaced, labelled, and boxed for shipment. The capacity of the plant is seventy or eighty cases in ten hours.

The shells are utilized for chicken-feed at both the Nanaimo and the Sidney canneries, being ground before sale at the former and sold whole at the latter. When sold unground in sacks, the price obtained is \$7.25 per ton at the wharf at Sidney, less the cost of sacking and transportation to the wharf. Both the shells from Sidney and Nanaimo are said to be shipped out of the Province—sometimes into the States. It is regrettable that the shells are not utilized on the oyster-beds, as they are splendidly clean and suitable for oyster-spat collectors. With the use of such on the oyster leases, it is probable that these shells will be purchased for that purpose.

#### VI. RECOMMENDATIONS FOR THE CONTROL OF THE CLAM-BEDS.

The distribution of the clams which are commercially important in scattered beds scattered among the islands and along the shores has a most important effect on the control of the beds. It will be very nearly impossible to lease these beds as separate areas, as the lessee would require a large number of them, and it would be very hard for him to prevent the use of his own leases by other men. When this is the case even with oyster-beds, it must be acknowledged that it would be much more so in the case of clam-beds. At present the distribution of the supply over scattered beds has led to the exhaustion of the most convenient beds and the shifting of the canneries when these are exhausted. This is simply the free exploitation of the beds for all they are worth at the time. It is obvious that some provision will have to be made that will require the permanence of the canneries—that is, the establishment of a settled industry. If this is done, then it is just as obvious that each cannery will have to be protected in its right to a certain amount of clam-beds.

To meet these conditions it is therefore recommended that certain areas or leased zones be established for each cannery, and the retention of this area be made dependent on the abundance of clams in the beds. This would result in the cessation of digging before the total exhaustion of the beds, and would provide an easy method of protection for areas threatened with exhaustion. In case of the growth in value of the clam-beds for other than clam-digging purposes, the utilization of these could be easily stopped. It would also result in the establishment of settled industries and a spirit of conservation of the clam resources.

It is also recommended that data be gathered for the proper determination of the close seasons for the different species. This would necessitate an investigation into the breeding seasons and the natural history or habits of the animals. It may be necessary to establish close seasons for the whole coast-line, but it is more probable that this would not be necessary, and that local close seasons would be much more effective. The zone arrangement for the canneries would serve this purpose admirably. The variation in the close seasons would, of course, be permitted by the divisions now in use for other purposes. The close seasons adopted by other districts of the coast will probably be found inapplicable here.

#### VII. RELATION OF CLAMS TO OYSTER-CULTURE.

In the consideration of the shell-fish resources it should not be forgotten that the different species are more or less interdependent. In the case of clams and oysters this is markedly the case. It is rarely true that they inhabit beds in commercial abundance at the same time, but the clams are found in sufficient numbers to provide the constant presence of their shells on the surface of the bed, or the shells are carried on to the bed by the currents. One of the most vital requirements for the successful existence of an oyster-bed is the presence of suitable objects for the young to settle on, for without these they invariably perish. It is a conservative statement to make that the clam-shells left on the surface of the oyster-beds through natural means are indispensable from this standpoint, and frequently furnish the only spat-collectors available save the shells of the adult oysters.

The shells of the clams are left on the surface through various means. In the case of the cockle, it frequently works itself out of the ground in its energetic movements and is unable to speedily re-enter. When this happens it may succumb to the heat of the sun, or be so greatly weakened by the exposure as to fall an easy prey to its enemies. Other species are washed out of their burrows by currents. By all these means there is always found a supply of dead clam-shells on the surface of the beds. Of this natural supply, the greatest part, of course, does not lie on the oyster-beds. This could be raked up without great expense and utilized by spreading over the beds.

Beside this supply there is that left by the canneries after the meat is extracted. This is always very clean, and is more suited than the natural supply of shells for the spat-collectors. In the case of the natural supply there is always a thin film of dirt or slime over the surface of the shell, and this prevents the proper adhesion of the spat. In the case of the cannery shells this is not so, because the shells are washed clean and left to dry in the air. If planted at the proper time the effectiveness of these shells is by far the greater. It is probable that in the course of time these shells will be so utilized, although at present they are sold for chicken-feed.

In the case of the native oyster, the small size of the species and the habit of selling them in their shells prevents the retention of the same on the beds and their later use for spat-collecting purposes. In this respect they differ from the eastern oysters, and there thus arises a problem peculiar to the native oyster in the necessity of finding a cheap supply of spat-collectors. Where the eastern oyster is imported, this is provided for to some extent by the dead shells of this species, and as they are brought here as spat there is no necessity for spat-collectors for them. It is easy to see, then, that there must be a careful conservation of the clam-shells, and that with the development of the native oyster-beds must arise a great need for them. The clam-beds are hence to be considered from this standpoint when they are leased, provision made for the right to the clam-shells as well as to the live clams themselves.

#### VIII. REPORT ON THE CLAM-BEDS OF BOUNDARY BAY.

1. *General Information.*—Boundary Bay is on the western end of the Boundary-line between the United States and Canada. It is twenty-four miles from Vancouver by the Great Northern Railroad, which runs around its head, and fifteen from New Westminster, reckoning from Crescent, at the mouth of the Nicomekl River. Colebrook is at the other side of the head of the bay, a few miles distant, and is the only suitable shipping-point besides Crescent. At present no clams are shipped from the bay, oysters only being utilized. There are no towns of any size nearer than New Westminster, and Blaine on the American side, although there are numerous farms in the immediate neighbourhood, and a small settlement of summer residents is forming at Crescent. In consequence, the local use of clams is very small. With the sure growth of the use of the various species, it is probable that a part of Vancouver's supply of clams will come from Boundary Bay.



2. *Description of the Beds.*—The flats bared by the tide, which rises and falls 10 to 12 feet, are about twenty square miles in extent. Of this a conservative estimate would place the productive part at seven, but the whole is more or less inhabited by clams. The supply of fresh water is not so great as to injure the beds, but renders portions more suitable for certain species. At the eastern end of the bay two streams enter, the Nicomekl and the Serpentine, and as would be expected that portion of the bay is very soft, heavy mud, including much of the area between the two and their junction. From this part the flats extend in a great semicircle to the westward around to Point Roberts, as shown on the accompanying map. Along the margin of this numbers of small streams enter and flow on to the beds. The united channels of the two main streams extend south-westward to the open gulf, with a spit along its southern edge a distance of two miles, forming thus a triangular tide-flat adjoining the main part. Into the main portion of the flats extend four sloughs of varying length, which drain off the tidal water, and end in areas of shallow standing water at some distance from the shore. The whole flat is a sedimentary formation, as are the sand-heads of the Fraser River, and the bed appears to be in fact a continuation of these. It is one of the numerous large similar areas which lie on the eastern shore of the Washington end of Puget Sound, and is the only one which is north of the boundary-line. Like these, it is a great extent of sand-banks, or muddy areas alternating with weeded parts in which the water stands, and cut up by channels which end in the heads of standing water.

The formation of the beds exposes them to two methods of water-action. Up and down the channels strong tidal currents sweep, leaving their banks shifting sand, and carrying off the mud. This results in banks of sand which are slightly higher than the surrounding flats, and are drained more quickly than the portions farther back. Wave-action, too, has its effect on the flats, as southerly winds have somewhat of a sweep. The southern spit protects to a certain degree the eastern part of the beds, and prevents the formation of sand-flats save by the currents. The wave-action results in the washing-out of the muddy sediment and forms sand-flats, as would a current, save that they are not on the edges of the channels and are more extensive, as well as less shifting in character. The result has been in general the formation of a narrow shore belt of firm undisturbed sediment, an intermediate softer area, somewhat muddy and with occasional standing water, and an outer stretch of sand, or sandy mud, the outer edge of shifting sand. Each of these areas possesses its species of clams, as remarked in the following pages.

3. *Species of Clams found in Boundary Bay.*—There are nine species of clams found in Boundary Bay, all of them abundant enough in places for commercial use. *Ostrea lurida*, the native oyster, is the most important, but is treated in a preceding section of the report. The others are, in order of importance, *Mya arenaria*, the "soft-shell mud-clam"; *Schizothoerus nuttalli*, the large "otter-shell" or "summer-clam"; *Cardium corbis*, the "cockle"; *Paphia staminea*, the "little-neck" or "hard-shell" clam; *Saxidomus giganteus*, the "butter-clam"; *Macoma secta*, i. e. "oyster-shell" or "sand-clam"; and *Macoma nasuta*, the "mud-clam." Of these, the first three are the abundant ones, the next two are found in but small beds, and the others are at present not utilized.

The distribution of these shell-fish has been carefully worked out for Boundary Bay, as it is one of the main types of clam-flats, and with a good understanding of the natural relationships of the species much will be understood regarding their distribution in other regions. In the accompanying maps (Plates XIII. and XIV.) this has been carefully charted from actual observation. It will be observed that there are two groups of species, those which dwell near the shore—in other words, at a higher level—and those which are found on the lower and more exposed parts. To the first group belong *Mya arenaria* and *Macoma nasuta*; to the second *Schizothoerus nuttalli*, *Cardium corbis*, and *Macoma secta*; while *Ostrea lurida* has a distinctly different distribution, its beds clustering around the heads of the sloughs. The first of the two groups inhabits the slightly higher and firmer bottoms, and those soft ones which are well protected; while the second is found on the lower, more exposed areas, where the bottoms shift and where the siphon-holes are being continually filled by sand or the surface eroded. All of these species are specifically adapted to meet their several conditions, and it is these conditions which are the most important considerations in determining the death or survival of the clam. It is here desired to emphasize the fact that the distribution of the species as shown is typical in all regards. Given the same types of tide-flats it is possible to prophesy the species to be found in its various parts.

A. *MYA ARENARIA*, the "soft-shell clam" of Boundary Bay.

At present this species is the most important clam in Eastern and California markets, but it is not utilized to any extent in British Columbia. Boundary Bay possesses a large amount of them, in some places very abundantly. All of these species lying within a hundred yards of the shore are almost invariably too small for use, because they are not covered a sufficient part of the time. This shore belt nevertheless breeds and aids in maintaining the marketable supply. At a distance of a quarter of a mile from the shore, beds of commercial abundance and size are found in irregular patches, and also along the sloughs flowing into the Serpentine River. The total area of the beds may be estimated at seven to nine square miles, but of this it is probable that but 400 or 500 acres may be considered good—that is with commercially abundant clams at the present standard. Chinese ranch-hands frequently dig messes for themselves, but do not peddle them. I have never seen the Indians digging them, nor do their shell-mounds at Crescent show any traces of their presence. It is probable that in the course of time these clams will be utilized in the markets of Vancouver.

B. *SCHIZOTHOERUS NUTTALLI*, the "otter-shell" of Boundary Bay.

This large clam grows abundantly in the sandy, more exposed reaches of flats, always close to low-tide line. It here reaches an average of about 3 lb. when freshly taken from the water. It is not utilized to any extent by the local inhabitants, and, of course, not shipped at all, due to the general indifference to the species and its poor shipping qualities. If it were possible to utilize this species at all, it would undoubtedly be very valuable, but the only available way would be by canning, and as far as I know no canneries have attempted putting up this species. The largest bed lies on the outer side of the spit to the south of the Nicomekl River. Here about thirty individuals are found in an area about 15 feet square. Those on the inner, less exposed portions of the flats are smaller on the average and less abundant. The total area of the beds of this species may be estimated at two and a half square miles. It would be very difficult to give any estimate of the yield of such an area, because the details of the life-history are not known. Its shells form a good part of the natural "cultch" supply for the spat of the native oysters.

The average size of the shells from the inner flats is 4.7 inches long, but from the outer 6.4 inches, the average weight of the latter being about 3 lb. when fresh from the water.

C. *CARDIUM CORBIS*, the "cockle."

This species is found abundantly, but is rarely utilized in any way here, although its use is widespread among the Indian tribes of the coast. It is found over most of the areas inhabited by *Schizothoerus nuttalli* and *Ostrea lurida*, a total of about three square miles. As remarked in another portion of the report, *Cardium corbis* does not lie as closely on the beds as is true of some of the other species, hence the above area would represent but a portion of the value of the similar areas of other species. Its shells form a large portion of the natural oyster-spat collectors, although much of the supply is not on the beds. This is due to the tendency of this species to work itself out on to the surface. The average size of this species in Boundary Bay is large, nearly 3 inches.

D. *PAPHIA STAMINEA*, the "little-neck."

As is true of *Saxidomus giganteus*, the beds of this species are very small in Boundary Bay. They will never be of much commercial importance and should be reserved for the use of the local inhabitants. It is used at present by them to as great an extent as any of the others. The abundance in the beds is not as great as it is usually in beds of this species. They form a small per cent. of the shells in the Indian shell-mounds.

E. *SAXIDOMUS ARATUS*, the "butter-clam."

The beds of this species are not extensive in Boundary Bay, as shown on the map accompanying. They are nevertheless well stocked and very valuable in proportion to their size. They would be very soon exhausted if used commercially. At present it is utilized by the local inhabitants, and forms a good part of the shell-mounds of the Indians. None are shipped out or peddled as far as could be discovered.

F. *MACOMA SECTA*, the "white-sand clam."

This species has never, to my knowledge, been utilized by Indians or white people in the vicinity of Boundary Bay. The majority of people are not conscious of its presence, lying deeply as it does, and without striking surface indications of its location. It is nevertheless the abundant shell-fish in the bay, with the exception, possibly, of *Mya arenaria* or one of the very small species. As is the case with the large "otter-shell," the areas it lies in are utilized by none of the other species save the cockle. The individuals grow to as large a size as the species has been recorded as reaching, and the shells are very clean and white. Provided some method is discovered to rid the alimentary canal of sand, this species should be of considerable value commercially. The total area of the beds is about two and a half square miles.

G. *MACOMA NASUTA*, the "mud-clam."

This species is very abundant along the shore in about the same territory that *Mya arenaria* is, but is of little value at present, as no one but the Indians eat it.

## IX. REPORT ON THE CLAM-BEDS OF THE FRASER SAND-HEADS.

1. *General Information.*—The sand-heads of the Fraser River are without doubt the most extensive tide-flats in the Province, covering nearly fifty square miles. Of this great area but about four square miles may be said to have any importance as clam-beds. This results from the great volume of fresh water poured over them by the Fraser River, which kills all marine life save on the upper and lower angles of the flats. The southern end is inhabited a distance of four miles from Point Roberts, hence about a third of the productive area is in American territory. That at the northern end is very small in extent, and may be said to be of almost no value. The main part of the flats is broken up into islands surrounded by channels of the Fraser River, but the upper and lower ends are continuous stretches, very flat, and with much standing water. The southern end is a soft sandy mud or pure sand, occasionally weeded, and with a shore strip of very soft mud, into which one sinks somewhat. This southern end is in reality a continuation of Boundary Bay, which lies across the peninsula of Point Roberts. Clams marketed from this region would have to be carried some distance to Port Guichon or Ladner's Landing in order to find transportation to Vancouver or Victoria.

2. *Species.*—A very few *Mya arenaria*, or the Eastern mud-clam, may be found at the outer edge of the main flats, but in such small quantity that they are of no commercial use. The only bivalve found in any abundance is the small *Macoma balthica*, or "pink-shell." In the southern end *Mya arenaria* is found in abundance in a narrow belt near the shore, but I know of no use to which they are put, and it is doubtful whether they are so abundant as to pay to dig for market.

*Cardium corbis*, the cockle, is found over almost the whole of the productive area, not in great abundance, but in such as to repay their collection by the Indians. Their beds extend over the outer parts of the flats where there is standing water at low tide. They are very seldom found on the northern end of the sand-heads, near Point Gray.

*Schizothoerus nuttalli*, the "otter-shell" or "summer-clam," is found to be the most abundant of all the species. It extends farther over the area affected by the fresh water, and is found over the whole outer edge of the productive area. They cannot be said to inhabit the flats as densely as they do in Boundary Bay, and it is doubtful whether they are in commercial abundance. They are found in only slight abundance on the northern end of the flats.

*Macoma secta* and *Macoma nasuta*, the former the white-sand clam and the latter the mud-clam, called "bent-nosed," are found in some abundance, but no use is made of them, and it is doubtful whether any could.

3. *Present Utilization of the Clams.*—There are at present a number of Indians living along the western side of the peninsula of Point Roberts, and these make some use of the clam-supply for their own sustenance, but, as far as I know, ship none to market, nor depend on it to any great extent. The whole area is regarded by them as a good "crabbing" ground, and when in search of the crabs it is usual to find them also gathering a certain amount of clams, usually *Cardium corbis*, the cockle. When desirous of clams especially, it is their habit to go to the flats at the end of Point Roberts and gather *Saxidomus giganteus*, the "butter-clam." This species seems to be favoured even more than the cockle. The large *Schizothoerus nuttalli* is not dug because the depth to which it is necessary to go for them in the shifting sand.

As far as can be foretold, there does not seem to be any prospect of this area becoming of any importance from a commercial standpoint, but it is likely to be a favourite place for digging by campers, etc., who also desire the crabs which may be caught stranded on the flats. The utilization of any of the area for the growth of oysters would be doubtful, although the eastern oyster might be bedded there, providing it were protected from the storms and too much fresh water.

#### X. CLAM-BEDS OF BURRARD INLET.

1. *General Information, Area, and Description.*—As may be seen from the map, Burrard Inlet is composed of two main parts, one of them running east and west, and another joining this at right angles and extending north from it. The latter is called North Arm. That composing the southern part is thirteen miles long, a third wide at the narrowest part, and two at the widest. At the southern side of the entrance lies the City of Vancouver, and at the other end lies the town of Port Moody. Along the southern shore runs the Canadian Pacific Railroad. On the north shore, opposite Vancouver, lies North Vancouver, a small but growing town.

North Arm is of little importance from a shell-fish standpoint. Its shores are steep and mountainous, the arm deserving the name of canyon. There are no beaches save at the northern end at the mouth of the Indian River, and at the southern, where there is a small clam-bed at the head of Bedwell Bay. Along either side there are occasional mountain-streams. The depth of the water is greatest at the head of the arm, being over 100 fathoms, while the entrance is about 20. As a result of the shade of the mountains, the cold fresh-water streams, and the great depth of the water, the temperature is low. The salinity is also too low for shell-fish, especially on the surface, because the great mass of the water is not affected by the tides. With the exception of Bedwell Bay, there are no beds, save for a few mussels on the rocks at the southern end, where the salinity is greater. North Arm is then of no importance from the shell-fish standpoint, save as it affects the salinity and temperature of the southern portion.

The latter is throughout a shallower body of water, being 25 fathoms deep at most, and is affected to a great degree by the tides. At the eastern end the depth is not over 5 fathoms, and at its head lies a flat of over 200 acres, which is not at all productive. This results in great part from the influence of North Arm on the salinity of the water, but also from the fact that there are several small streams of fresh water flowing over them. As may be seen from the map, there are two stretches of flats at the two Narrows, leaving in each case about 250 yards of open water through which flows a seven-knot current. At both of these a creek enters, at the first or outer Capilano Creek and at the inner Seymour Creek. The total volume of fresh water entering the inlet is thus large, and it is due to the great effect of the tide that the salinity is such as to permit the growth of shell-fish. The flats at the north side of the First Narrows, nearest the entrance, cover about 350 acres, of which not more than 100 are productive of any kind of shell-fish. Those of the Second Narrows are 440 acres in extent, of which 160 are more or less productive. Along the southern shore is a narrow beach averaging 15 to 20 yards in width, which is inhabited by clams throughout the most of its length. The total area of beds in this stretch, however, cannot be said to be more than 10 acres. That along the water-front of Vancouver is not taken into consideration. The whole area of shell-fish beds may then be estimated as about 275 acres, including all that is productive in any degree whatever. This is about a sixth of the total area of the flats.

That this area will be greatly reduced by the growth of the cities on Burrard Inlet is certain. The flats at the First Narrows will be the first to suffer, as even now great wharves are projected for North Vancouver. Whether the other areas will be utilized commercially, time only will tell. The beach bordering the water-front of Vancouver cannot be considered, because it is, of course, too dirty and crowded, and the same will be true wherever there are wharves.

For its supply of fresh clams the City of Vancouver is almost wholly dependent on the area within Burrard Inlet at present, and all of the supply taken from them goes into the markets of Vancouver. An estimate of the total of fresh clams marketed per year is 800 or 900 sacks or more. This is not a large supply for a city of the size of Vancouver, and it is fully to be expected that other regions will have to be drawn upon—namely, Boundary Bay and the islands of the Gulf. As the latter are at present not connected with Vancouver by the best of transportation facilities, it is evident that the problem of supplying that city with fresh clams may be somewhat difficult.

2. *Species*.—There are at present but two species marketed in Vancouver to any extent—namely, *Saridomus giganteus* and *Paphia staminea*. These are termed respectively "large" and "small" clam, or the first is called the "butter clam" and the second the "little neck." They are dug in the flats at the Narrows, and to some extent along the southern beach. The areas are indicated on the map. The beds of *Paphia staminea* are found in small patches, but are very abundant in these and of good size. The flats of the First Narrows are generally considered the best for this species, while those of the Second Narrows have more *Saridomus* in proportion; but in both cases the two species are intermingled and may vary greatly in abundance at either bed. As a general thing, *Paphia staminea* is the more abundant.

Besides these two species there are found a number of others in small quantity, and one very abundantly. The latter is the common edible mussel of the European coast, *Mytilus edulis*, which is considered a valuable food-fish in all European countries, but which is not at all utilized on the coast of British Columbia. At the western end of the First Narrows there are found dense masses of this species, covering the surface to a depth of 3 to 5 inches, and from this area alone Vancouver could be largely supplied. Other beds are found on the flats at the Second Narrows, but not in such great abundance, and small mussels of very thin shell are seen as far inland as the Indian River. They may be seen at a great distance, as they give the flats and the rocks a blue appearance. The shells are somewhat covered with barnacles at times, but not to such an extent as to seriously diminish the value of the product. There is no reason why the species should not be extensively utilized in Vancouver, providing laws are passed to regulate the sale of the animals after a certain length of time out of water. (See general part of report.)

Other forms available in sparse numbers are: *Mya arenaria*, the eastern mud-clam; *Mya truncata*, its near relative; *Schizothoerus nuttalli*, the large "otter-shell"; and *Cardium corbis*, the "cockle." None of these can be said to be of much importance. The first-named species is found in slight abundance just westward of Port Moody and occasionally on the flats of the Narrows. It is of interest solely on account of its occasional appearance in the markets. The cockle is found more frequently and occasionally in considerable quantity.

3. *Enemies*.—There are no especially injurious enemies found in the inlet. The large borer, *Polynices lewissii*, is found sparsely, as are starfish. The building of wharves, the dredging of the flats, and the utilization of the beds for booms damages them very greatly, and may in time mean their extinction. The oil-refinery a short distance westward of Port Moody, on the southern shore of the Inlet, allows to escape large quantities of oil and waste, which flow on to the water and float there as a slight but continuous film. At the time of my inspection there was a large amount of it a distance of a mile or a mile and a half along the shore in the neighbourhood of the refinery, and for three-quarters of a mile all life was killed off along the beach. This film of oil is not merely destructive of clam and beach life in general, but also to the water-birds which may chance to alight in it. Allowing this to escape in such a fashion is generally punishable by law in all countries.

4. *Methods of Utilization of the Supply*.—At the present day in the United States and in other countries as well there is a great tendency to combination in the handling of fish, and shell-fish are usually handled by the same people as are the fish. In Vancouver, however, this is far from being the case. It is unique in being supplied by Indian diggers, who market their own produce in the streets, and this fact, it seems to me, is worthy of record as of historical interest. The general relation of the Indian to the clam and salmon industries is an important one and worthy of careful consideration. It is evident that the state of affairs in Vancouver is one which is rapidly passing, as it is a peculiar survival of old conditions. The Indians have been allowed to occupy the reserves opposite the city up to the present time, until these have become very valuable, and it is now proposed to sell them and move the Indians to the main Squamish Reserve. When this is done it is probable that the clam-digging will fall into other hands, if it is carried on at all.

Every suitable low tide there may be seen on the flats a number of the Indians, for the most part the women, barefoot or with old rubber boots. Occasionally the men come out, but not often. The clams are dug with a short steel blade with a home-made handle, or by means of an old butcher-knife. This requires the taking of a rather uncomfortable squatting position, and most white men use a fork or spade. As fast as the clams are found they are thrown into a home-made basket, which may hold as much as 25 lb., and when this is full it is carried to the canoe and another taken to fill. Each woman digs about 50 lb. or more in the low tide. From the beds the clams are either taken home and held overnight, or taken across the bay to



sell. The primitive dug-out canoe is still used for this purpose, and every morning these may be seen tied up at the foot of Gore Street. The marketing is always done by the squaws. The clams are carried in baskets, one in either hand and a third strung over the back by a forehead band or otherwise. As is usual with Indians, the price is that which is most likely to be obtained, although the markets usually give them about 25 cents per basket. This means about 5 cents per pound. I was informed by some of the tribe that these women in cases possessed \$3,000 or \$4,000 as a result of their clam-digging, but cannot vouch for this.

There are 200 of the Indians in the two reserves, one at the mouth of Capilano Creek and another at the eastern end of the flats of the First Narrows. Of these, I was informed by the father in charge of the Catholic Mission on the reserve that from ten to fifteen derived at least a part of their livelihood from digging clams, this, of course, meaning only the adults, each of them perhaps having others dependent in part on them. During the proper season all the Indians are employed in the salmon-canneries, thus filling in the time when the clams are popularly supposed to be out of season.

During the past year there have been two white men employed in digging clams for the Vancouver market, selling their catch in the streets with a cart and horse. As they are said to undersell the Indians, it is probable that the selling of clams is profitable even to white men at the present scale of wages. There seems to be, however, a general aversion to engage in the work as long as it is considered the work of an Indian.

#### XI. CLAM-BEDS OF THE EASTERN SIDE OF VANCOUVER ISLAND.

These beds are all easily reached by railroad, the Esquimalt and Nanaimo Railroad touching all the points on the coast from Nanoose Bay to the southern end of Saanich Inlet, and the Victoria and Sidney Railroad all those on the Saanich Peninsula. The beds are situated at Nanaimo Harbour, Kuleet Bay, Chemainus River Flats, Cowichan Harbour, Union Bay, and along Cortova Channel. They are thus all available for the supply of Victoria, as well as Vancouver and the smaller towns along the coast. The beds of value are almost all those of the "butter-clam," *Saxidomus giganteus*, and the "little-neck," *Paphia staminea*.

1. *Departure Bay and Nanaimo Harbour.*—Departure Bay and Nanaimo Harbour are at the ends of the same body of water, that lying behind Newcastle and Protection Islands. Nanaimo is a town about seventy-three miles distant from Victoria and forty from Vancouver. It is the shipping-point for many of the small beds of the surrounding islands and bays. The value of the beach along the water-front of the city is greatly impaired by the presence of the coal-docks and herring-saltries, as well as the sewage that is emptied over them from the town sewers. There is situated here a clam-cannery, as mentioned in a preceding part of the report, and clams are brought from False Narrows, Comox, and even Thetis and Kuper Islands.

The clam-beds in Departure Bay are those of *Paphia* and *Saxidomus*, lying in rather narrow beaches along the inner shore and the north-west edge of Newcastle Island. There are 4 acres, utilized by the Indians in part, which are good beds, and a considerable area which has sparse quantities of the other species. Those beds along the water-front of the city cannot be regarded as of value. At the mouth of the Nanaimo River there is an extensive area, with the cockle and the "otter-shell" clam, with an acre or so of *Mya arenaria*, the "mud-clam" beds, but they cannot be said to be valuable as a whole. They are not suitable for oysters, apparently, because of the character of the bottom and the fresh water of the river. It might be possible to build up a bed of eastern oysters, but the prospects are not bright for this. As a whole, the beds in this immediate locality cannot be said to be of much value.

2. *Kuleet Bay.*—Kuleet Bay is a small cove about three and a half miles from Ladysmith by water and three or four by land, to the north-east; exposed to a long stretch of straits to the north-east and east. At present an Indian village lies on the south-western shore, near a couple of lagoons. The clam-beds lie along the head and southern shore, covering about 2½ acres, more or less, and are formed of light gravel. *Paphia staminea*, the "little-neck," is most abundant, and *Saxidomus giganteus*, the "butter-clam," is next, with some *Cardium corbis*, the cockle. The second species is probably kept well gathered by the Indians. The beds are not of great value.

I was informed that *Ostrea lurida*, the native oyster, had been planted in one of the lagoons, but at the time that I was there there were none to be observed. It is possible that these lagoons are suitable for them, but each is somewhat less than an acre in extent and too high.

4. *The Saanich Peninsula.*—The Saanich peninsula has a number of small beds along its northern end and along Cordova Channel, as well as in Union Bay. The shipping-point is Sidney, on the eastern side, eighteen miles from Victoria by the Victoria and Sidney Railroad. At Sidney is situated the cannery of the Sidney Trading Company, which is supplied by the beds to the north on the islands, as well as those on the shores of the peninsula.

The most extensive and productive clam-beds lie to the south of Sidney, but I was told that these were not utilized by the Indians to any great extent. They extend for about two miles along the shores of what is known as Bazan Bay. The beds are coarse gravel, and possess a moderately abundant supply of clams, covering at the most but 15 acres, of which probably a third is commercially valuable. *Paphia staminea* and *Saxidomus giganteus*, the "little-neck" and the "butter-clam," are found.

North of Sidney lies Shoal Harbour, which is the union of a number of small, shallow muddy bays, with but a small area of productive flats. Of these the greater part is soft, deep mud bottom, and not more than 2 or 3 acres show any clams whatever. These are *Paphia staminea* and *Saxidomus giganteus*. There is a small area in the southern portion which may be fit for the eastern oyster, but it cannot be said to be very promising. If the bottom were modified, it is probable that much more could be utilized.

Along the northern end of the peninsula there are scattered numerous small beds, composing about a twenty-fifth of the whole shore-line, and very narrow but of good quality. There may be about an acre of these, with the "little-neck" and the "butter-clam."

On the west side of Saanich Peninsula are Deep Cove and Union Bay, portions of which might be utilized for native-oyster beds. *Paphia staminea* is found in abundance in the northern half of Deep Cove, about half an acre in extent, Union Bay has about 2 acres of clam-beds of *Paphia staminea* and *Saxidomus giganteus* in fair abundance, with about an acre of *Macoma seta* beds. Of the whole bay, it is possible that the southern half could be utilized for transplanted oysters, but their propagation, either native or eastern, could not be expected.

5. *Cowichan Har. ur.*—This is at the mouth of the Cowichan River, about four miles by road from Duncan, on the Esquimalt and Nanaimo Railroad, and about fifteen miles from Sidney by water. On its southern shore is the Cowichan Harbour wharf and a few houses, including those of a number of Indians. At the head of the harbour is the Koksilah Indian Reserve. There are about 350 acres of tide flats, of which 40 may be said to be productive. These are in a rectangular area at the mouth of the river. From this stretch there extends a long narrow strip along the shore of the southern side as far as Boatwains Bank, three and a half miles from the wharf. In this piece there is approximately 40 acres of productive beds. Of the rectangular area at the river-mouth nothing but the edge and the southern angle is productive, the species found being *Cardium corbia*, the "cockle," and *Schizothoerus nuttalli*, the "otter-shell." These are not often dug, as most of the diggers prefer the more densely populated beds along the southern edge of the harbour. Here is found for the most part *Saxidomus giganteus*, the "butter-clam," but *Paphia staminea* and *Schizothoerus nuttalli* are also found to some extent. It is one of the most popular of the clam-beds, and at all the low tides people may be seen digging clams here. This is especially true on Sundays. The Indians of the near-by reserve also make good use of the clams, both the cockle and the other species. I was informed that the canneries have also made use of the beds, but this I cannot vouch for, as I did not inspect the beds during the canning season. These beds are undoubtedly valuable.

6. *Chemainus River Flats.*—The mouth of the Chemainus River is about fifty-two miles from Victoria by railroad, and forty from Vancouver by water. The total area of the flats is about two and a half square miles, of which somewhat more than one is productive of shell-fish of some sort. At present nothing but oysters is marketed from the flats, and these are transplanted from Ladysmith. Crofton is distant a mile and a half, and Chemainus but half a mile to the north. Either of these places may be utilized for shipment, the former by water only.

The flats are of sedimentary formation, being, in fact, a delta. The river breaks at high-tide line into branches and spreads over the bottoms. Around the outer side of the delta there are a number of small islets, lying parallel to the coast and connected at half-tide with it. Between the islets and the shore the flats are high and non-productive for the most part, but at the northern end and outside of the islets there are large flats that are low and weed-covered, with some shell-fish. As is usual with river-flats, there are extents of different bottom, weeded

heavily or nearly bare, soft-bottomed or somewhat firm. At the southern end there is a considerable extent between the scattered islands of this end which is firm and somewhat sandy, bordered on the low-tide line by broad reaches of weeded flats. The latter are continued up the whole of the outer side of the islands and southward around the head of Osborn Bay.

The species of clams found living in the flats are: *Mya arenaria*, the "soft-shell mud-clam"; *Schizothoerus nuttalli*, the "otter-shell"; *Cardium corbis*, the "cockle"; *Paphia staminea*, the "little-neck"; and a few of the "butter-clam," *Saxidomus giganteus*. They are placed somewhat in the order of their abundance, but from the standpoint of present utilization the cockle only is important. *Macoma secta*, the "white-sand clam," is found in the firm white sand of the southern end, but is not utilized. The cockle is found on the outer beaches, the soft-shell mud-clam on the higher flats in less than commercial abundance, the little-neck in small quantity in the northern end and in the gravelly parts of the southern, while the large otter-shell is found over the outer parts of the flats. The type of flat is much the same as that at Boundary Bay, and the enemies are the same.

At present there is an Indian family living on one of the outer islands, and they dig the cockle for their own use by primitive methods. As far as I was able to ascertain, they do not sell much of their product. It cannot be said that at present these flats are to be regarded as very valuable, but they may become so if oysters are transplanted to them in greater quantity and the canneries begin to utilize other species of clams than is done at present.

## XII. THE CLAM-BEDS OF THE ISLANDS SOUTH-EAST OF VANCOUVER ISLAND.

These islands, extending from Nanaimo on the north to Saanich Peninsula, seem to form irregular arcs of circles drawn with the mouth of the Fraser River as a centre, and the long axis of each island extends north-west to south-east. Vancouver is thirty miles from the nearest of them, while Victoria is fifteen from the southernmost and seventy-five from the northern end of the group. They are rocky, with stone or gravel beaches in great part, rough and hilly, with but few large bays or harbours, Ganges Harbour being the largest. It is unlikely that they will ever become densely inhabited save in the most favourable places. At present regular transportation service is by steamer once or twice a week to one or two of the islands. Numerous private launches and small boats are owned among the islands.

The shipping-points which would be made use of are Ganges Harbour, Sidney, Chemainus, Ladysmith, and Nanaimo. Ganges Harbour is on Salt Spring Island, about forty miles from Vancouver and thirty-five from Victoria. Chemainus, Ladysmith, and Nanaimo are on the Esquimalt and Nanaimo Railroad, and are respectively fifty-two, fifty-nine, and seventy-three miles from Victoria. Sidney is about eighteen miles from Victoria by the Victoria and Sidney Railroad. These places are the most convenient for the establishment of canneries. In treating of each island, its approximate position in regard to one of these places will be given. No other convenient method of subdivision for the treatment of the area presents itself save that of the islands.

As a general rule, the beds on the islands are of a different type than those of Boundary Bay, resembling to some degree those of Burrard Inlet. The species most generally found are the little-neck and the butter-clam, but the other species are occasionally found. The second-named species is the one used almost exclusively by the canneries and is at present the most highly valued. The beds of the first two are usually densely stocked.

1. *Sidney Island*.—Between Saanich peninsula and San Juan Island lies Sidney Island. On its northern end is a long sandspit about a mile in length, a broad beach runs down the whole western side, and on the eastern there is a shallow bay. The sandspit has a small bed of *Saxidomus giganteus*, the "butter-clam," and *Paphia staminea*, the "little-neck" at its tip of not more than 2 acres in extent. Either side of the gradually broadening spit is typically fine grey sand on the lower third of the beach, heavy weeds above, and a gravel or sandy area at the highest level. In the fine grey sand are found large numbers of the white-sand clam, *Macoma secta*, probably an area of 8 or 9 acres. At the base of the spit, on the western side, is a large lagoon, which is utterly barren, probably because of its very soft bottom. At its entrance are small beds of *Paphia staminea* and *Mya arenaria*, less than an acre. At about the centre of the island is a moderately abundant bed of the large "otter-shell clam." The bay on the east coast is edged by gravel beach in which is a fairly good bed of *Saxidomus* and *Paphia*, probably 3 acres. The total area of clam-beds of commercial importance may be placed at about 6 acres. They are "feeders" for the Sidney cannery.



2. *Salt Spring Island*.—The principal beds of the island lie in Ganges Harbour, Long Harbour, and Fulford Harbour, while the smaller are found along the northern shores and in the shallower bays of the western side. Salt Spring is the largest of the islands and has the greatest extent of clam-beds.

(a.) *Ganges Harbour*.—This is a bay on the east side of Salt Spring Island, at a distance of about sixteen miles from Sidney, and hence about thirty-two from Victoria, although five or six miles farther by the water route. The distance from Vancouver is about fifty miles. It is the principal wharf and post-office on the island, and roads connect it with all parts.

The most valuable bed in Ganges Harbour lies in the lagoon on the south-western side. It contains a great abundance of *Paphia staminea*, the "little-neck," and a fair proportion of *Saxidomus giganteus*, the "butter-clam." The total area of clam-bed in and near this lagoon is approximately 15 to 20 acres, a part of which lies on the outer side of the spit enclosing the lagoon, in a bed about 15 yards wide. The upper end of the lagoon is somewhat muddy, and the centre weeded. No oysters were present, although there is no apparent reason why they should not flourish here if transplanted. The spat would always be lost, however. A small stream of fresh water enters near the mouth of the lagoon, but during the summer did not provide a very large volume. *Mya arenaria*, the "soft-shell mud-clam," is found in slight abundance around its mouth. The lagoon is but a few minutes' run from Ganges Harbour, but does not seem to have been utilized very greatly by clam-diggers.

The beaches to the south of the lagoon are not of great extent, and are productive mainly of *Macoma secta*, the "white-sand clam." The beaches on the east side of the harbour are small, but occupied by *Paphia staminea* and *Saxidomus giganteus*.

(b.) *Fulford Harbour*.—This is a southern inlet of Salt Spring Island, its head about eight miles from Sidney. It is bordered on both sides by very steep and high hills. There is no large settlement, a few residences being situated along the eastern side and a store at the head of the bay. The clam-beds are utilized by the Indians digging for the Sidney Trading Company, and I was informed by local residents that the beds were depleted to a considerable degree. They are the nearest beds to the cannery, and would, of course, be dug more extensively. The total area of productive beds is 4 or 5 acres, although probably double that is inhabited by clams.

Along the eastern side of the bay there are four small coves, on the western two fairly broad beaches, and at the head of the bay an extensive flat of light gravel. The coves possess beaches of very small area and no great value, although native oysters might be grown in them by transplantation. The beach at the head of the bay is apparently well fitted for native oysters, and may be utilized for transplanted beds. At present *Tapes staminea* is found in very slight abundance over the whole, and in commercial abundance at the eastern side in an area of a quarter of an acre along the shore-line. The beaches of the western shore are two in number, the southernmost with less than an acre of gravel-bed with clams. The northern is an extension of that at the head of the bay, and has about an acre of good clam-beds at one end and slightly more at the other, making about 2 acres. It is covered in great part by log-booms and the beds thus rendered poorer.

(c.) *Long Harbour*.—This is a long narrow inlet on the south-east side of Salt Spring Island, separate from Ganges Harbour by a long peninsula, the heads of the two harbours being but a short distance apart. Its width is but 400 or 500 yards at the most, and less than 100 at the head. The length of the harbour is between three or four miles. The greater portion of the inlet is bordered by rocky beaches until within less than a mile of the head. At this distance fairly extensive beaches are found on the eastern side, and farther toward the head there are also similar beaches found along the western side. The flats at the head of the inlet are of small extent, at a rough estimate about 15 to 20 acres being good oyster-ground. The population around the head of the harbour is at present small, but two or three families living there. The supply of fresh water is small and enters at the head of the flats.

The principal beds are those of the "small-clam," *Paphia staminea*, of the Vancouver markets, and these are as rich as any in the southern end of the Province. The clam is of good size and colour, and the beds should become of considerable commercial importance as soon as the species is sought for canning purposes. When rapid transportation to Vancouver is secured, there is no reason why that market should not be supplied in part from these beds. They are situated in the steeply sloping beaches on either side of the upper reaches of the inlet, particularly on the eastern side. The width of the bed is small on either side, as the soft-shell or mud-clam, *Mya arenaria*, displaces them above. A crude estimate places the total

area as about 3 or 4 acres of actual clam-bearing ground. I am inclined to place the value of these clams above that of the oysters at the head of the inlet. The character of the bottom in which they are found is the usual gravelled sand, with an admixture of mud.

There is a considerable amount of the soft-shell or mud-clam found, the area of whose beds is very much less than that of the other species, but the value of those that exist is considerable. They are of good size and fair abundance. The "butter-clam," or *Saxidomus giganteus*, is found in very small quantity, and cannot be considered of very great value. The same is true of the cockle, *Cardium corbis*.

(d.) Booth Bay.—This is an open inlet about two miles distant from the head of Ganges Harbour by land, but on the opposite side of the island. It is steep-shored, open to north-west winds, and the outer beaches are of doubtful value from a shell-fish standpoint. The Booth Canal opens into its head. There may be an acre of shell-fish beds here.

(e.) Vesuvius Bay.—This is an open cove a mile and a quarter north of Booth Bay, with less than an acre of good clam-beds, for the most part *Saxidomus giganteus*.

(f.) Northern End of Salt Spring Island.—The clam-beds are found here on small beaches at Fernwood Point, along Houston Passage, at Southey Point, and probably do not aggregate more than 10 acres. Of this the major portion is of low value. *Paphia staminea* and *Saxidomus giganteus*, the "little-neck" and the "butter-clam," are the most abundant.

3. *Galiano Island*.—Montague Harbour and Retreat Cove contain practically all the clam-beds on the island. The former has gravel beaches containing a fair supply of *Paphia staminea* and *Saxidomus giganteus*, over a total area of at most 7 acres. Immediately to the north of the harbour is a small bed in a bight of the shore about an acre in extent, containing *Cardium corbis* for the most part. Retreat Cove has not more than an acre of good clam-bed, containing *Paphia staminea* and *Saxidomus giganteus*. Ganges Harbour is their nearest port, seven or eight miles in the case of Montague Harbour and about twelve in that of Retreat Cove. Their beds are important simply as parts of the numerous small ones available for the clam-canneries.

4. *Prevest Island*.—This island lies just outside of the mouth of Ganges Harbour. There are about 2 acres of good clam-beds to the island. Annette Cove, on the northern side of the island, contains about 7 acres of muddy bottom, with very few clams. Parts of this might be available for oysters. James Bay, on the same side, contains slightly less than an acre of good clam-beds along the southern side and another at its head, making about 1½ acres of *Paphia staminea* beds. A short beach lies on the western side behind a small island opposite the head of Annette Cove, with about a fifth of an acre of abundant *Paphia staminea*.

5. *Pender Island*.—Pender Island is composed of two portions separated by a canal connecting two harbours, Bedwell and Browning. In the latter are the only beds on the islands worth consideration. They are thirteen or fourteen miles from Sidney. There are about 1 or 2 acres of good *Paphia staminea* and *Saxidomus giganteus* beds at the eastern mouth of the canal. At the northern end of the harbour there are three or four more, but with a less abundant supply.

6. *Saturna Island*.—Saturna Island is just the other side of Pender Island from Sidney, a distance of half a mile. It is thirteen miles from Ganges Harbour. The clam-beds are situated at Winter Cove, Lyal Harbour, and Boot Cove, covering about 10 acres or more. The first has rocky shores, interspersed with muddy gravel beaches containing *Paphia staminea* and *Saxidomus giganteus*, with some soft-shell clams, *Mya arenaria*. Lyal Harbour has the same type of beaches along the southern end and eastern side. Boot Cove is a well-enclosed shallow bay with muddy beaches containing *Mya arenaria*. The only use to which the clams were being put in the latter place was as food for a herd of pigs which dug the clams out at low tide.

7. *Secretary Islands*.—Between the two small Secretary Islands there is a small bed of *Paphia staminea* and *Saxidomus giganteus* of an acre and a half. It is fifteen miles from Ganges Harbour. The beds are well stocked, and show traces of digging.

8. *Gabriola Island*.—Gabriola Island is important chiefly because of the flats at the south-east end of False Narrows. This is about eight and a half miles from Nanaimo. The supply for the clam-cannery of Broder and Menairy at Nanaimo was said to have come from these beds during the year 1911-12. The "little-neck," *Paphia staminea*; the "butter-clam," *Saxidomus giganteus*; *Mytilus edulis*, the mussel; and a few of the other species of clams were found. These beds lie between Gabriola Island and Judge Island, at the south-west end of a narrow passage, through which the tidal currents ebb and flow at about three or four

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knots. On the map accompanying, the *Saxidomus* beds are stippled. The mussel-beds are well stocked and should prove valuable if the species is ever utilized. The total area of productive flat is less than 50 acres, of which two-thirds may be termed good beds (in the past, in part). Their composition is a coarse gravel.

During the clam season, which extends from September to May, it is said that as many as a hundred Indians are digging at one time during the good tides, but this may be exaggerated somewhat. During the inspection of the beds there was no digging being done. This number of Indians means about forty families. Their shacks or tents are set up on the Mudge Island shore, and the clams are carried to the cannery in their canoes or in the lau-laes. Two persons may manage to gather as many as six sacks at low tide, according to the local residents, but I think this a little high. A potato-fork or a spade is usually employed. It is obvious that this is too much of a strain on the beds, and, as would be expected, they were exhausted, for the year at least. This area is one of the best of the island beds, and must be considered very valuable.

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PLATE I.



*Saxidomus giganteus*, Deshayes ("Butter-clam"). (Natural size.)

PLATE II.



*Paphia staminea*, Conrad ("Little-neck"). (Natural size.)

PLATE III.



*Cardium corbiae*, Martyn ("Cockle"). showing large foot protruded. (Natural size.)

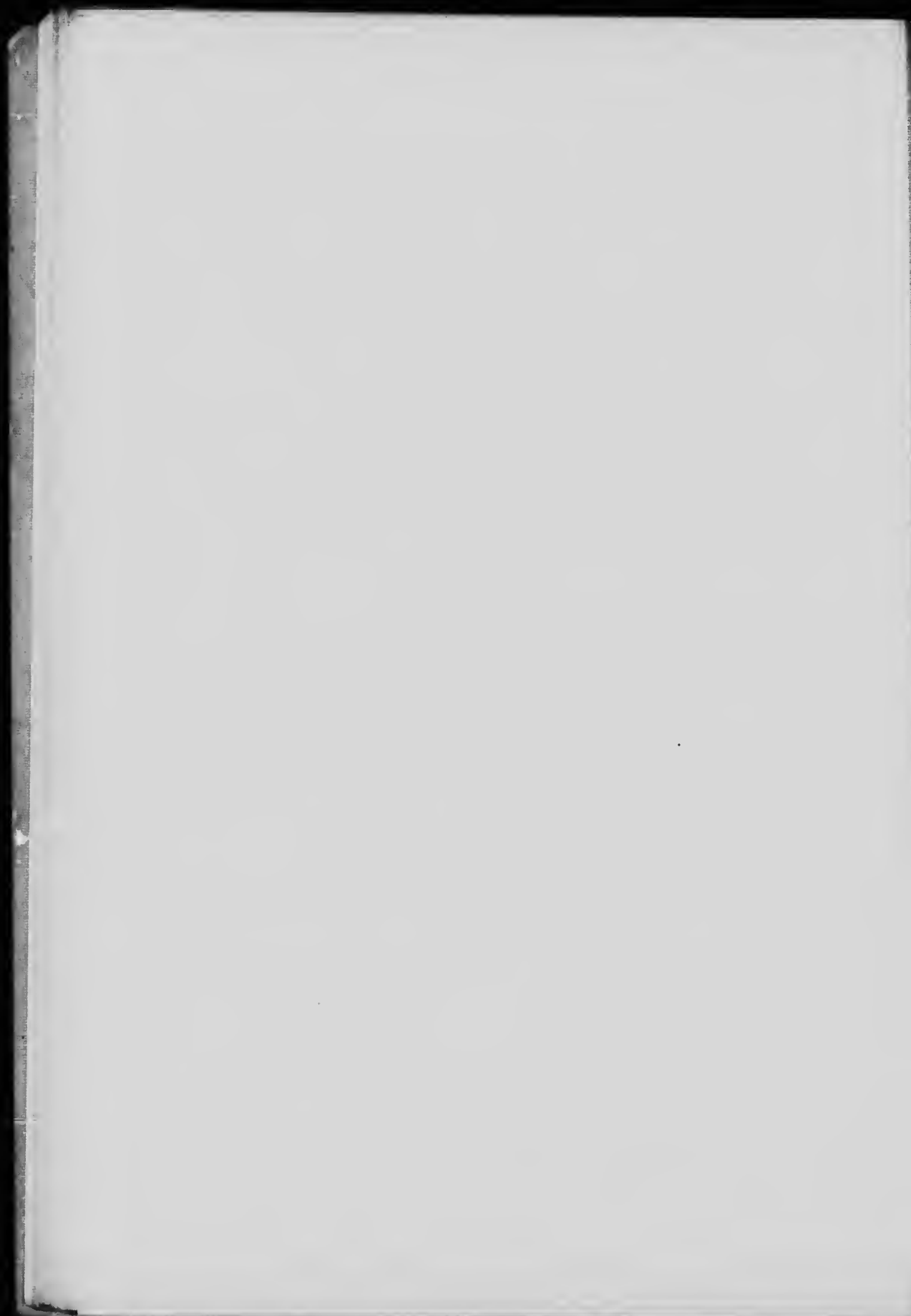


PLATE V



*Schizothaerua nuttalli*. Conrad ("Summer-clam"). (Three-quarters natural size.)

PLATE IV.



*Cardium corbia*, Martyn ("Cockle"). View from siphonate end, to show heart-like shape of the shell, the lack of siphons, and the large foot. (Natural size.)



PLATE VI.



*Mus arvensis*, Linnaeus ("Mudclam"), (Six-sevenths of natural size.)

PLATE VII.



*Mutilus edulis*, Linnaeus ("Mussel"), (One and one-third times natural size.)



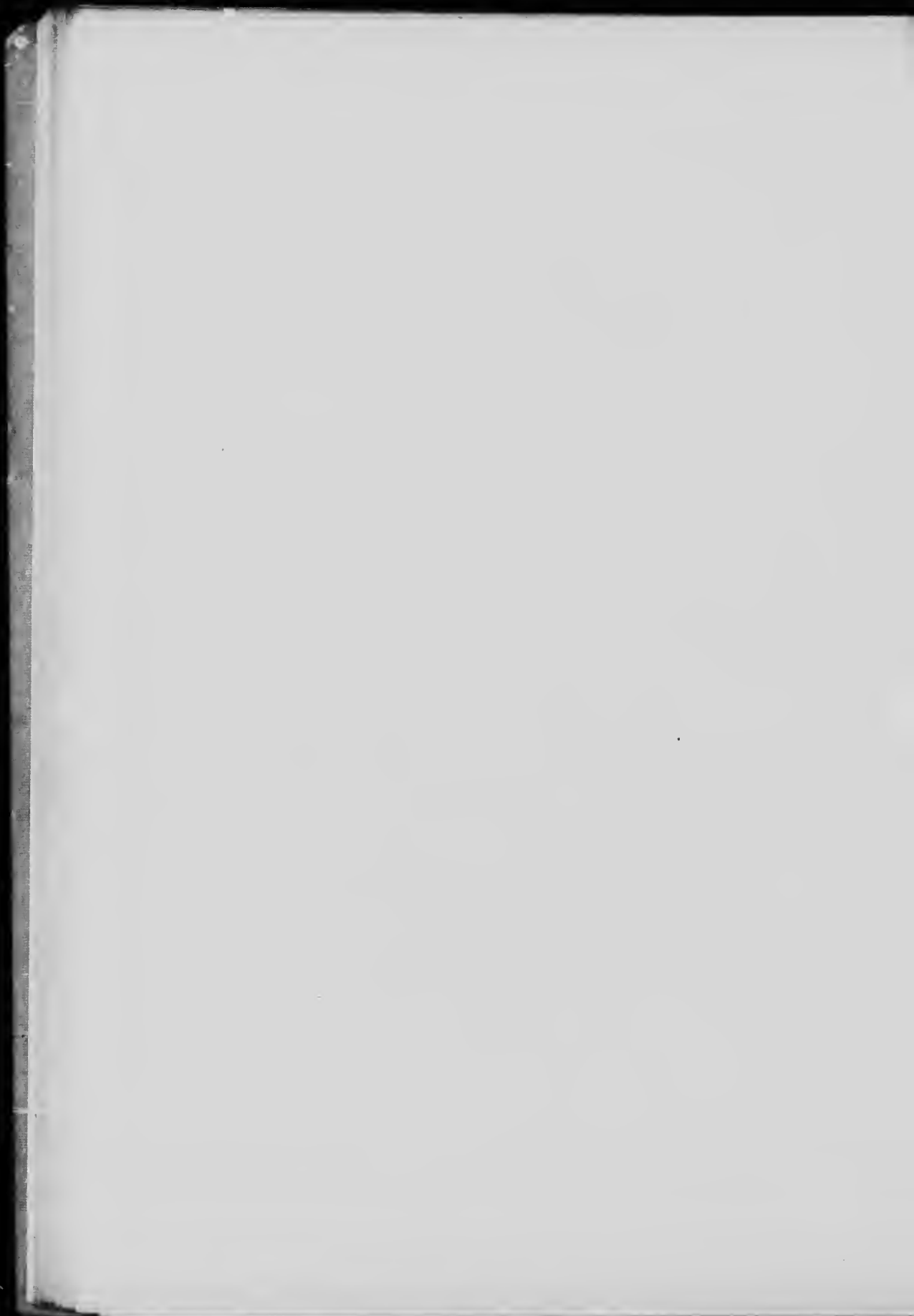


PLATE VIII.



*Macomaacca*, Conrad ("White-sand clam"). (Natural size.)

PLATE IX.



*Thais lamellosa*, Gmelin ("Small Borer"). (Natural size.)

PLATE X.



Egg capsules of *Thais lamellosa* on the valves of *Cardium corbis*, Martyn. (Two-thirds natural size.)



PLATE XI.



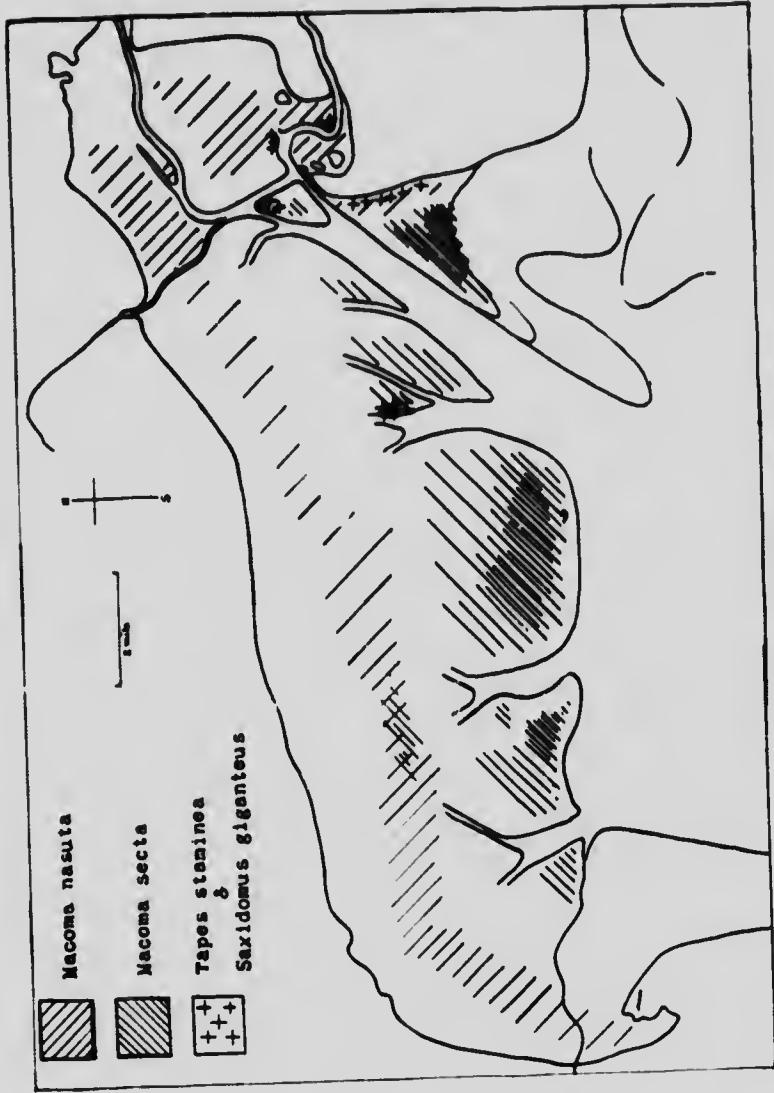
*Thuis variola*, Valenciennes ("Small Borer"), its egg-capsules, and a valve of *Mytilus edulis*, Linnæus, showing at its upper end the hole made by the drill of the borer. (One and one-fifth times natural size.)

PLATE XII.



*Polynices levissi*, Gould ("Large Borer"). (Small example, life-size.)

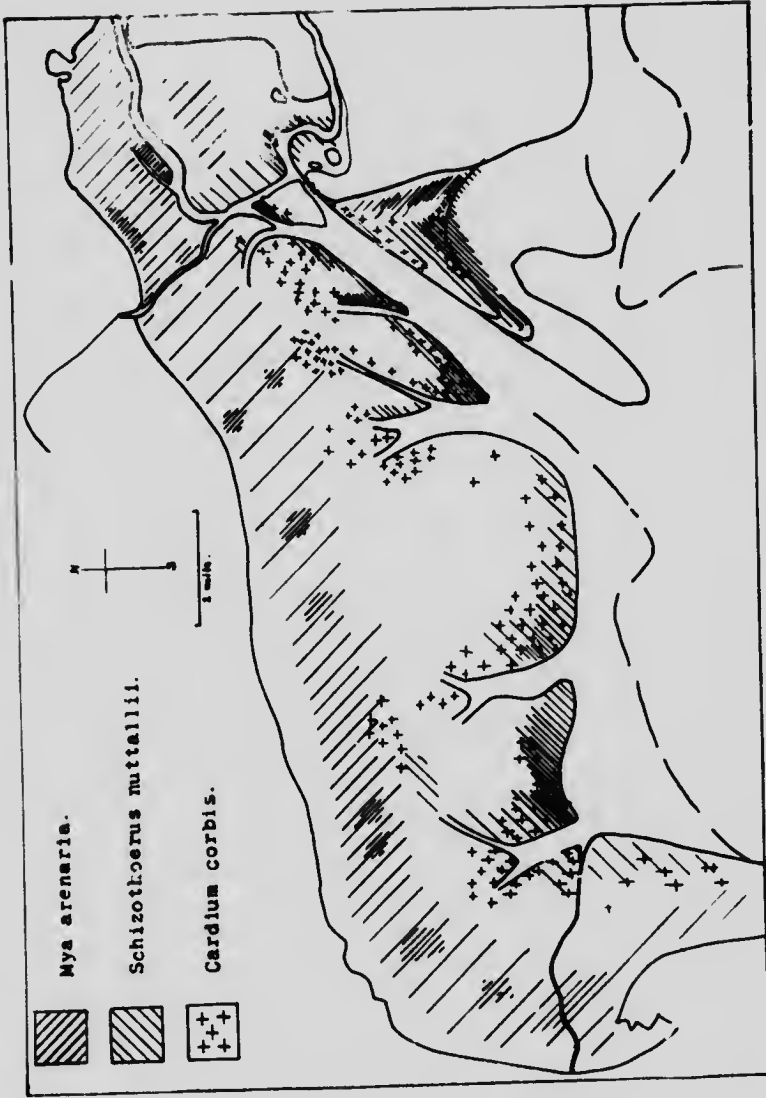
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Boundary Bay. Showing distribution of shell fish.



PLATE XIV.



Boundary Bay. Showing distribution of shellfish on flats.



