now been stated, that the increase of height and dimensions which has been observed in the reefs and inlets of the skär during the last half century, may be adequately accounted for by the action of ice, which has piled up (generally on a basis of *fixed* rock) accumulations of transported *débris*.

Rise of Land around the Baltic.—Early in the last century the Swedish physicist Celsius (to whom we owe the invention of the centigrade scale) formed the opinion that the waters both of the Baltic and of the North Sea were gradually subsiding; and this opinion, though controverted by other authorities, was embraced by Linnæus. It is now clear that many of the facts by which it was supported are explicable by the transporting agency of rivers and of ice, as already explained; and it was pointed out by Playfair in 1802, that even admitting the proofs on which Celsius relied, they would rather show that the land is rising, than that the water is receding. During the present century a great deal of attention has been given to this question, on account of its geological interest, by many very able observers; and the results may be briefly summarised as follows:—(1.) An elevation of the whole of Norway, from the North Cape to the Naze, has taken place within a comparatively recent period,—as is evidenced by the numbers of raised beaches containing existing shells,[1] which are found at different points along the western coast, frequently at a height of 200 feet above the present sea-level, and in some spots at a height of more than 600 feet. As these beaches, where one lies above another, are not always parallel, it appears that the elevatory action did not take place equally over the whole area; and the movements were probably intermittent, with long pauses between. (2.) At various points along the coast of the Baltic and the Gulf of Bothnia, alike in Sweden and in Finland, similar collections of shells have been found, belonging to species now inhabiting the basin, and characterised by the peculiar *facies* to be presently noticed as distinguishing its molluscan fauna from that of the ocean. Such deposits have been found very far inland, and at a height of 230 feet above the sea. Hence it appears that before this upheaval took place, the Baltic must have been separated, as now, from the North Sea by the mountain ridge of Norway, although it extended over a considerably larger area of what is at present low-lying land. (3.) Notwithstanding the numerous observations which have been made with a view to ascertain whether any change of level is now going on, the question must be regarded as still undetermined. Little reliance can be placed on occasional comparisons of the height of marks made upon rocks above the sea-level, since, although there are no tides, the height of the water in the basin is subject to considerable variations, from causes to be presently explained. (4.) There is a good deal of evidence, on the other hand, that, towards the southern extremity of Sweden, there has been a *depression* of the land since the historic period. In this portion, known as Scania, no elevated beds of recent marine shells have been met with; in its seaport towns there are streets now at or even below the level of the water, which must have been above it when first built; and a large stone whose distance from the sea was measured by Linnæus, in 1749, was found 100 feet nearer the water's edge when its distance was again measured in 1836. Near Stockholm, again, a fishing-hut, with remains of boats of very antique form and construction, was found, in 1819, at a depth of 60 feet, covered over with gravel and shell-marl; and it was considered by Sir C. Lyell to be impossible to explain the position of this hut without imagining first a subsidence to the depth of more than 60 feet, and then a re-elevation. On the whole, it appears clear that oscillations of level, not uniform either in direction or in degree, have taken place in various parts of the Scandinavian peninsula within a recent period, whilst in regard to the continuance of any such changes at the present time we have no certain knowledge, though it is considered probable by many of the most distinguished *savans* both of Sweden and Norway.

Movements of Water in the Baltic.—There is scarcely any tidal movement in the Baltic; for though there are sensible tides in the Skager Rack, these begin to diminish in the Cattegat, and are very trifling in the Sound and Belts, averaging only about a foot at Copenhagen. There is usually a general movement of the upper waters of the Baltic towards the three channels which form its outlet, and a considerable flow of water through them. The large volume of water discharged by the rivers that empty themselves into the upper end of that gulf forms a southward current, which becomes very rapid where it narrows at Quarken (being partly blocked also by the Walgrund Islands), and again where it is obstructed by the Aland Islands, as it enters the Baltic proper. In that part of the basin the current is liable to considerable modification from prevalent winds; but it is usually very perceptible in the spring and early part of the summer, when the snows are melting. On the other hand, when an unusual continuance of north-west wind concurs with high spring-tides to drive the water of the North Sea into the outlet of the Baltic, a large body of water flows back into its basin, producing a reverse current, which is felt as far as Danzig.

There are also considerable variations in the height of the water, that seem for the most part referrible to three different conditions, which may operate separately or in combination, viz., (1), the seasonal increase and decrease of the amount of water brought down by rivers; (2), the banking-up of the outflow by opposing winds; and (3), variations in atmospheric pressure.

(1.) During the winter months the quantity of fresh water poured into the Baltic by the rivers which discharge themselves into it is greatly reduced by the freezing of their sources; and this is, of course, especially the case with those that empty themselves into the Gulf of Bothnia. Hence the general level of the surface is at its lowest at this season. With the melting of the snow in spring and early summer, however, there is an enormous increase in the quantity of fresh water poured into the basin, and the level of its surface then rises. There is always, of course, a tendency to equalisation of the level of the Baltic with that of the sea outside, by outflow or inflow currents through its three channels of communication; but the narrowness of these prevents that equalisation from being immediate, and it is often interfered with by winds. (2.) The influence of winds in banking up the water at the outlets, and even in reversing the usual currents, is very decided, as has been especially shown by the recent researches of Dr Meyer of Kiel.[2] The strongest and most constant surface-outflow is seen during the autumn and winter months, when there is little or no elevation of level, but when the prevalent direction of the wind is such as to drive the Baltic water towards and through the straits. When, on the other hand, the winds prevalent in the North Sea tend to drive its water into the straits, their usual outcurrent may be reversed; and this most frequently happens during the spring and summer months, although the excess

[1] The shells found in the raised beach at Uddevalla by Mr J. Gwyn Jeffreys in 1862, were characterised by him as glacial; but they have been shown to be specifically identical with mollusca now living at Spitzbergen; and it is probable that when the water was deeper than at present along the coast of Norway, these would have ranged southwards along the cold bottom, as they do even now to a certain extent.

[2] *Untersuchungen über Physikalische Verhältnisse des Westlichen Theiles der Ostsee.*

water to be discharged is then at its greatest. It sometimes happens, especially about the autumnal equinox, that a N.W. gale concurs with a high tide in the Skager Rack to drive its water towards the Baltic, causing it to overflow the lower portions of some of the Danish islands. If, then, a southerly wind should carry this water onwards into the Gulf of Finland, the check which it gives to the downflow of the Neva produces disastrous inundations at St Petersburg. (3.) The influence of atmospheric pressure upon the height of the water in the Baltic is very remarkable. It had long been noticed that its level occasionally rises even as much as 3 feet without any apparent cause, and maintains itself at that height, sometimes only for a few days, but occasionally for several weeks together, and this at all seasons. Schultén, having observed that such elevations of level are preceded by a fall of the barometer, and that when the barometer rises again the water subsides, was led to recognise the dependence of these changes upon converse changes in atmospheric pressure; and this reference was confirmed by observation of the constant proportion borne by one to the other. A similar consequence of variation in atmospheric pressure has been observed in the Mediterranean (see MEDITERRANEAN); and it has also been noticed in England as a disturbing element in modifying the height of the tides.

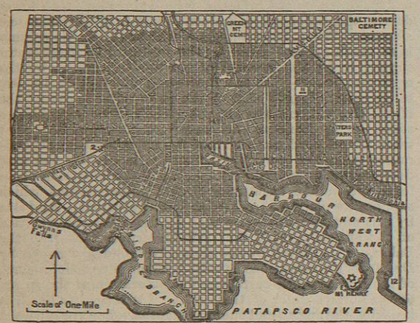
Salinity of Baltic Water.—As might be expected from what has been already stated, the proportion of salt in the water of the Baltic is very much below that of oceanic water, and varies greatly at different seasons. In the Gulf of Bothnia, at the time the river-flow is greatest, the surface water is often so little salt as to be quite drinkable, its sp. gr. having been found as low as 1·004. But it is said to contain at Christmas six times as much salt as at midsummer, showing that when the river supply is at its lowest, its place is taken by a reflux of salt water from the outside ocean. In the Baltic proper there is a very decided difference in salinity between the upper and the lower stratum; the less saline water of the surface flowing towards the outlet over the more saline water beneath, just as the fresh-water current of a great river runs out to sea, even far beyond the sight of land. Thus the proportion of salt in 1000 parts of a sample of *surface*-water taken near Stockholm being 5·919, that of *bottom*-water, brought up from 120 fathoms, was 7·182; and in like manner the proportion of salt in *surface*-water at the entrance of the Gulf of Finland being 3·552, that of *bottom*-water at 30 fathoms depth was 4·921,—the proportion of salt in North Sea water averaging 32·823 parts in 1000. Nearer the outlet the proportion of salt is greater alike in surface and in bottom-water. From the careful and systematic observations of Dr Meyer (*op. cit.*), it appears that the sp. gr. of the surface-stratum at Kiel ranges between about 1·0082 in summer and 1·0142 in winter, the latter showing somewhat above half the quantity of salt contained in ordinary sea-water. But if the direction of the prevalent winds during the autumn be such as to maintain a strong surface out-current, and consequently (as will presently appear) a very strong inward under-current, as happens in some years, the maximum of salinity will present itself at that season. The sp. gr. of the deeper stratum ranges at Kiel from 1·0145 to 1·0190; at Helsingör on the Sound from 1·0190 to 1·0220; and at Korsör on the Great Belt from 1·0180 to 1·0243; thus showing it to be principally composed of North Sea water, whose sp. gr. may be taken as 1·0264.

Currents in the Baltic Straits.—The results of observation of the movements of the upper and under strata of water in the Baltic Straits, strongly confirm the doctrine elsewhere enunciated (see ATLANTIC) in regard to the potency of slight differences of downward pressure in the production of under-currents. The prevalent movement of the upper stratum in the Baltic Straits is *outward*; and this concurs with the low salinity of Baltic water to indicate that it is partly an *overflow* current, produced by the excess of river supply over loss by evaporation, which tends to raise its level. But even when this *outward* surface-current is strong, there is usually an *inward* under-current of North Sea water, carrying back into the basin of the Baltic a large proportion of the salt which would otherwise be lost to it; and the existence of this under-current, which has been abundantly established by experimental inquiries, as well as by the observations of divers, is exactly what theory would lead us to predict. For if two columns of water of the same height, but differing in specific gravity, be made to communicate with each other alike at the surface and at the bottom, the lower part of the heavier column, having a greater lateral pressure, will flow towards the lighter, thus tending to produce an elevation of level in the latter, which will rectify itself by a surface-flow in the opposite direction; and thus a vertical circulation will be maintained, as long as the causes which maintain the difference of salinity remain in operation. Now, as the salinity in the oceanic column may be regarded as practically constant, whilst the salinity of the Baltic column, though not uniform, is kept down by the influx of river-water to a much lower degree, this difference will always exist to a greater or less amount. When, however, the height of the Baltic column is so much raised—either by the excess of its fresh-water supply, or by the reversal of the surface-current by the agency of wind—that the downward pressure of its less saline water exceeds that of the more saline water of the North Sea column, the under-current will be brought to a stand, or its direction will be reversed. Thus it is that when the outward movement of the upper stratum depends rather upon the prevalent winds (as is usually the case during autumn and winter) than upon the elevation of its level within the basin, the inward under-current which supplies its place is strongest and most constant. And it is by this means, much more than by the occasional reversal of the surface-current, that salt is carried back into the Baltic,—as is proved by the close correspondence shown by Dr Meyer's observations to exist between the predominance of the inward under-current and the elevation of the sp. gr. of the surface-water of the Baltic. On the other hand, it is during the spring and summer months, when the outward movement of the upper stratum is rather an overflow-current, and the salinity of the surface-water is the lowest, that the under-current sets less strongly and less constantly inward.

Zoology.—The fauna of the Baltic may be regarded as that of a large estuary, having a narrow communication with the sea,—its marine inhabitants being such as can adapt themselves to considerable variations in the salinity of its water. Whales rarely enter the Baltic; but porpoises frequent the neighbourhood of the Danish islands. Seals are obtained in considerable numbers at the breaking up of the ice around Gottland and the Aland Isles. The salmon is among the most abundant fishes of the Baltic proper, ascending its rivers from April to June; and salmon-trout are caught in some of its bays. The portion of the Baltic in the neighbourhood of the Danish islands is frequented by various species of *Gadidæ*, which do not range further east. In the 14th and 15th centuries there was a considerable herring-fishery within the Sound and along the coast of Scania (the southern portion of Sweden); but this fish seems to have latterly quite deserted the Baltic, and rarely shows itself even in the Cattegat. On the eastern coast of Sweden, on the other hand, and in the Gulf of Bothnia, a fish called the strömling, which is nearly allied to the herring, being chiefly distinguished by its small size, is

caught in great numbers, and is dried and salted for distant markets. The molluscan fauna of the Baltic is chiefly made up of common shells of our own shores,—such as *Cardium*, *Mytilus*, and *Littorina*, which can bear an admixture of fresh water, together with several proper fresh-water shells, such as *Paludina*, *Neritina*, and *Lymnæa*; the marine types, however, being remarkable for their very small size, which is often not above one-third of their usual dimensions. There is an entire absence, except in the neighbourhood of the straits, of such essentially marine types as *Buccinum*, *Ostrea*, *Pecten*, *Patella*, and *Balanus*. It is interesting to remark that the Danish *Kjökkenmödding* contain abundance of oysters, and also of full-sized cockles, mussels, and periwinkles; from which it may be inferred that even within the human period the outside ocean had freer access to the basin of the Baltic than it has now,—probably through what is now the peninsula of Jutland, which seems at no remote period to have been an archipelago. (W. B. C.)

BALTIMORE, in Maryland, one of the largest and most flourishing cities in the United States of North America, is situated on the north side of the Patapsco River or Bay, 14 miles above its entrance into the Chesapeake, 37 miles N.E. of Washington and 100 S.W. of Philadelphia. Lat.



Ground-Plan of Baltimore.

1. Northern Central Railway Station.
2. Mount Clare do.
3. Camden do.
4. St Mary's College.
5. Baltimore College.
6. Prison.
7. Penitentiary.
8. City Hall.
9. Washington Monument.
10. Battle Monument.
11. Hospital.
12. Lazaretto and Lighthouse.

39° 17′ N., long. 76° 36′ W. The natural advantages of this position were long overlooked by the settlers in the vicinity of the Chesapeake; and it was only in 1729 that they directed their attention to the place, and laid out a plan of the town. At that time a part of it was under cultivation as a farm, but all the rest was a wilderness. For some years its growth was by no means rapid, as it had to contend with all the obstacles that could be thrown in its way by the jealousy of older rivals. From an authentic sketch of Baltimore made in the year 1752, it appears that it then contained about twenty-five houses, only four of which were built of brick, the rest being of a more primitive structure. In 1768 it became the county town; and in 1775, according to a census then taken, it contained 564 houses, and 5934 inhabitants. From this time it rose rapidly into importance; and in 1780 became a port of entry, when a custom-house was opened. Previous to this all vessels trading to and from the port had to be entered, cleared, and registered at Annapolis. In December 1796 it obtained an act of incorporation. By the census of 1870 Baltimore contained 267,854 inhabitants.

The city is pleasantly situated on slightly undulating ground, and extends about 4½ miles from E. to W., and 3½ from N. to S., covering an area of 10,000 acres. It is divided into two nearly equal parts by a small stream called Jones's Falls, crossed by a number of bridges. The division east of the falls is nominally subdivided into two parts—Fell's Point and Old Town. The former, the most easterly part of the town, is the principal resort of seamen, and is the place where the shipbuilding and manufactures are principally carried on. The Old Town lies to the N. and W. of this. The portion west of the Falls is likewise divided into two parts, the city proper and Spring Garden. The former is the centre of trade, and the residence of the more wealthy inhabitants; while the latter, which is the extreme south-western quarter, and the lowest and most unhealthy portion of the city, is inhabited by the poorer classes. Baltimore contains about 200 churches, and has Building three universities, several colleges, 122 public schools, a state normal school, a manual labour school, besides numerous private schools and academies, an academy of art and science, an infirmary, hospitals, asylums, dispensaries, &c., three theatres, an opera-house, a museum, and many fine public buildings. The most imposing building in the city is the new city hall, one of the finest structures of the kind in the country. It occupies an entire square of ground, an area of about 26,000 square feet, near the centre of the city, and contains the various municipal offices. The style of architecture is the Renaissance, of which it is a fine specimen. The entire outer facing of the walls, the portico, and all the ornamental work, are of white Maryland marble; the inner walls and floors are of brick, and are fire-proof. It is four stories high, surmounted by a Mansard roof of iron and slate, with a dome and tower of iron on a marble base, rising to the height of 240 feet. The interior is very finely finished. It was begun in 1867, and cost about $2,600,000. Another important public building is that of the Peabody Institute, founded by the late George Peabody, Esq., of London, and endowed by him to the amount of $1,400,000. It has provisions for a public library, a gallery of art, and a conservatory of music, also for lectures and musical performances. It was incorporated in 1857. One wing of the building, which is immediately contiguous to the Washington monument, is completed, and the remainder is in progress. The completed wing is faced and ornamented with white marble, in a simple but massive and imposing style, and contains the library of over 56,000 volumes (1875), and a hall for lectures, concerts, &c. The custom-house is a spacious building, 225 feet long, by 141 feet wide. The principal room is 53 feet square, and is lighted by a dome 115 feet above the street. On its four sides are colonnades, the columns of which are each a single block of fine Italian marble. Baltimore has several splen- Monuments did monuments, which have acquired for it the name of "the Monumental City." The largest of these, erected to the memory of Washington, stands on an eminence of 150 feet, and has, with its base, an altitude of 200 feet. It is of white marble; the base is 50 feet square, and 24 feet in height, surmounted by a Doric column 25 feet in diameter at the base, with a spiral staircase in its interior, and on the summit is a statue of Washington, 13 feet high. The "Battle Monument," also of white marble, was erected by public subscription in 1815, to the memory of those who had fallen in defence of the city in the previous year. It is 52 feet high; the base is of Egyptian architecture; the column is in the form of a bundle of Roman fasces, upon the bands of which are inscribed the names of those whom it commemorates; and the whole is surmounted by a female figure, the emblematical genius of the city. The city