Tilbury, consisting of blue clay with peaty bands, above sand and gravel, strongly resembles those given by Prof. Sollas of the alluvial deposits of the estuary of the Severn; the amount of subsidence, as shown by the present position of the lower peaty band, being also nearly the same. Mr. Holmes considered the notions promulgated in the brief newspaper reports regarding the antiquity of the remains to be entirely misleading. If any strata were entitled to be styled "recent," those at Tilbury must be so; for their deposition would now be going on but for the embankment of the Thames during the Roman occupation of Britain. Yet the newspaper reports described these beds by the extremely vague term "Pleistocene," while the skeleton was styled "Palæolithic." The remains of man, however, have been found in alluvial deposits fifty feet above the present level of the Thames, and remains found in such beds must be immensely more ancient than any discovered in recent alluvium. Geological position furnishes the only absolute test of relative age. The test of association with extinct mammalia is largely dependent on negative evidence. A hint on this point was given by the results of the drainage of Haarlem Lake thirty years ago. Excellent sections were made in all directions across its bed, and carefully examined by skilled geologists. Hundreds of men were known to have perished in its waters three centuries before, and it had always been the centre of a considerable population. Yet no human bones were found, though works of art were. Thus hundreds or even thousands of mammalia, incapable of producing works of art, might be interred in particular strata, and yet leave no signs whatever of their former existence two or three centuries afterwards. And, on the other hand, were extinct mammalia present in the Tilbury Dock beds no additional antiquity would thereby be conferred on the beds themselves, but the period at which the animals became extinct would be shown to be later than had been supposed. Similarly as regards the rude implements known as Palæolithic; their presence could confer no antiquity on recent beds. Still, as the skeleton was found thirty-two feet below the surface, in alluvium that has received no additions since Roman times, it is unquestionably prehistoric. And the extreme rarity of prehistoric human skeletons gives to this discovery an interest greater than could have been claimed for that of a bushel of flint implements. The age of the Tilbury skeleton may possibly be not far removed from that of the Neanderthal man, to which it is said to have a strong resemblance: a resemblance which, if as great as it is stated to be, goes far to show that we have in each a normal type of prehistoric man.

At the same meeting a communication from Mr. Worthington G. Smith was read. Mr. Smith stated that he had seen the skeleton, and specimens of the sand in which it was found. Palæolithic sands with fossil bones and stone implements occur about a mile to the north of Tilbury, and with these Mr. Smith was well acquainted. The Palæolithic sand is quite different in colour from the Tilbury sand, and the former swarms with fossil shells of land and freshwater mollusks. As far as could be seen no such shells were present in the Tilbury sand sent to the British Museum. Mr. Smith's specimens of fossil bones from the Palæolithic sand were in an entirely different mineral condition from the bones of the Tilbury skeleton, and he could trace no resemblance whatever either in sand or bones. Mr. Smith made this statement with great deference to the opinion of Sir Richard Owen, and confessed that a Palæolithic skeleton might have been washed from the high ground to the low, and got into the mineral state of the Tilbury skeleton, although at present there was no evidence of anything of the sort having taken place. His opinion was that there was no proof of the Palæolithic age of the Tilbury relic.

NOTES ON THE VOLCANIC ERUPTION OF MOUNT ST. AUGUSTIN, ALASKA, OCTOBER 6, 1883[1]

ON the western side of the entrance to Cook's Inlet (forty-five miles wide) lies Cape Douglas; and to the northward of the cape the shore recedes over twenty miles, forming the Bay of Kamishak. In the northern part of this bay lies the Island of Chernaboura ("black-brown"), otherwise called Augustin Island. It is eight or nine miles in diameter, and near its north-eastern part rises to a peak, called by Cook Mount St. Augustin. As laid down by Tebenkoff, the island is nearly round. The northern shores are high, rocky, and forbidding, and are bordered by vast numbers of rocks and hidden dangers. The southern shore is comparatively low.

Mount St. Augustin was discovered and named by Capt. Cook, May 26, 1778; and he describes it as having "a conical figure, and of very considerable height." In 1794 Puget describes it as—

"A very remarkable mountain, rising with a uniform ascent from the shores to its lofty summit, which is nearly perpendicular to the centre of the island, inclining somewhat to its eastern side. . . . Towards the seaside it is very low, from whence it rises, though regular, with a rather steep ascent, and forms a lofty, uniform, and conical mountain, presenting nearly the same appearance from every point of view, and clothed with snow and ice, through which neither tree nor shrub were seen to protrude; so that, if it did produce any, they must either have been very small, or the snow must have been sufficiently deep to have concealed them."

At that time there were native hunters, under the direction of two Russians, hunting or living in the vicinity of the north-eastern point of the island.

Vancouver placed the peak of this mountain in latitude 59° 22′; Tebenkoff places it in latitude 59° 24′.

The peak of St. Augustin is distant forty-nine miles nearly due west (true) from the settlement on the southern point of Port Graham, or, as it is sometimes called, English Harbour. This harbour is situated on the eastern side of Cook's Inlet, near Cape Elizabeth.

In connection with the fall of pumice-dust at Iliuliuk on October 16, 1883, it may be of interest to observe that the peak of Augustin is over 700 miles to the north-eastward of Bogosloff Island off Unalashka.

About eight o'clock on the morning of October 6, 1883, the weather being beautifully clear, the wind light from the south-westward (compass), and the tide at dead low water, the settlers and fishing parties at English Harbour heard a heavy report to windward (Augustin bearing south-west by west three-fourths west by compass). So clear was the atmosphere that the opposite or north-western coast of the inlet was in clear view at a distance of more than sixty miles.

When the heavy explosion was heard, vast and dense volumes of smoke were seen rolling out of the summit of St. Augustin, and moving to the north-eastward (or up the inlet) under the influence of the lower stratum of wind; and, at the same time (according to the statements of a hunting-party of natives in Kamishak Bay), a column of white vapour arose from the sea near the island, slowly ascending, and gradually blending with the clouds. The sea was also greatly agitated and boiling, making it impossible for boats to land upon or to leave the island.

From English Harbour (Port Graham) it was noticed that the columns of smoke, as they gradually rose, spread over the visible heavens, and obscured the sky, doubtless under the influence of a higher current (probably north or north-east). Fine pumice-dust soon began to fall, but gently, some of it being very fine, and some very soft, without grit.

At about 8.25 a.m., or twenty-five minutes after the great eruption, a great "earthquake-wave," estimated as from twenty-five to thirty feet high, came upon Port Graham like a wall of water. It carried off all the fishing-boats from the point, and deluged the houses. This was followed at intervals of about five minutes, by two other large waves, estimated at eighteen and fifteen feet; and during the day several large and irregular waves came into the harbour. The first wave took all the boats into the harbour, the receding wave swept them back again to the inlet, and they were finally stranded. Fortunately it was low water, or all of the people at the settlement must inevitably have been lost. The tides rise and fall about fourteen feet.

These earthquake-waves were felt at Kadiak, and are doubtless recorded on the register of the Coast Survey tide-gauge at that place. Also the pumice-ashes fell to the depth of four or five inches, and a specimen of the deposit was given to the tidal observer at St. Paul. It will be interesting to compare these ashes with those collected at Iliuliuk on October 16, and which, from a confusion of dates, were supposed to have come from the new Bogosloff volcanic island. I am of the opinion that they came from St. Augustin.

The condition of the Island of Augustin or Chernaboura, according to the latest accounts, is this:—

At night, from a distance of fifty or sixty miles, flames can be

[1] From *Science*.

seen issuing from the summit of the volcano; and in the daytime vast volumes of smoke roll from it. Upon nearer approach from English Harbour it was found that the mountain had been split in two from peak to base by a great rupture extending across it from east to west, and that the northern slope of the mountain had sunk away to the level of the northern cliff.[1] This is corroborated by the statement of the hunting-party in Kamishak Bay. Smoke issued from the peak at a very short distance to the southward of the rupture.

The party of natives on Kamishak did not approach the islet, though they gave clear and distinct accounts of its eruption and subsequent appearance; but Capt. C. T. Sands, who was at English Harbour, gave the Alaska Company a full description; and Capt Cullie, of the *Kodiak*, states that, if there were plenty of water in the line of rupture, it would be possible for a vessel to sail through. At the time of Capt. Sands' observations the low ground of the island was visible, and seemed to be a vast crater, from which smoke and flames were issuing.

But beyond all these phenomena, apart from the volcanic eruption and the rupture of the island, we have the report of Capt. Cullie, of the schooner *Kodiak* (from whom we also obtain a statement in regard to the rupture), who approached the island from English Harbour on November 10, and found that a new island about a mile and a half long and seventy-five feet high, had been upheaved in the ten-fathom passage between Augustin and the mainland to the westward. This passage is from six to eight miles wide, and was sailed through by Puget in Vancouver's voyages of discovery.

This new island (also reported by the hunting-party in Kamishak) would appear to have arisen during the late volcanic activity. It lies to the north-westward of Chernaboura Island (Augustin), and was distinctly seen from the *Kodiak*, as that vessel lay ten miles to the north-eastward, and had clear weather.

To show the violence of the volcanic convulsions at this time, two extinct volcanoes on the Alaska peninsula, which are reported to be about west (true) from the active volcano Iliamna (twelve thousand feet high), had burst into activity; and during the day volumes of smoke were distinctly seen, and columns of flame at night. Usually, at that season, Augustin and the peak are covered with deep snow. On November 10, however, when Capt. Cullie approached the island, while there was a depth of four feet of snow at Port Graham (English Harbour), Mount St. Augustin was bare and black.

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THE ORIGIN OF THE SCENERY OF THE BRITISH ISLANDS[2]

THE Plains of Britain, like those elsewhere, must be regarded as local base-levels of denudation, that is, areas where, on the whole, denudation has ceased, or at least has become much less than deposit. Probably in all cases the areas they occupy have been levelled by denudation. Usually a greater or less depth of detrital material has been spread over them, and it is the level surface of these superficial accumulations that forms the plain. But in some instances, such as the flats of the Weald Clay and the Chalk of Salisbury Plain, there is hardly any such cover of detritus, the denuded surface of underlying rock forming the actual surface of the plain. Our plains, if classed according to the circumstances of their origin, may be conveniently regarded as (1) river plains—strips of meadow-land bordering the streams, and not infrequently rising in a succession of terraces to a considerable height above the present level of the water; (2) lake plains—tracts of arable ground occupying the sites of former lakes, and of which the number is ever on the increase; (3) marine plains—mostly flat selvages of alluvial ground, formed of materials originally laid down as a littoral marine deposit when the land lay below its present level: in the northern estuaries these up-raised sea-beds spread out as broad carse-lands, such as those of the Tay, Forth, and Clyde; (4) glacial drift plains—tracts over which the clays, sands, and gravels of the Ice Age form the existing surface; (5) submarine plains—the present floor of the North Sea and of the Irish Sea, which must be regarded as essentially part of the terrestrial area of Europe.

When plains remain stationary in level, they may continue for an indefinite period with no material change of surface. But, should they be upraised, the elevation, by increasing the slope of the streams, augments their erosive power, and enables them once more to deepen their channels. Hence, plains like that of the New Forest, which have been deeply trenched by the water-courses that traverse them, may with probability be assigned to a time when the land stood at a lower level than it occupies at present. In this connection the successive river-terraces of the country deserve attention. They may be due not to the mere unaided work of the rivers, but to the cooperation of successive uplifts. It would be an interesting inquiry to correlate the various river-terraces throughout the country, for the purpose of discovering whether they throw any light on the conditions under which the most recent uprise of the country took place. That the elevation proceeded intermittently, with long pauses between the movements, is shown by the succession of raised beaches. It may be possible to establish a somewhat similar proof among our river-terraces.

The submarine plains are by far the most extensive within the British area. In the case of the North Sea the tendency of tidal scour and deposit must modify the form of the bottom. This great basin of water is obviously being slowly filled up by the deposit of sediment over its floor. A vast amount of mud and silt is borne into it by the rivers of Western Europe, as well as by those that drain the eastern and larger part of Britain, and the sea itself is cutting away the land on both sides and swallowing up the waste. We have only to contrast the colour of the Atlantic on the west of Ireland or Scotland with that of the North Sea to be assured of the wide diffusion of fine mud in the water of the latter. There is practically no outlet for the detritus that is thus poured into the basin of the North Sea. From the north a vast body of tidal water enters between Scotland and Norway, and travelling southward, aided by the strong northerly winds, sweeps the detritus in the same direction. On the other hand, another narrower and shallower tidal stream enters from the Strait of Dover, and, aided by the south-west winds, drives the sediment northward. Yet, making every allowance for the banks and shoals which this accumulating deposit has already formed, we can still, without much difficulty, recognise the broader features of the old land-surface that now lies submerged beneath the North Sea. It presents two plains, of which the southern has an average level of perhaps a little more than 100 feet below the surface of the water. This upper plain ends northward in a shelving bank, probably the prolongation of the Jurassic escarpment of Yorkshire, and is succeeded by the far wider northern plain, which lies from 100 to 150 feet lower, and gradually slopes northward. As mentioned in a previous lecture, the drainage-lines of the united Rhine, Thames, &c., on the one side, and the Elbe, Weser, &c., on the other, can still be partially traced on the sea-floor. The Irish Sea was probably, in its later history, a plain dotted with lakes. It appears to have been submerged before the whole of the present fauna and flora had reached Ireland.

Some of the most characteristic and charming scenery of the British Islands is to be found along their varied sea-board. Coast-scenery appears to depend for its distinctive features upon (1) the form of the ground at the time when by emergence or submergence the present level was established; (2) the composition and structure of the shore-rocks; (3) the direction of the prevalent winds, and the relative potency of subaërial and marine denudation. The British coast-line presents three distinct phases: in many places it is retreating; in others it is advancing; while in a few it may be regarded as practically stationary. As examples of retreat, the shores of a large part of the east of England may be cited. In Holderness, for instance, a strip of land more than a mile broad has been carried away during the last eight centuries. Even since the Ordnance Survey maps were published, thirty-three years ago, somewhere about 500 feet have in some places been removed, the rate of demolition being here and there as much as five yards in a year. The advance of the coast takes place chiefly in sheltered bays, or behind or in front of projecting headlands and piers, and is due in large measure to the deposit of material which has been removed by the sea from adjoining shores. The amount of land thus added does not compensate for the quantity carried away, so that the total result is a perceptible annual loss. The best examples of a stationary coast-line where there is no appre-

[1] Capt. Cullie's account.

[2] Abstract of fifth and concluding lecture by Archibald Geikie, F.R.S., Director-General of the Geological Survey, given at the Royal Institution, March 3. Continued from p. 420.