HALLSANDS AND START BAY.

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(Read at Launceston, 29th July, 1969.)

PART II. HALLSANDS.

WHEN writing the paper on "Hallsands and Start Bay," published in Vol. XXXVI of our *Transactions*, I had to state, as regarding the amount of shingle removed by Sir John Jackson :—

"We know very well when and where the dredging took place, but as to the actual amount removed no certain information is available."

This uncertainty no longer exists. In Vol. CLXXII of the *Proceedings of the Institution of Civil Engineers* are papers by Sir Whately Eliot, Resident Superintending Civil Engineer, and Mr. G. H. Scott, contractor's agent and engineer, descriptive of the works at Keyham. Mr. Scott states (p. 40) that the shingle was loaded into barges each carrying 800 to 900 cubic yards, by means of suction dredgers capable in good weather of filling a barge in one hour and a half.

From Sir Whately Eliot I learn, in reply to an inquiry on another matter, that at least 600 barge-loads were taken from Hallsands and delivered at Keyham. If we set each barge-load at 850 cubic yards, this gives us 510,000 cubic yards of beach as a minimum so removed. In my paper above mentioned I adopted a provisional estimate of 500,000 cubic yards, a close approximation. There is therefore no necessity to vary in any way the calculations which I founded on my previous assumption.

Sir Whately Eliot also kindly informs me that, as the result of an examination of each cargo of beach material, it was found that the shingle from Hallsands contained

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33 per cent of sand capable of passing a sieve of 100 meshes per square inch (sand grains practically $\frac{1}{10}$ inch diameter and under), and that when freed from sand the interstitial spaces in the shingle were found to amount to 35.5 per cent. Hence it is evident that the sand originally fully filled the interstices of the shingle. This agrees with my own observations on the material immediately below the surface of the beach.

Six sections of the beach were published with my last paper, and on each was shown the level attained on 13 July, 1903, this being the date of highest foreshore subsequent to the dredging. On 12 July, 1907, I again surveyed these same section lines; this was the date on which the Committee of the Royal Commission on Coast Erosion visited Hallsands; and on 12 December, 1908, I once more surveyed the four northern sections. Time was not available to enable me to examine in detail the southern sections (5 and 6). On both these dates the beach had attained, and for some time previously maintained, positions of maximum elevation. Especially was the shingle at its greatest foreshore development on 12 December, 1908, when the low-water gradients toward the southern end of Hallsands were steeper than ever previously recorded.

The annexed sections give the comparison 1903-1907-1908. As a general result of these surveys I find that the shingle is rearranging its distribution to a slight extent, and the beach at Greenstraight is growing or has grown at the expense of the beach in front of the village. In 1903, as is now evident, the excavation made by the dredgers off Greenstraight had not yet robbed the beach lying southward to the full extent that was yet to be. If we say that Greenstraight has since recovered an additional 1 ft. 3 in. in height, and the extreme south of the village has consequently lost about 1 ft. 9 in. in height of beach, this would probably be a fair statement of fact. And one conclusion from my sections admits no question : between 13 July, 1903, and 12 December, 1908, no addition, even of the smallest, has been made to the total quantity of shingle between the Hare Stone and Tinsey Head. Five years and five months have passed without any indication of a recovery of the loss at Hallsands.

The sections above referred to are : Sec. 1, sixty feet south of bridge at Greenstraight; Sec. 2, in line of



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northern face of old lime-kiln; Sec. 3, in line of southern face of northernmost house of village; Sec. 4, immediately north of Wilson's Rock; Sec. 5, in line of south end wall of southern house of old London Inn block; Sec. 6, southern end of village. The variations of the surface of the shingle, averaged over the whole extent of each section above low-water mark, are given in the following table :--

	Variation,	1903–1907.	Variation, 1907–1908.	Variation, 1903-1908.			
Sec. 1. Sec. 2. Sec. 3. Sec. 4. Sec. 5. Sec. 6.	Gain. 0' 9.8"	Loss, 0' 0.5" 1' 7" 0' 1.9" 1' 0" 1' 10.6"	Gain. 0' 4:4" 0' 5:8" 0' 7" 0' 5:4" Not obs. Not obs.	Gain. 1' 3·2" 0' 5·3" 0' 3·5" Not obs. Not obs.	Loss. 1' 0" Not obs. Not obs.		

As regarding Section 4, there was no real gain, but rather a loss, between 1907 and 1908, the beach, although slightly higher, being coincidently thirteen feet narrower; and this same restriction in width certainly extended to Sections 5 and 6, although I cannot there give exact figures.

BLACKPOOL.

I have recently had cause to make a detailed examination of the beach at Blackpool, a beach from which, I am glad to say, the removal of shingle is now totally prohibited by order of the Board of Trade. A similar prohibition should, to my mind, be extended to all the beaches in Start Bay.

Blackpool Sands front somewhat east of south ; their total length along low-water mark is about 1950 feet, and they lie embayed between Matthew's Point to the west and an unnamed headland to the east. The distance between these headlands is about 2400 feet, and the depth of the embayment, measured to ordinary high-water mark, is 850 feet.

These sands occupy a place in history as the reputed landing point of the French when, in 1404, Du Chastel attacked Dartmouth and suffered grievous defeat.

In 1869, the shingle having been stripped from the beach by a storm, certain gold and other coins were found on this shore. These Mr. A. R. Hunt recorded in our *Transactions* in 1873; and although some were of French origin, the fact that dates as late as 1465–1483 were represented makes it impossible that they should be relics of Du Chastel's adventure. Mr. Hunt's suggestion that some formed part of the treasure of Warwick's fleet in 1470 is, at least, a very probable explanation of their presence, and if correct constitutes another link of Blackpool beach with the history of our land.

Blackpool Sands are, to all intents, isolated from the other beaches of the Start Bay. They correspond with Slapton Sands and Hallsands in that they form the seaward defence of a low-lying valley, the surface of which is little above high water. Across the mouth of this valley the beach extends as a barrier, rising some feet above the general level of the land behind it.

From time to time exceptional gales have had the effect of driving the sand and shingle away from one or other end of the beach, and piling it up at the farther end, or in some cases of withdrawing it from at or below high water and distributing it at or below low water. Such disturbances of the sand and shingle expose at times the remains of a submerged forest, clays, peat, and tree trunks.

The dates on which such occurrences have taken place appear to have been the year 1802, another date some fifty years later, again in 1869, and yet again, after an interval of sixteen years, in 1881. The latest stripping took place in 1903, and Mr. R. L. Newman then secured a photograph of the exposed submerged forest, which he has kindly permitted me to use for the illustration of this paper.

Mr. A. R. Hunt has described the stripping of this beach as it occurred in April, 1881. The eastern end was then denuded of its sand and shingle, and apparently about twelve feet in depth of its materials were removed, the footing of the sea wall was laid bare, and the wall itself was damaged. The material removed from the eastern end had been piled up at the western, and so far as Mr. Hunt could judge the additional depth there created amounted to sixteen feet or thereabouts of sand.

The wall, to which reference is made above, bears at its western end the following inscription. "This Sea Wall— Planned by Thos. H. Newman, Esq., of Blackpool, and constructed by H. Wills, of Strete, under the superin-



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tendence of Mr. Michelmore, of Berry, Totnes, was commenced in 1860 and finished in 1873. Total length 1823 feet, average height 16 feet, average thickness at foundation 6 feet."

It was so placed that the grass-grown summit-levels of the old beach lay behind it, while for about 700 feet at the eastern end it fronts and protects the cliff; here, of course, it was built at the shoreward limit of the beach. The foundation is for the more part on the materials of the submerged forest beds, and hence an exposure of these by the occasional fall of the beach has usually been followed by considerable damage to the wall.

If the foundation is at times exposed, on the other hand the sand and shingle sometimes rise to within one foot of the top of the wall, but never throughout its whole length at once. They stood at this height when I visited the spot on the 14th August, 1908. It follows that against the wall there is from time to time a variation of at least fifteen to sixteen feet in the level of the beach.

On the same date I observed the gradients of the beach. At high-water mark of that day the gradient was 1 in $4\frac{1}{2}$, and this passed through a decreasing range to a fall of 1 in 6 at low-water mark. Above high water, and separated from it by a narrow level surface, was an old fall of the beach, which had a gradient of 1 in $2\frac{5}{3}$, probably the steepest at which this sand and shingle would naturally dispose itself.

On the whole the material is distinctly smaller in size than at Hallsands, but I have not estimated the proportion of finer and coarser on this beach, or taken any measures for accurately comparing it with the Hallsands shingle. Much fine gravel is, however, to be found on the foreshore at Blackpool of a grade which is practically confined to parts below low water at Hallsands.

The fine gravel I have graded through sieves with round holes, with the following result, the percentages being expressed by weight.

Particles	over 15 mm	per cent. . 4.9	
,,	under 15 mm., over 5 mi	n 9.6	
,,	under 5 mm., over $2\frac{1}{2}$ mm	45.9	
,,	under $2\frac{1}{2}$ mm., over 1 mm	39.1	
,,	under 1 mm	5	

This is by no means a fine sand, the smallest particles, under 1 mm., are almost entirely small chips of the local slate, chips of flint, and fragments of shell.

The fine gravel, of which the mechanical constitution is given above, was also examined lithologically. For this purpose it was divided into two parts, the particles which were left on the sieve having round holes $\frac{3}{20}$ of an inch in diameter, and the particles which passed through such sieve. The analyses expressed as original rocks are as follows, percentages being expressed by weight :—

Quartz		2.2		10.01	1994		54.6
Flint					fines 1	-	23.4
Devonian		2076	14,10				9.4
Dartmoor		31.7	ta b				12.1
Organic	2.11	.80	21.1	ingar.	E 7,014	1 1	0.5

Analysis B. Particles under $\frac{3}{20}$ inch.

Quartz						per cent.
Flint		30.0			1997 T	25.0
Devonian	100		al tine	- Sine		13.6
Dartmoor	14	1.0	200	Dana	11	9.0
Organic	1940		19. 1		di la	present

100.0

In each analysis it was found practically impossible, except with undue labour, to ascertain precisely how much of the quartz sand was of local origin, and how much came from Dartmoor, but a fair proportion has obviously been derived from the latter source. Materials definitely classed as "Dartmoor" are all either felsites or quartzschorl rocks of highly distinctive character.

"Devonian" comprises small tabular fragments of the local slates, and a much less proportion of particles of local igneous rock, conveniently termed "diabase."

Something more than half the fine material is certainly foreign to the locality.

Two hundred and fifty pebbles taken from the beach were also examined; these were not picked up by myself, and accordingly any unconscious geological choice was

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avoided. In size they ranged from about $1\frac{1}{4}$ inches to about 4 inches in greatest diameter, the majority measuring between $2\frac{1}{4}$ and $2\frac{1}{2}$ inches. This collection also was analysed lithologically.

Analysis C. Pebbles of from $1\frac{1}{4}$ to 4 inches greater diameter.

Devonian fissile s	lates.	soft a	nd in	thin :	flat s	tones	per cent. 14·2
Vein-quartz from	the]	Devor	nian s	lates	-	in out	27.0
Devonian igneou	s (dia	base)	-	ny dh	ingen i	na, iti ji	6.0
Quartzites, foreig	n to t	he loo	cality			101,120	16.5
Flint			0.13				35.6
Dartmoor Rocks							0.7
							100.0

This analysis gives 47.2 per cent of rocks derivable from the adjacent cliffs, and 52.8 per cent foreign material. But in reality the proportion of local rocks, effective as beach-forming material, is considerably less, since the Devonian slates are mere temporary constituents, liable to total destruction after a brief succession of stormy days.

The average weight of the pebbles included in this collection of 250 was 1.95 ounces, and the quartzites were the largest, averaging 3.14 ounces, although much more thoroughly rounded than the vein-quartz pebbles, which averaged only 1.95 ounces. The average of the flints was 1.64 ounces.

While at Hallsands there is little cliff capable of yielding much material for beach formation, at Blackpool the cliffs are not only of a different and more easily broken rock, but have long been much more fully exposed to the waves. None the less, in all the time which has elapsed since the forest was submerged, they have not been able to supply sufficient material, by way of replacement of wear and tear, to constitute one-half the total beach. Wear and tear, as aforesaid, has so far reduced the beach that it is not now, and has not for at least a hundred years past, been sufficient to ensure that the substratum on which it rests shall be protected from marine erosion. From time to time the clays and peat of the submerged forest are exposed, and each time some small part is removed, lowering the foundation of the beach. Here too, as at Hallsands, the adjacent sea-bed is no possible recruiting ground for a shingle beach.

At Hallsands and at Blackpool I have now had reason to thoroughly examine the beaches; Slapton Sands I have somewhat more casually examined, but find them more closely resembling the first-named. The evidence is abundant and clear that the whole of Start Bay is fronted with shingle of foreign origin, and that any loss to its total quantity is permanent.

It is also clear that a flint and felsite beach, once its constituents are well water-worn and rounded, is a singularly permanent institution. But Blackpool proves that it does in fact wear out by natural agencies, aided by occasional human interference, and must, sooner or later, become an inadequate protection to the coast, and Hallsands proves that any artificial abstraction in this way is a permanent loss.

Notwithstanding which determined facts, the beach material at Slapton is still for sale, and may be purchased in cartloads from the local Rural District Council. Is it too much to hope that wiser counsels may yet prevail, and slight present convenience be sacrificed to avoid future permanent loss?

Once let the beach at Slapton cease to be an adequate protection to the coast, and a main road as well as very many acres of arable land will be destroyed by the sea, while Slapton Lea will cease to exist. A beginning has been made in a correct policy in closing Blackpool to all shingle seekers, and the extension of this closure to the whole bay would be a wise step, necessary to the protection of the land. A Royal Commission is sitting which is inquiring into the defence of the shore from erosion, and at the same time no one moves to ensure that Nature's provision for the protection of our Devon coast be maintained.