

G E O L O G Y

The Surtsey Eruption  
Course of events and the development of  
Surtsey and other new islands

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Introduction.

As stated in my former report (SRPR I, pp. 51-55) my main contribution to the research work connected with the Surtsey eruption has been to follow the different phases and changing habits of the eruption and also to study the changes of the island(s) due to the destructive forces, mainly marine abrasion.

As before I have enjoyed the helpfulness of the Director of the Coast Guard Service, Pétur Sigurdsson, and the Director General of Aviation, Agnar Kofoed Hansen, when I needed a trip to the eruption area.

Since my first report was written I have made nearly 40 reconnoitring flights over the Surtsey area and been on Surtsey eleven times. As to the course of events I have received much valuable information from the pilot Sigurjón Einarsson, who has been over Surtsey 200 times since the eruption started. Another pilot who has given me a lot of information is Björn Pálsson. The two men working in the control tower of the Vestmannaeyjar airfield, Bjarni Herjólfsson and Skarphéðinn Vilmundarson, have on my request kept a diary about the behavior of the eruption.

Aerial mapping.

Using the Coast Guard Service's aircraft SIF, the Icelandic Survey Department has aerialphotographed Surtsey and adjacent areas nine times, viz.: Febr. 17, 1964; April 11, 1964; June 16, 1964; Aug. 25, 1964; Dec. 15, 1964; Febr. 23, 1965;

April 21, 1965; Aug. 24, 1965; Febr. 6, 1966. The maps here reproduced are based on these aerial photos and on a trigonometric survey carried out in Surtsey by the Survey Department during the summer of 1965.

#### Course of events.

When I wrote my previous report in late February 1965, the effusion activity was still going on in Surtsey. It continued until the middle of May 1965. Lava was for the last time seen flowing in Surtsey May 17. The total area of the lava flow above sea level was then 1.53 km<sup>2</sup> and the area of Surtsey 2.45 km<sup>2</sup>. The height of the lava dome was then practically the same as it had been Oct. 23, 1964, the dome proper 100 m high and the highest point of the crater rim 118 m. The total volume of lava, including its submarine part, consisting to a great extent of hyaloclastites (pseudotephra), pillow lava and pillow lava breccia, can only be roughly estimated as we still lack bathymetric maps. A likely estimate is 250 a 300 million m<sup>3</sup>, corresponding to an average volume increase of 7 a 8 m<sup>3</sup>/sec. during the 13 1/2 months of effusive activity. Although varying considerably from day to day the lava flow on the whole gradually diminished throughout the winter of 1964/65. During the last months of effusive activity the average flow hardly exceeded 3 m<sup>3</sup>/sec.

#### The Syrtlingur phase.

No sooner had the activity in Surtsey come to an end than there were signs of submarine activity 0.6 km ENE of the island. May 22 (possibly already May 11) vapour was seen rising from this place. May 28 the submarine cone, which was in progress protruded the sea level for the first time. The tiny spot visible seemed to consist of lava lumps and not of scoria and lapill. June 6 the island was 16 m high, its diam. 170 m. This island was washed away the following days, but became visible again

June 14. June 16 its height was 37 m and its max. diam. 190 m. Aug. 24 its height was 45 m, max. diam. 420 m and its area 0.08 km<sup>2</sup>. Sept. 15 its height was 67 m, max. diam. about 650 m, and its area about 0.15 km<sup>2</sup>. Two days later its height probably exceeded 70 m, but from then on the destructive forces, mainly the marine abrasion began to get the better of the constructive ones. The eruption kept on, although on a gradually diminishing scale and the volcano was last seen in action Oct. 17, but after a very stormy week it had completely disappeared Oct. 24, and no activity has later been observed in this place.

The island never got an official name, but it was popularly called Syrtlingur, that is little Surtur. Its activity was strikingly similar to that of Surtsey during its explosive phase, although on a much smaller scale, periods of intermittent explosions alternating irregularly with continuous uprush. Fig. 1 shows a typical activity in Syrtlingur. During the most powerful uprush paroxysms the tephra columns reached about 700 m height. Tephra was spread all around. When the activity of Syrtlingur ended the thickness of the tephralayer on the northeasternmost part of Surtsey was 3.5 m, but on the southwesternmost part of the lava flow it was only 2 cm. The total volume of tephra produced by the Syrtlingur activity, the socle of the island included, is of the order of 50 mill. m<sup>3</sup>, corresponding to an average production of 4 m<sup>3</sup>/sec. during the 5 months its activity lasted. This is roughly one tenth of the productivity of Surtsey during its first months.

#### Activity SW of Surtsey.

On Dec. 26, 1965, submarine volcanic activity was for the first time observed about half a naut. mile SW of Surtsey. The ridge that was piled up there protruded the sea surface for the first time Dec. 28, and since then a small island has repeatedly disappeared and reappeared. It has reached a max. height of

about 40 m and a max. length of 250 m. Its activity was of the same type as Syrtlingur, but was on a still smaller scale. The max. height of tephra-columns observed was about 250 m. Febr. 24, when this is written, the eruption is still going on.

The total volume of tephra and lava produced by the two Surtur vents and other vents that have been active in the adjacent area has now exceeded  $0.8 \text{ km}^3$ . The eruption is now the second largest recorded in Iceland since the settlement 1100 years ago, only the "Mývatn Fires" 1725-1729 did last longer.

The Surtsey activity has shifted at least four times to a new vent (fissure). The distance between the NE-most and SW-most of these vents is 5 km, direction  $N65^\circ E$  —  $S65^\circ W$ , whereas the individual fissures seem to run about  $N25^\circ E$  —  $S25^\circ W$  and the system of eruption fissure thus seems to be arranged en échelon.

#### Area changes of Surtsey.

The map, Fig. 3, worked out by the Icelandic Survey Department, shows the outlines of Surtsey at various times. Table I is based on this map and on measurements of the diameter and height of the island carried out by officers on the coast guard vessels and supplemented by my photos. The figures before Febr. 17, 1964, cannot be regarded as accurate. The figures within brackets are based on the knowledge that there was practically no change of the area of Surtsey and its lava flow between the end of April and July 9, 1964, and between May 17 and Aug. 24, 1965.

The diagram, Fig. 4, is based on Table I and on measurements of the height of Surtsey carried out many times.

#### Studies on Surtsey.

Continued studies of the lava flow when it entered the sea strengthened the writer's impression of the rapid formation

of pseudotephra or hyaloclastites, which must constitute a considerable part of the submarine part of the advancing lava flow. The similarity between Surtsey and the glacial tablemountains of Iceland and the tuyas of British Columbia is obvious. The main difference seems to be that Surtsey was built up in an open and often stormy sea which for months was constantly breaking through the crater ring and flooding the vent and thereby prolonging the phreatic explosive activity of the volcano, whereas the tablemountains were piled up in calm water. Consequently airborne pyroclastics (tephra) are likely to constitute a proportionately much greater part of oceanic tablemountains than the glacial ones.

My geomorphological studies in Surtsey during the summer of 1965 were similar to those carried out before, viz. studies of the increasing roundness of blocks and gravels, studies of the changing profiles of the lava shore etc. The thickness of the tephra layer from Syrtlingur was measured several times all over the island. The material has not yet been worked out in any detail.

Text of figures

- Fig. 1. Typical explosive (phreatic) activity in Syrtlingur.  
1. Small. 2. Medium size. 3. Big explosions. 4. Nearly continuous uprush. 5. Continuous uprush. 6. No observations.
- Fig. 2. Surtsey and Syrtlingur Aug. 24, 1965. Shaded: Lava covered area. The Icelandic Survey Department.
- Fig. 3. The changing outlines of Surtsey according to aerial photographic mapping by the Icelandic Survey Department.
- Fig. 4. Diagram showing the area increase of Surtsey and its lava flow and the increasing height of the island.

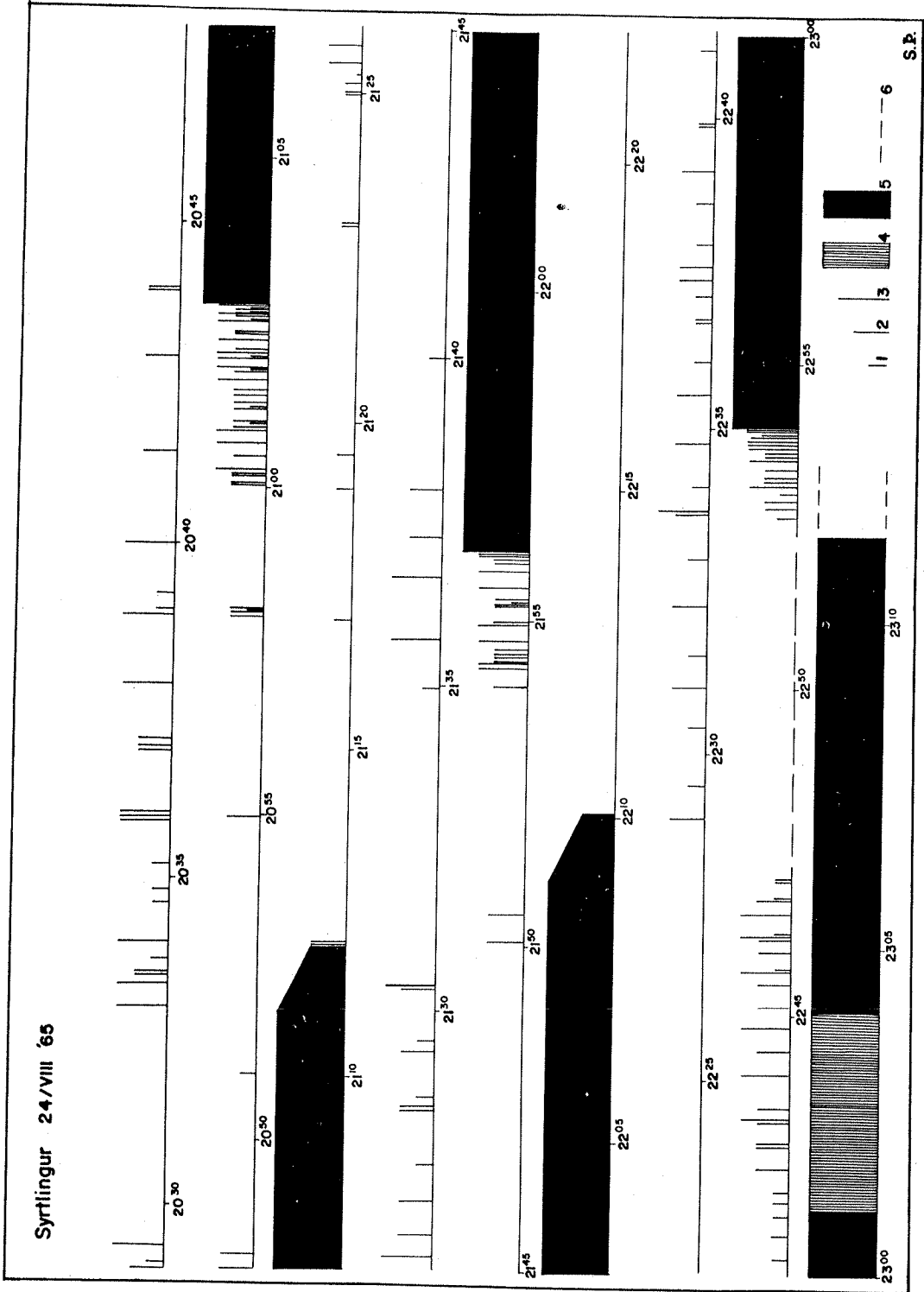
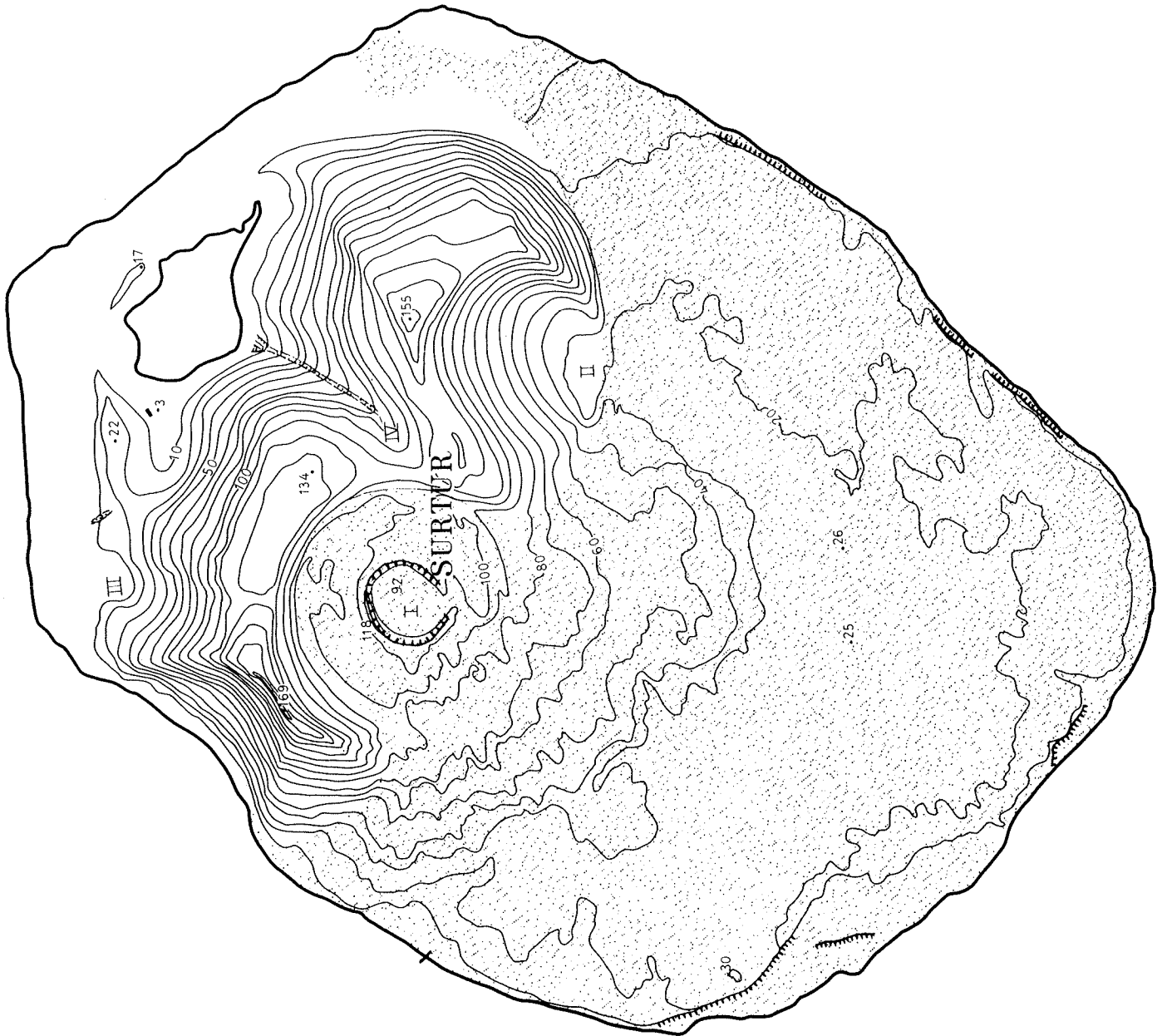
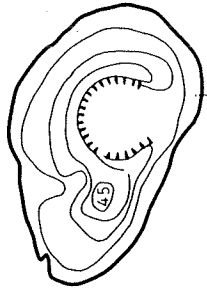




Fig. 2

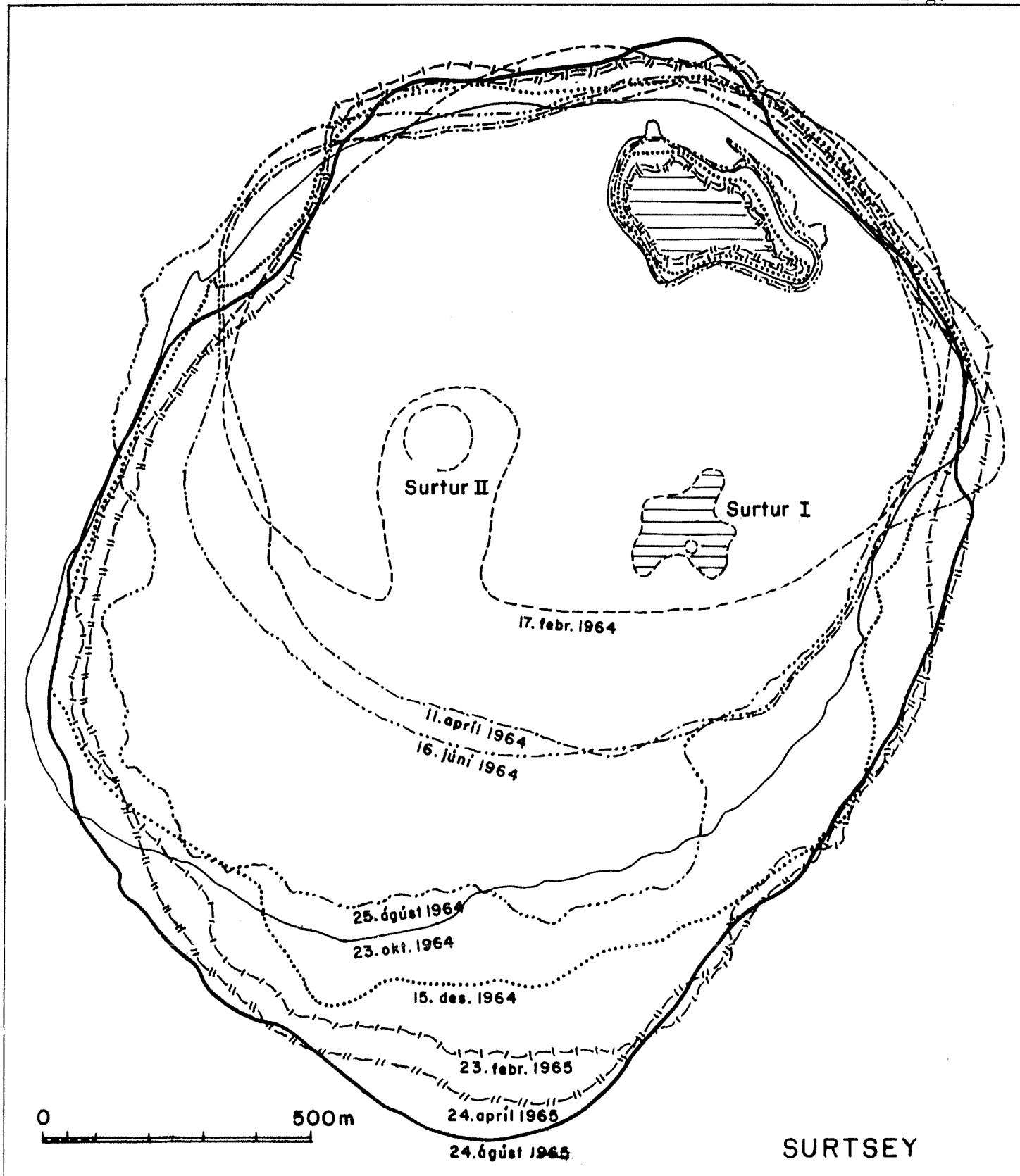


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Fig. 3



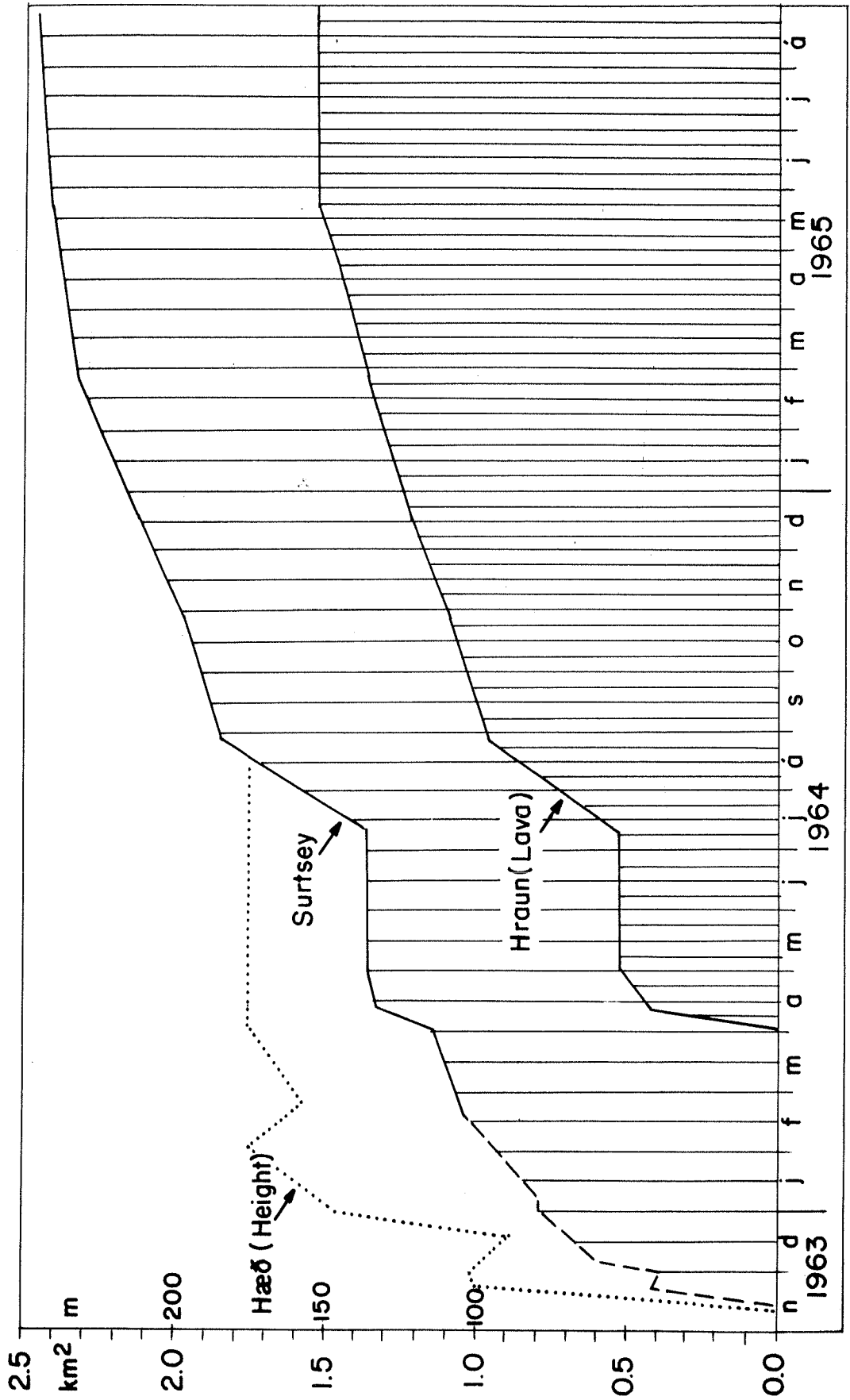
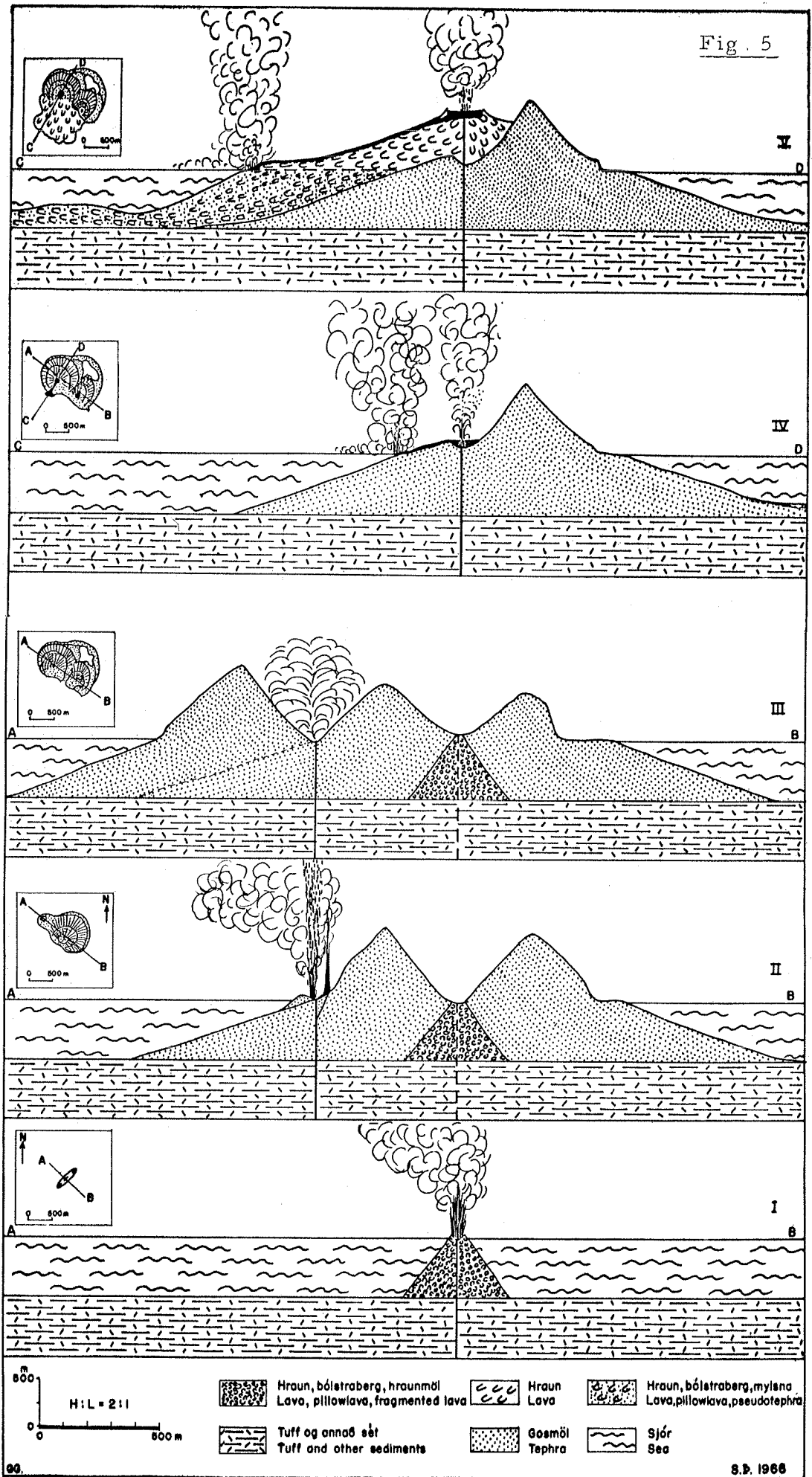


Fig. 5



Sections, somewhat schematized, illustrating the development of Surtsey. I. Nov. 15, 1963; II. Febr. 5, 1964; III. End of March, 1964; IV. April 4, 1964; V. Aug. 25, 1964.

TABLE IArea changes of Surtsey and its lava flow in hectares.

	Total area ha	Increase ha	Increase ha/day	Lava ha	Increase ha	Increase ha/day
1963:15. nóv.	0					
16. "	8	8	8.00			
20. "	40	32	8.00			
1. des.	37	- 3	- 0.30			
7. "	60	23	3.30			
1964:31. jan.	90	30	0.55			
17. feb.	102	12	0.70			
4. apr.	115	13	0.30	0		
11. "	133	18	2.50	42	42	6.05
30. " (137)		4	0.20	42	8	0.40
16. júní	137	0	0.00	(50)	0	0.00
9. júlí (137)		0	0.00	50	0	0.00
25. ág.	182	45	0.95	(50)	46	0.95
23. okt.	196	14	0.25	96	14	0.25
15. des.	213	17	0.30	110	13	0.25
1965:23. feb.	234	21	0.30	123	14	0.20
24. apr.	236	2	0.05	137	9	0.15
17. maí (245)		9	0.40	146	7	0.30
24. ág.	245	0	0.00	(153)	0	0.00