CICATRIZATION OF WOUNDS.

III. The Relation between the Age of the Patient, the Area of the Wound, and the Index of Cicatrization.

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The observation of many wounds in the process of cicatrization, on patients of different ages, has shown that there is a proportional relation between the age of the patient, the area of the wound, and the index calculated by means of the formula

$$(1) \qquad \frac{\frac{S - S'}{S}}{i + \sqrt{T}} = i$$

In other words, one of these quantities may be considered a continuous function of the other two.

A chart has been plotted, and from the curves thus obtained, the intermediate points may be computed without calculation (Text-fig. 1). The index, the only unknown quantity, may thus be obtained directly. It then becomes unnecessary to take two measurements of the wound, 4 days apart, S and S', and one no longer needs to calculate the index i by Formula 1. On the other hand, it is evident that the index is purely theoretical, or rather an average index, which expresses normal cicatrization on a normal individual, and that marked differences may be observed between the index of a given individual, according to his general condition, and the index of the average individual of the same age.

In the course of many experiments it was found that, as a rule, the average, or normal index, was practically the same as the calculated index. Table I shows some of the figures used in making the curves.

TABLE I.

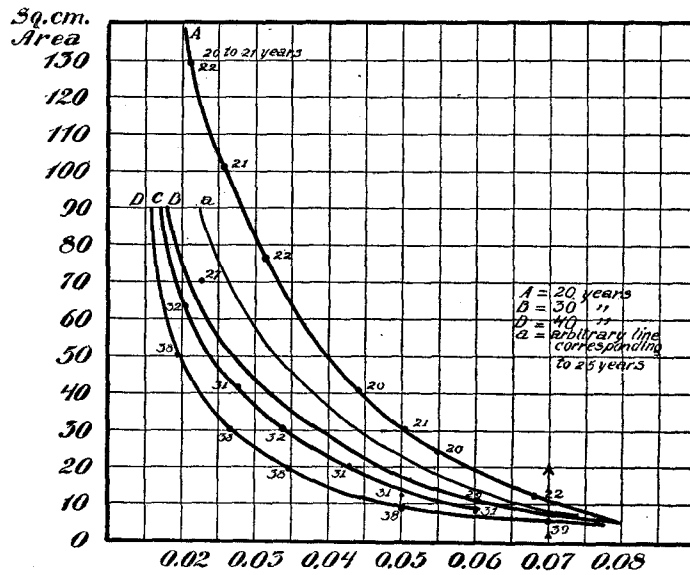| Area.		Index.	Age.	No. of patient.	Similar observations (No. of patient).
sq. cm.			*yrs.*		
130—	......				
	129	0.0236	22	360	
125 —	......				
120—	......				
	118	0.021	36	263	
115 —	......				
110—	......				
105 —	......	0.022	35	269	
100—	101	0.0264	21	327	
95 —	......				
90—	......				
85 —	......				
80—	......				
75 —	.. ...				
70—	......	0.0225	27	366	
65 —	......				
	64	0.020	32	318	
60—	......				
55 —	......				
50—	......				
	46	0.0223	38	408	
45 —	......				
40—	......	0.0445	20	361	
35 —	......	0.031	33	266	
30—	......	0.05	21	Ja. (75)	444
-					
-					
-	•	·			
25 —	......	0.03	38	408	383
-					
-					
20—	......				
-					
-	16	0.057	27	221	289, 300, 336
15 —	......	0.046	37	217	408, 403, 450
-					
-	12	0.068	22	256	
10—	......	0.065	29	289	479, 415, 366 (2 experiments).
-					
-	7	0.060	31	330	
5 —	......	0.070	39	354	
-					
-	2	0.070	30	286	409 (2 experiments).
0—	......				

The figures show that the index is generally small for the larger wounds (about 0 020), that it increases for the smaller wounds, and that, the area of the wounds being the same, young individuals have the largest index. Since the index indicates the activity of cicatrization, the formula may be expressed:
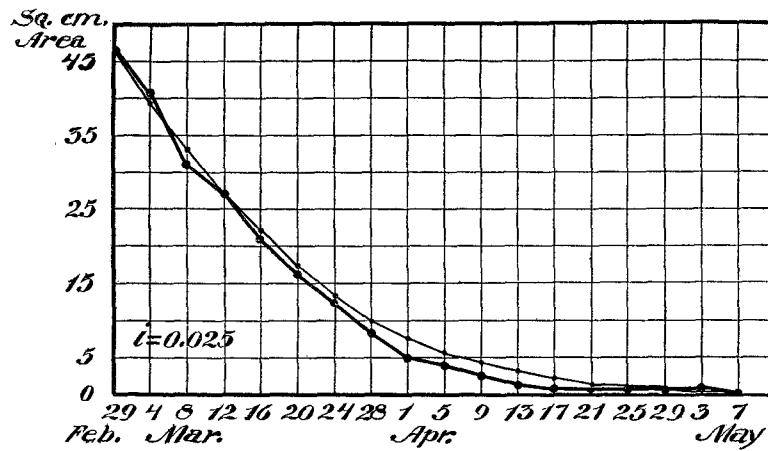
$$\frac{ds}{dt} = f(A, i)$$

in which A is the age of the patient; S, the area of the wound; i, the index. The curves representing the ages are of the general form: $S^a \times i = K$ (K being a constant).

Text-fig. 1 has been plotted from thirty-five observations of wounds, taken at the beginning of sterilization.

The curves in Text-figs. 2 to 9 have been calculated by means of the index given in Text-fig. 1.

TEXT-FIG. 1. Composite curve for obtaining index directly.

——— observed curve.

——— calculated curve.

TEXT-FIG. 2.

Experiment 23.—Patient 318, age 32 years (Text-fig. 2).   Index = 0.02.

	1916 Feb. 6	10	14	18	22	26	Mar. 1	5	9	13	17
Observed area.	56.6	44.3	42.0	33.6	30.2	24.2	22.1	17.0	13.6	11.0	9.2
Calculated "		49.1	42.0	35.4	29.7	24.9	20.1	16.4	13.2	10.5	8.3

	Mar. 21	25	29	Apr. 2	6	10	14
Observed area	6.5	4.2	3.1	1.8	1.15	0.8	Cicatrization.
Calculated "	6.6	4.3	3.1	1.8	0.70	0.2	"

TEXT-FIG. 3.

Experiment 27.—Patient 408, age 38 years (Text-fig. 3).   Wound of the thigh.
Index = 0.025.

	1916 Feb. 29	Mar. 4	8	12	16	20	24	28	Apr. 1	5
Observed area......	46.7	40.5	31.1	27.0	21.1	16.0	12.5	8.3	5.0	4.0
Calculated "		39.7	32.9	26.8	21.4	16.9	13.1	10.0	7.5	5.6

	Apr. 9	13	17	21	25	29	May 3	7
Observed area.......	2.3	1.4	1.0	1.0	0.9	0.5	0.7	Cicatrization.
Calculated "	4.2	3.1	2.2	1.6	1.1	0.8	0.6	"
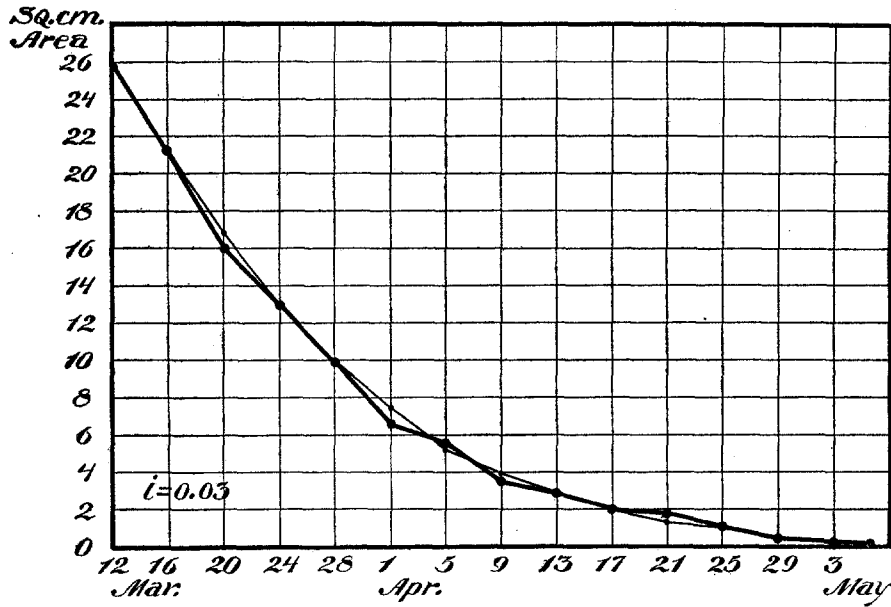
TEXT-FIG. 4.

*Experiment 28.*—Patient 408, age 38 years (Text-fig. 4). Wound of the arm. Index = 0.03.

	1916 Mar. 12	16	20	24	28	Apr. 1	5	9	13	17	21
Observed area.	25.8	21.1	16.0	13.0	9.9	6.5	5.6	3.6	2.7	2.0	1.7
Calculated "		21.1	16.8	13.0	9.9	7.4	5.4	3.9	2.7	1.9	1.3

	Apr. 25	29	May 3	7
Observed area................................	0.9	0.5	0.3	Cicatrization.
Calculated "	0.88	0.59	0.4	"
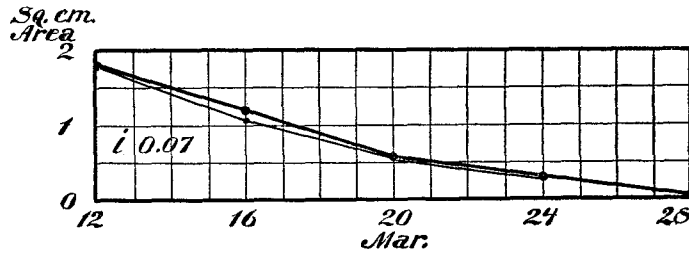
TEXT-FIG. 5.

*Experiment 29.*—Patient 408, age 38 years (Text-fig. 5). Wound of the arm.
Index = 0.07.

	1916 Mar. 12	16	20	24	28
Observed area	1.8	1.2	0.6	0.3	Cicatrization.
Calculated "		1.05	0.55	0.27	"
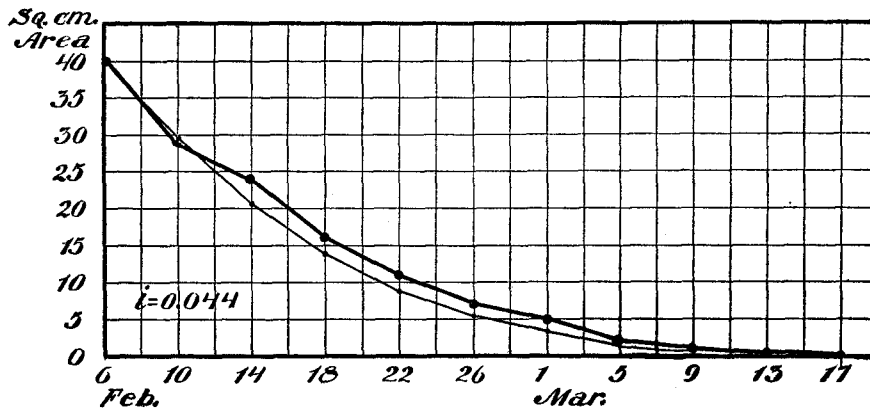
TEXT-FIG. 6.

Experiment 30.—Patient 361, age 20 years (Text-fig. 6). Wound of the back.
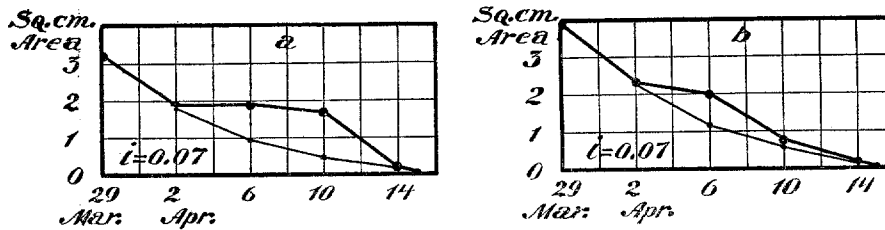Index = 0.044. Wound infected.

	1916 Feb. 6	10	14	18	22	26	Mar. 1	5	9	13	17
Observed area	40.0	29.3	24.0	16.0	11.0	7.1	5.0	2.0	1.0	0.65	Cicatrization.
Calculated "		29.4	20.5	13.7	8.9	5.5	3.3	1.8	1.1	0.64	"
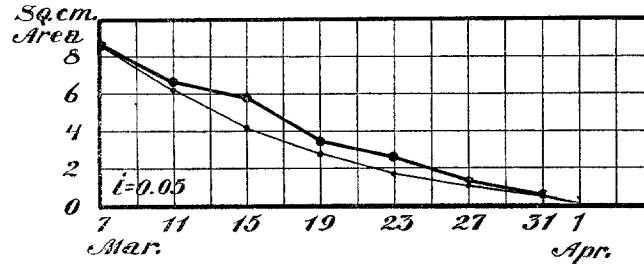
TEXT-FIG. 7.

Experiment 31.—Patient 403, age 40 years (Text-fig. 7).   Index = 0.05.

	1916 Mar. 7	11	15	19	23	27	31	Apr. 1
Observed area	8.7	6.6	5.6	3.4	2.5	1.2	0.5	Cicatrization.
Calculated "		6.1	4.1	2.8	1.7	1.0	0.5	"

TEXT-FIG. 8.

Experiments 32 and 33.—Patient 366, age 27 years (Text-fig. 8).   Index = 0.07

Wound A.

	1916 Mar. 29	Apr. 2	6	10	14	15
Observed area	3.2	1.9	1.9	1.7	0.2	Cicatrization.
Calculated "		1.85	0.96	0.46	0.21	"

Wound B.

	1916 Mar. 29	Apr. 2	6	10	14	15
Observed area	3.9	2.3	2.0	0.75	0.2	Cicatrization.
Calculated "		2.25	1.2	0.56	0.25	"
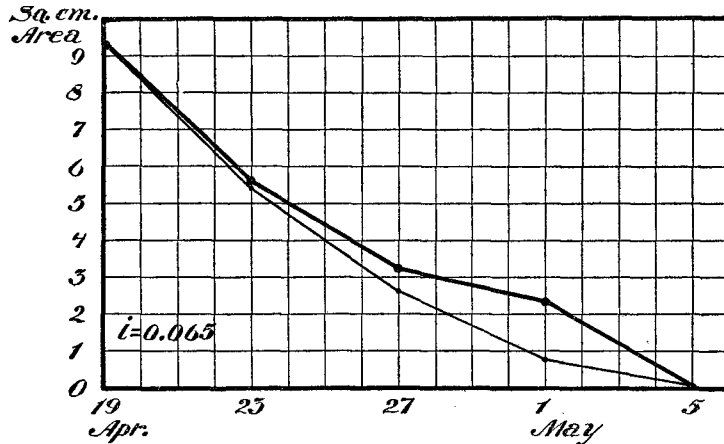
TEXT-FIG. 9.

Experiment 34.—Patient 415, age 31 years (Text-fig. 9). Index = 0.065.

	1916 Apr. 19	23	27	May 1	5
Observed area	9.3	5.6	3.2	2.3	Cicatrization.
Calculated "		5.4	2.6	0.72	"

SUMMARY.

The first article of this series showed that it was possible to express mathematically the phenomenon of cicatrization. The principal point consisted in determining by means of an equation, a constant, or index, characterizing each wound. The calculation had to be made for each patient for each wound, and required two observations, 4 days apart.

The index having proved to be a continuous function of the size of the wound and of the age of the patient, of the form

$$S^a \times i = K$$

where S is the area, i the index, a a decimal exponent, and K a constant, it was then possible to draw a chart by means of which this index i could be obtained without calculation.

The advantage of the new way of determining the index is, above all, that this index is a general, average, normal index, and no longer an individual index. Hence, the differences between the observed

rate of cicatrization of man and the normal rate may give some in-
dication of the general state of the patient.   Another advantage is
that the determination of the index is no longer controlled by the
temporary accidents which may happen between the two observa-
tions of S and S'.