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RCC7.960518.001

# ARCTIC AEROMEDICAL Laboratory

THE BODY SURFACE AREA OF ESKIMOS AS  
DETERMINED BY THE LINEAR AND THE  
HEIGHT-WEIGHT FORMULAS

PROJECT NUMBER 22-1301-0001  
PART I

LADD AIR FORCE BASE  
ALASKA

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**THE BODY SURFACE AREA OF ESKIMOS AS  
DETERMINED BY THE LINEAR AND THE  
HEIGHT-WEIGHT FORMULAS**

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**PROJECT NUMBER 22-1301-0001  
PART I**

**ARCTIC AEROMEDICAL LABORATORY  
LADD AIR FORCE BASE, ALASKA  
May 1952**

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**PRECIS****OBJECT:**

It has been suggested that the DuBois-DuBois height-weight formula for the estimation of body surface area, when utilized for the calculation of basal metabolic rates, may not be applicable for the Eskimo race. This would introduce an error in the calculation of the results which might partially explain the high basal metabolic rates usually observed in Eskimos. The purpose of this study was therefore to determine whether the height-weight formula is applicable to the Eskimo, as part of a series of comprehensive studies on Eskimo metabolism.

**SUMMARY AND CONCLUSIONS:**

The body surface area has been determined by the DuBois linear method in 53 Eskimos of both sexes from 5 different localities in Alaska. The average difference between the linear and the height-weight formula was  $\pm 1.3\%$ ; the maximum difference was 3.8%. On an average the height-weight formula gave results which were 0.9% higher than the results obtained by the linear method. This is within the limit of accuracy claimed for the height-weight chart, and is therefore insignificant. The Eskimos have relatively larger trunks, heads and hands than the whites. It may thus be concluded that the height-weight formula is also applicable to the Eskimo, and that the use of this formula does not cause any significant error in the calculation of the basal metabolic rates of this race.

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## THE BODY SURFACE AREA OF ESKIMOS AS DETERMINED BY THE LINEAR AND THE HEIGHT-WEIGHT FORMULAS

### I. Introduction.

In discussing the basal metabolic rates in Eskimos, it has been suggested by several workers (1,2) that the DuBois-DuBois height-weight formula, when utilized for the calculation of body surface area, may not be applicable for the Eskimo. This would introduce an error in the calculation of the results, which might partly explain the high basal metabolic rates usually observed in the Eskimo.

Small errors in the DuBois-DuBois height-weight formula, as applied to the Chinese and Japanese, have been reported (3). Necheles and Loo (4) found the height-weight formula on the average 4.4% higher for the Chinese, and concluded that it was not necessary to alter the constants of the DuBois-DuBois height-weight and linear formulas for the Chinese. Waddell, Han and Chen (5) observed in their series of 74 Chinese subjects a maximum variation between the two methods of 4.2%, the average being  $\pm 1.25\%$ , which is about the same as is found among Europeans and Americans.

According to DuBois (3), Stevenson measured the surface of 10 Chinese using both the linear and height-weight formulas. The totals obtained by adding the surface of different parts according to the linear formula agreed closely with the results calculated according to the height-weight formula. This, however, was due to a fortuitous compensation between errors in different regions, and Stevenson has suggested a new set of constants for the linear formula when applied to the Chinese.

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Takahira and Kitagawa (6) made careful measurements of 10 adult Japanese men and found the best results by using a constant for the height-weight formula of 72.46, which is 0.9% higher than the original constant. The method they used for their measurements is described as follows: "The hair was first cropped close to the head, and then paper was pasted on the nude body with water and then with 1% starch paste, and dried with a fan. When there was formed a thin filament over the body, it was removed. The surface of this was measured with a number 4 Amsler's planimeter. The planimeter gives a 0.2% error which was neglected, but the shrinking of the paper was corrected."

The surface areas for the different parts of the body in Whites, Chinese and Japanese are given in the authoritative monograph by Edith Boyd in table 1, pages 6 and 7 (8).

The actual body surface area of Eskimos has never been measured previously. Since surface area determined from weight in kilograms (Wt.) and height in centimeters (Ht.) according to the DuBois-DuBois height-weight formula:  $\text{Area (Sq. Cm.)} = \text{Wt.}^{0.425} \times \text{Ht.}^{0.725} \times 71.84$  (Fig. 6) is widely used as a standard of reference in the calculation of basal metabolic rates in Eskimos, it is necessary to ascertain whether or not the height-weight formula is applicable to the Eskimo race.

## II. Material.

In conjunction with a series of comprehensive studies of the metabolism in Eskimos, the body surface area has been carefully measured by the DuBois-DuBois linear method (7) in 53 Eskimos from 5 different locations in Alaska. The present paper reports the results of these measurements compared with the results obtained by the height-weight formula. All of the subjects, with two exceptions, were believed to be full-blooded

TABLE 1. BODY SURFACE AREA IN ESKIMOS

SUBJ NO.	NAME	SEX	AGE	WEIGHT Kg	HEIGHT Cm	LENGTH Cm	SURFACE AREA, M <sup>2</sup>			
							HT. WT.	L. WT.	LINEAR	
							DIFFERENCE IN PERCENT			
							$\frac{L_2 - L_1}{L_1} \times 100$			
							$\frac{HT_2 - HT_1}{HT_1} \times 100$			
							$\frac{WT_2 - WT_1}{WT_1} \times 100$			
1	(Barter Island) REXFORD, Mildred	F	34	84.0	157.5	157.5	1.85	1.86	-0.5%	-0.5%
2	AKOOTCHOOK, Eliz.	F	21	49.7	156.8	156.8	1.48	1.47	+0.7%	+0.7%
3	PUTUGOOK, Annie	F	32	64.6	162.6	163.2	1.70	1.67	+1.8%	+1.8%
4	AKOOTCHOOK, Mary	F	29	51.8	155.6	156.2	1.50	1.49	+0.7%	+0.7%
5	APAYAK, John	M	16	43.1	151.8	154.9	1.33	1.36	-2.2%	+2.2%
6	PUTUGOOK, Donald*	M	22	62.9	171.5	172.7	1.74	1.70	+2.3%	+3.0%
7	AKOOTCHOOK, Daniel	M	18	54.5	163.2	163.8	1.58	1.54	+2.6%	+2.6%
8	AKOOTCHOOK, George	M	19	56.3	160.0	161.0	1.58	1.54	+2.6%	+3.2%
9	AKOOTCHOOK, Isaac	M	29	71.7	165.1	165.7	1.80	1.83	-1.6%	-1.6%
10	REXFORD, Herman	M	35	64.7	160.0	160.1	1.68	1.71	-1.8%	-1.8%
	(Gambell)									
11	IKKOKINOK, Clifford	M	23	66.5	164.5	166.4	1.73	1.75	+1.8%	+2.9%
12	KANAHOK, Howard	M	38	58.6	163.2	165.1	1.63	1.64	+1.2%	+1.9%
13	ANINGAYOU, Norman	M	39	67.1	168.3	171.8	1.76	1.79	+1.7%	+3.5%
14	NAWPOKUOK, Leonard	M	19	61.2	167.0	169.9	1.70	1.71	+0.0%	+0.6%
15	IYAKITAN, Daniel	M	30	61.3	165.7	169.5	1.68	1.71	+2.4%	+4.3%
16	IYAKITAN, Lewis	M	25	62.9	163.8	164.8	1.69	1.68	+0.6%	+0.6%
17	ANTAGHAME, Jack	M	39	62.0	160.0	163.5	1.64	1.67	+0.0%	+1.8%

\* Half-breed

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TABLE 1. BODY SURFACE AREA IN ESKIMOS (Contin'd)

SUBJ No.	NAMES	SEX	AGE	WEIGHT KG	HEIGHT Cm	LENGTH Cm	HT. WT. WT.	SURFACE AREA, M <sup>2</sup>			DIFFERENCE IN PERCENT	
								L. WT.	LINEAR	L. WT-LIN x 100 Linear		
												L. WT-LIN x 100 Linear
18	SILOOK, Roger	M	27	69.9	167.6	169.2	1.79	1.80	1.75		+ 2.3%	+ 2.9%
19	SILOOK, Nolan	M	35	61.7	168.3	169.2	1.70	1.71	1.67		+ 1.8%	+ 2.4%
20	APPASSINGOK, Herbert	M	24	59.9	166.4	169.2	1.67	1.69	1.64		+ 1.8%	+ 3.0%
21	OOZEVOSEUK, Conrad	M	25	61.3	157.5	158.8	1.62	1.62	1.61		+ 0.6%	+ 0.6%
22	HARRY, Don	M	30	62.7	165.7	167.6	1.70	1.71	1.70		+ 0.0%	+ 1.1%
23	SLWOOXO, Howard	M	31	74.2	168.9	171.8	1.85	1.87	1.85		+ 1.1%	+ 2.3%
24	SLWOOXO, Roger	M	19	68.1	170.2	172.7	1.79	1.81	1.77		+ 1.1%	+ 1.7%
25	SLWOOXO, Joseph	M	24	65.4	167.6	169.9	1.74	1.76	1.73		+ 0.6%	+ 2.3%
26	JAMES, Winfred	M	27	67.5	168.5	169.9	1.77	1.78	1.74		+ 1.7%	+ 0.6%
27	IYAKITAN, Lene	M	21	59.9	167.0	168.9	1.68	1.69	1.68		+ 0.0%	+ 2.3%
28	WALUNGA, Willis	M	25	67.6	168.3	169.5	1.77	1.78	1.74		+ 1.7%	+ 2.3%
29	SLWOOXO, Vernon	M	33	70.1	168.9	170.8	1.80	1.83	1.80		+ 0.0%	+ 1.7%
30	CHAUNCEY, Woodrow	M	19	59.9	165.7	167.6	1.66	1.68	1.60		+ 3.8%	+ 5.0%
31	SLWOOXO, Beda	F	32	56.3	156.2	156.2	1.55	1.56	1.53		+ 1.3%	+ 2.0%
32	MALEGOOHTIK, Florence	F	44	57.2	152.4	153.4	1.52	1.53	1.48		+ 2.7%	+ 3.4%
33	OYAGLOK, Marcella	F	21	57.0	151.1	154.3	1.52	1.54	1.48		+ 2.7%	+ 4.1%
34	NAWPOKUHOK, Gall (Anaktuvuk Pass)	F	23	55.4	153.7	156.8	1.53	1.54	1.53		+ 0.0%	+ 0.7%
35	MEKIANA, Justus	M	22	60.8	165.5	167.0	1.67	1.68	1.66		+ 0.6%	+ 1.2%

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TABLE 1. BODY SURFACE AREA IN ESKIMOS (Contin'd)

SUBJ NO.	NAME	SEX	AGE	WEIGHT Kg	HEIGHT Cm	LENGTH Cm	HT. WT.	L. WT.	LINEAR HT. WT-LIN. x 100	LINEAR L. WT-LIN. x 100	SURFACE AREA, M <sup>2</sup> .	
											DIFFERENCE IN PERCENT	DIFFERENCE IN PERCENT
36	FULLUND, Johnny	M	22	59.0	160.0	161.3	1.61	1.62	1.59	1.63	+ 1.5%	+ 1.9%
37	ZACCHARIAS, Hugo	M	20	59.0	165.0	166.4	1.65	1.66	1.63	1.86	+ 1.2%	- 0.5%
38	MEKIANA, Homer (Kotzebue)	M	47	72.0	168.9	171.8	1.82	1.85	1.71	1.66	+ 2.3%	+ 2.9%
39	CURTIS, Diok	M	31	65.8	169.2	170.6	1.75	1.76	1.66	1.65	+ 1.2%	+ 1.8%
40	GOODWIN, Willie	M	36	62.2	162.5	165.4	1.67	1.68	1.70	1.70	+ 0.0%	+ 1.2%
41	SOURS, Marion	M	36	60.5	170.2	172.7	1.70	1.72	1.88	1.88	+ 0.0%	+ 1.5%
42	CURTIS, John*	M	35	71.7	177.8	180.3	1.88	1.91	1.68	1.68	+ 0.0%	+ 0.5%
43	SOURS, Eugene	M	40	61.3	167.0	168.3	1.68	1.69	1.55	1.55	+ 1.9%	+ 1.9%
44	ANALOAK, Mabel	F	24	59.0	156.2	156.2	1.58	1.58	1.72	1.72	+ 1.1%	+ 2.3%
45	KAGOONA, Janet	F	24	69.7	163.2	165.2	1.74	1.76	1.96	1.96	+ 0.0%	+ 1.0%
46	VESTAL, Dolly (Selawik)	F	53	90.6	162.6	165.1	1.96	1.98	1.78	1.78	+ 1.1%	+ 2.2%
47	BALLOT, Oscar	M	25	70.8	168.3	170.2	1.80	1.82	1.73	1.73	+ 0.5%	+ 1.1%
48	RAMOTH, Ralph	M	20	65.0	168.9	170.8	1.74	1.76	1.78	1.78	+ 1.1%	+ 2.2%
49	MITCHELL, Charlie	M	22	67.4	172.7	174.6	1.80	1.82	1.61	1.61	+ 3.1%	+ 4.3%
50	JONES, Jack	M	23	60.4	165.7	167.6	1.66	1.68	1.53	1.53	+ 1.9%	+ 3.2%
51	SMITH, Roy	M	26	54.5	161.9	164.0	1.56	1.58	1.70	1.70	- 0.5%	+ 0.5%
52.	CREIST, Stephen	M	35	63.7	162.6	166.0	1.69	1.71	1.60	1.60	+ 0.0%	+ 1.8%
	ROYGLOVE, Roy	M	22	56.9	163.2	166.5	1.60	1.63	1.60	1.60	+ 1.3%	+ 2.0%

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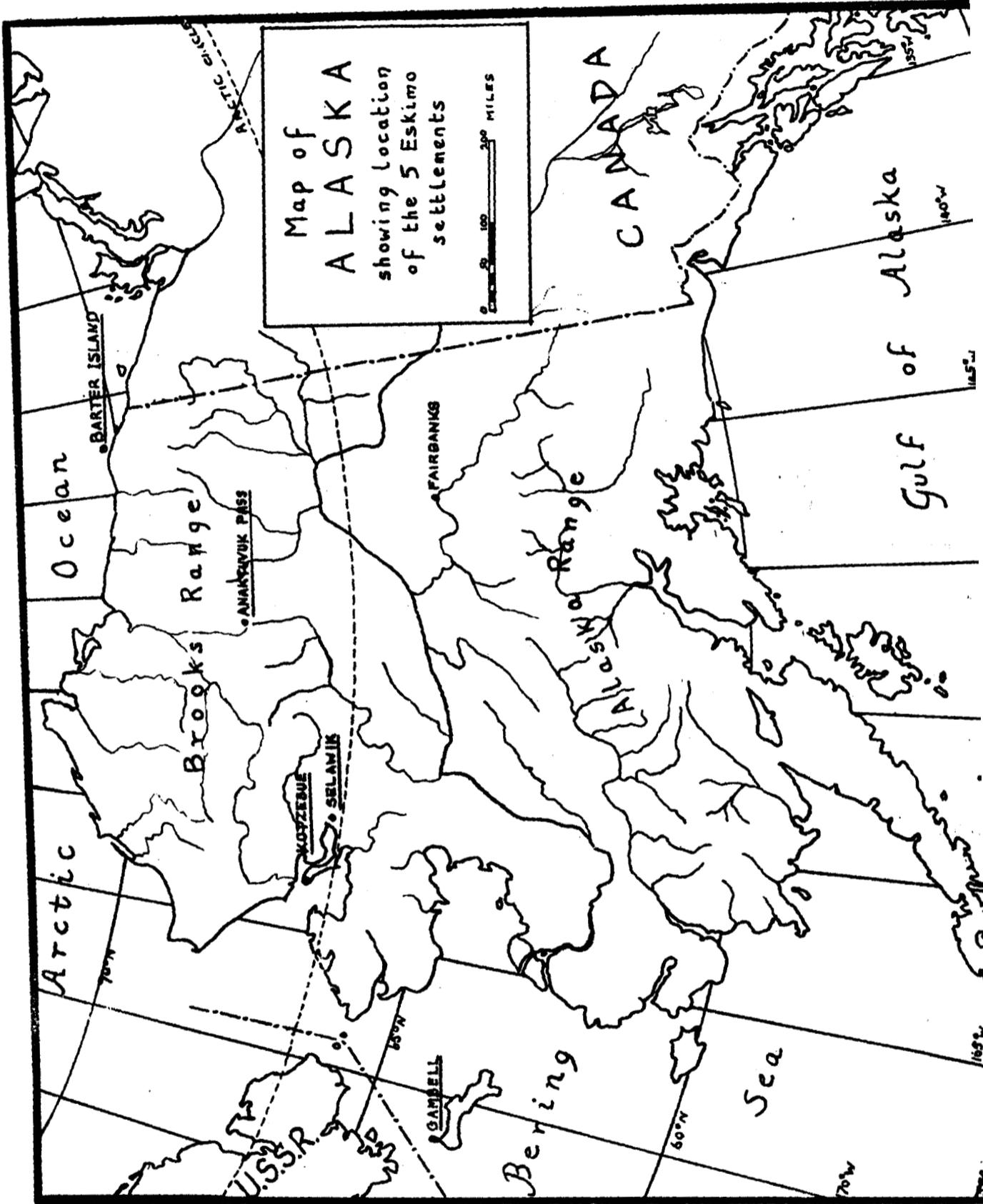
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Eskimos; 42 were males and 11 were females. Some typical subjects from the different groups are presented in Figs. 7 and 8. The age ranged from 16 to 53 years, but the majority were between 20 and 40 years of age, the average being 28. The study included the following groups of Eskimos: One group of 10 Eskimos came from Barter Island on the north coast of Alaska. A second group of 24 Eskimos lived at Gambell on St. Lawrence Island in the Bering Sea. A third group of 4 subjects came from Anaktuvuk Pass in the middle of the Brooks Range, 3000 feet above sea level. The fourth group, consisting of 8 Eskimos, were obtained from Kotzebue, and a final group of 7 came from Selawik on the west coast of Alaska. The above mentioned locations are indicated on the map in Fig. 1.

For the purpose of comparison, the surface area was measured in 7 Whites of similar age by the same investigators using identical technique.

### III. Method.

A great variety of methods are available for the measuring of surface area. Most of these, such as the covering method, geometric method, photographic method, integrator method or the electrical method, are complicated and time consuming. For the purpose of this study, the much simpler DuBois linear formula (7), which requires only about 15 minutes for each subject, was chosen. This method, which determines the average length and circumference of each part of the body, is probably the most accurate of the simplified methods of determining the surface area. Furthermore, we had the privilege of receiving personal guidance and instruction from Dr. E. F. DuBois, himself, for the measurements of our first subjects during his visit to our laboratory in February 1951.



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The method involves division of the surface of the body into several regions: head, arms, hands, trunk, thighs, legs, and feet, and the estimation of the area of each by measuring characteristic lengths and circumferences (Fig. 2), multiplying and correcting by means of factors (Fig. 3). The constants for arms, thighs, etc., when multiplied by the measurements of one side, give the surface of both sides. The total of the seven parts when added represent the total surface area. A sample of the DuBois' form used for the recording of the measurements, is reproduced in Fig. 4.

In all cases the subjects were measured lying on a flat table, stretched out with their legs close together (Fig. 5). The arms and legs on the right side were always measured. Both the height standing and height lying were carefully recorded for comparison, but for the final calculations only the height was used, since the height-weight formula is based upon the body height measured standing.

In some cases repeated measurements were made of the same subject as a check on the technique, and the results showed very close agreement. Furthermore, in a few cases measurements were made of the same Eskimo subject both in the winter and in the summer. The variations were found to be insignificant.

#### IV. Results.

From Table 1 it is observed that the average difference between the linear and the height-weight formula was  $\pm 1.3\%$  for Eskimos as against  $\pm 1.5\%$  for Whites reported by DuBois (7). The maximum difference was 3% in the Eskimos as against 5.0% in the Whites reported by DuBois (7). In 12 cases out of 53, the height-weight formula and the linear formula gave identical results. On an average the height-weight formula gave results

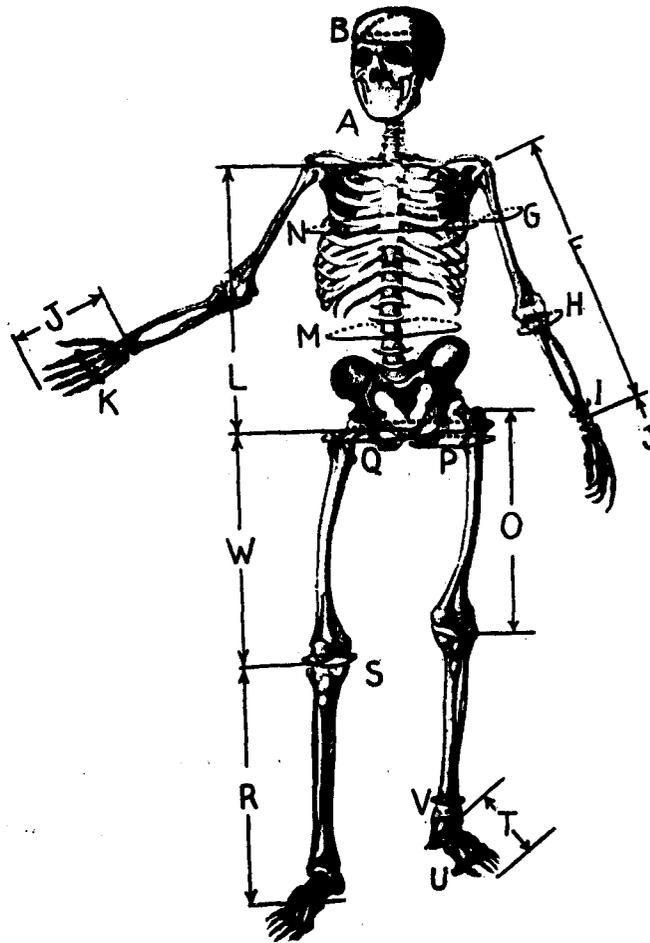


FIGURE 2

Measurements used in linear formula  
(taken from DuBois and DuBois (7)).

which were 0.9% higher than the results obtained by the linear method in the Eskimos. This is within the limit of accuracy claimed for the height-weight chart (7) and is therefore insignificant. In the 7 Whites measured by the same technique by the same investigators, the height-weight formula gave results which were on the average 1.9% higher than the linear formula (Table 2). The maximum difference in these Whites was 3.6% and in one case the two methods gave identical results.

In Eskimo women (11 subjects), the average difference between the height-weight formula and the linear formula was +1.1%. If the length

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## FIGURE 3

Measurements and constants for the linear formula.\*HEAD: AB 0.308.

- A - Around vertex and point of chin.
- B - Coronal circumference around occiput and forehead, just above eyebrows.

ARMS: F(G + H + I) 0.611

- F - Tip of acromial process to lower border of radius, measured with forearm extended.
- G - Circumference at level of upper border of axilla.
- H - Largest circumference of forearm (just below elbow).
- I - Smallest circumference of forearm (just above head of ulna).

HANDS: JK 2.22.

- J - Lower posterior border of radius to tip of second finger.
- K - Circumference of open hand at the metacarpophalangeal joints.

TRUNK (Including neck and external genitals in the male, breasts in female):  
L(M + N) 0.703.

- L - Suprasternal notch to upper border of pubes.
- M - Circumference of abdomen at level of umbilicus.
- N - Circumference of thorax at level of nipples in the male and just above breasts in the female.

THIGHS: W(P + Q) 0.552.

- W - Upper border of pubes to lower border patella (measured with legs straight and feet pointed anteroposteriorly).
- P - Circumference of thigh just below the level of perineum.
- Q - Circumference of hips and buttocks at the level of the great trochanter.

LEGS: RS 1.40.

- R - From sole of foot to lower border of patella.
- S - Circumference at level of lower border of patella.

FEET: T(U + V) 1.04

- T - Length of foot including great toe.
- U - Circumference of foot at base of little toe.
- V - Smallest circumference of ankle (just above malleoli).

\*Taken from DuBois and DuBois (7).

FIGURE 4.

LINEAR SURFACE AREA FORMULA

SUBJECT NO:..... GROUP:.....

NAME:.....SEX:.....DATE:.....

AGE:.....HEIGHT:.....in.....cm. WEIGHT: lb.....SURFACE AREA HT-WT:.....  
 LENGTH:.....in.....cm. kg.....SURFACE AREA LINEAR:.....

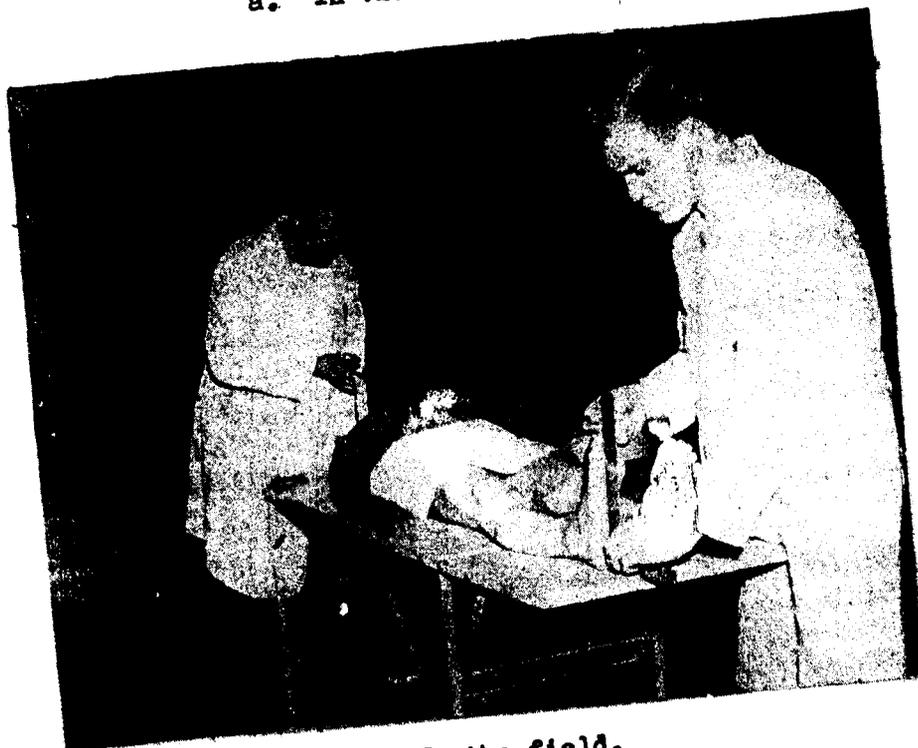
HEAD.	A. Vertex - Chin	.....	
	B. Circumference	.....	
	CONSTANT:		0.31
ARMS.	F. Acrom - Rad.	.....	
	G. Axilla	.....	
	H. Largest Forearm	.....	
	I. Smallest forearm	.....	
	CONSTANT:		0.61
HANDS.	J. Rad. - 2d finger	.....	
	K. Circumference	.....	
	CONSTANT:		2.22
TRUNK.	L. Supst.N. - Pubes	.....	
	M. Umbil.	.....	
	N. Nipples	.....	
	CONSTANT		0.70
THIGHS.	W. Pubes - Patella	.....	
	P. Thigh	.....	
	Q. Hips	.....	
	CONSTANT:		0.55
LEGS.	R. Sole - Patella	.....	
	S. Circumference Pat.	.....	
	CONSTANT:		1.40
FEET.	T. Length	.....	
	U. Base little toe	.....	
	V. Ankle	.....	
	CONSTANT:		1.04

TOTAL: \_\_\_\_\_

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a. In the laboratory.



b. In the field.

FIGURE 5

Showing the measurement of body surface area.

TABLE 2. BODY SURFACE AREA IN WHITES - At Ladd Air Force Base

SUBJ. NO.	NAME	SEX	AGE	WEIGHT Kg	HEIGHT Cm	LENGTH Cm	SURFACE AREA, M <sup>2</sup>				
							HT. WT.	L. WT.	LIN- EAR	DIFFERENCE IN PERCENT	
1	E.F.D.B.	M	68	75.8	176.0	179.7	1.92	1.95	1.91	+ 0.5	+ 2.0
2	K.E.B.	M	23	79.0	176.0	179.0	1.96	1.98	1.93	+ 1.6	+ 2.6
3	H.W.	M	21	62.0	174.0	175.0	1.75	1.76	1.72	+ 1.7	+ 2.3
4	F.L.O.	M	21	90.0	181.0	182.0	2.11	2.12	2.05	+ 2.9	+ 3.4
5	E.E.K.	M	19	73.0	178.0	180.0	1.92	1.93	1.92	+ 0.0	+ 0.5
6	L.C.L.	M	21	103.0	185.0	187.0	2.27	2.28	2.19	+ 3.6	+ 4.1
7	B.R.V.	M	21	63.0	168.0	170.0	1.71	1.73	1.66	+ 3.0	+ 4.2
	AVERAGE									+ 1.9%	+ 2.7%

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was used instead of height, the difference between the two formulas was +1.6%. In the 42 Eskimo men, the average difference between the height-weight and the linear formulas was +0.8%, and the difference between the "length-weight formula" and the linear formula was +1.8%.

Tables 3 and 4 present the surface area of the different parts of the body in Eskimos and Whites for comparison. In Table 5 these findings are expressed in percent of the total surface area. From this table it appears that in the Eskimo a comparatively larger part of the total body surface area is represented by the trunk, head, and hands than in the Whites, while the rest of the body constitutes a smaller portion of the total surface area in the Eskimo as compared with the Whites. These differences are small, however, and appear to have no practical significance.

#### V. Conclusion.

On the basis of the reported data, it may be concluded that in the Eskimo, the difference in the body surface area as estimated by the height-weight formula and by the linear formula, is within the limit of accuracy claimed for the height-weight chart. The height-weight formula is therefore applicable also to the Eskimo, and it is evident that the use of this formula does not cause any significant error in the calculation of the basal metabolic rates of Eskimos.

#### VI. Acknowledgment.

The authors are greatly indebted to Lt. Col. A. Karstens, the Commanding Officer of the Arctic Aeromedical Laboratory, for his never failing interest and support. We are also indebted to Brigadier General D. H. Baker, Commanding Officer of Ladd Air Force Base, and Col. A. W. Cruikshank, Commanding Officer of the Research and Development Group, Ladd Air Force Base, for their

TABLE 3. SURFACE AREA OF DIFFERENT PARTS OF THE BODY, M<sup>2</sup> — ESKIMOS

SUBJ. NO.	NAME	SEX	AGE	WEIGHT Kg	HEIGHT Cm	SURFACE AREA, M <sup>2</sup>								TOTAL
						HEAD	ARMS	HANDS	TRUNK	THIGHS	LEGS	FEET		
1	(Barter Island) REXFORD, Mildred	F	34	84.0	157.5	0.1328	0.2399	0.0768	0.7309	0.3710	0.2078	0.1041	1.86	
2	AKOOTCHOOK, Elizabeth	F	21	49.7	156.8	0.1098	0.1927	0.0760	0.5180	0.2864	0.1911	0.0933	1.47	
3	PUTUGOOK, Annie	F	32	64.6	162.6	0.1061	0.2109	0.0866	0.6488	0.3017	0.2132	0.1039	1.67	
4	AKOOTCHOOK, Mary	F	29	51.8	155.6	0.1057	0.1963	0.0680	0.5450	0.3036	0.1764	0.0909	1.49	
5	APAYAK, John	M	16	43.1	151.8	0.1131	0.1777	0.0840	0.4609	0.2473	0.1727	0.1031	1.36	
6	PUTUGOOK, Donald*	M	22	62.9	171.5	0.1187	0.2460	0.0951	0.6001	0.3277	0.1985	0.1099	1.70	
7	AKOOTCHOOK, Daniel	M	18	54.5	163.2	0.1179	0.2056	0.0861	0.5465	0.2854	0.1949	0.1053	1.54	
8	AKOOTCHOOK, George	M	19	56.3	160.0	0.1203	0.2091	0.0924	0.5511	0.2677	0.1930	0.1062	1.54	
9	AKOOTCHOOK, Isaac	M	29	71.7	165.1	0.1214	0.2522	0.0982	0.6356	0.3443	0.2196	0.1602	1.83	
10	REXFORD, Herman	M	36	64.7	160.0	0.1169	0.2359	0.1021	0.6349	0.3178	0.1923	0.1096	1.71	
	(Gambell)													
11	IKNOKINOK, Clifford	M	23	66.5	164.5	0.1141	0.2349	0.0892	0.6271	0.3125	0.2113	0.1103	1.70	
12	KANAHOK, Howard	M	38	58.6	163.2	0.1058	0.2211	0.0919	0.5968	0.2887	0.2023	0.1061	1.61	
13	ANINGAYOU, Norman	M	39	67.1	168.3	0.1154	0.2264	0.0942	0.6244	0.3307	0.2287	0.1103	1.73	
14	NAWPOKUHOK, Leonard	M	19	61.2	167.0	0.1191	0.2388	0.0956	0.5880	0.3325	0.2128	0.1178	1.70	
15	IYAKITAN, Daniel	M	30	61.3	165.7	0.1140	0.2254	0.0801	0.5884	0.3216	0.2098	0.1030	1.64	
16	IYAKITAN, Lewis	M	25	62.9	163.8	0.1164	0.2275	0.1002	0.6267	0.2928	0.2039	0.1073	1.68	
17	ANTAGHAME, Jack	M	39	62.0	160.0	0.1201	0.2230	0.0857	0.6064	0.2902	0.2054	0.1060	1.64	
18	SILOOK, Roger	M	27	69.9	167.6	0.1280	0.2500	0.0960	0.6253	0.3178	0.2149	0.1185	1.75	

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SURFACE AREA, M<sup>2</sup>  
ESKIMOS (Contin'd)

SUBJ NO.	NAME	SEX	AGE	WEIGHT Kg	HEIGHT Cm	SURFACE AREA, M <sup>2</sup>							TOTAL
						HEAD	ARMS	HANDS	TRUNK	THIGHS	LEGS	FEET	
19	SILOOK, Nolan	M	35	61.7	168.3	0.1178	0.2300	0.0688	0.6291	0.2975	0.2002	0.1041	1.67
20	APPASINGOK, Herbert	M	24	59.9	166.4	0.1136	0.2159	0.0835	0.6013	0.3214	0.2019	0.0992	1.64
21	OOZEVOSEUK, Conrad	M	25	61.3	157.5	0.1169	0.2233	0.0901	0.5684	0.2872	0.2083	0.1131	1.51
22	HARRY, Don	M	30	62.7	165.7	0.1190	0.2249	0.1232	0.6176	0.3025	0.2071	0.1092	1.70
23	SLWOOKO, Howard	M	31	74.2	168.9	0.1181	0.2641	0.0998	0.6841	0.3456	0.2199	0.1191	1.85
24	SLWOOKO, Roger	M	19	68.1	170.2	0.1223	0.2312	0.1031	0.6234	0.3487	0.2246	0.1191	1.77
25	SLWOOKO, Joseph	M	24	65.4	167.6	0.1171	0.2234	0.0950	0.6426	0.3346	0.2029	0.1136	1.73
26	JAMES, Winfred	M	27	61.5	168.5	0.1217	0.2352	0.1041	0.6281	0.3141	0.2209	0.1184	1.74
27	IYAKITAN, Lane	M	21	59.9	167.0	0.1142	0.2209	0.0973	0.6258	0.3035	0.2056	0.1176	1.68
28	WALUNGA, Willie	M	25	67.6	168.3	0.1187	0.2528	0.1012	0.6398	0.3149	0.2037	0.1108	1.74
29	SLWOOKO, Vernon	M	33	70.1	168.9	0.1207	0.2369	0.0955	0.6497	0.3513	0.2286	0.1173	1.80
30	CHAUNCEY, Woodrow	M	19	59.9	165.7	0.1157	0.2153	0.0883	0.5789	0.2976	0.1928	0.1076	1.60
31	SLWOOKO, Beda	F	32	56.3	156.2	0.1128	0.2018	0.0719	0.5724	0.3001	0.1755	0.0918	1.53
32	MALEGOOHTIK, Florence	F	44	57.2	152.4	0.1122	0.1970	0.0722	0.5498	0.2845	0.1742	0.0898	1.48
33	OYAGLOK, Marcella	F	21	57.0	151.1	0.1126	0.1898	0.0707	0.5404	0.2965	0.1841	0.0902	1.48
34	NAWPOKUHOK, Gail (Anaktuvuk Pass)	F	23	55.4	153.7	0.1131	0.1935	0.0752	0.5730	0.2915	0.1858	0.0948	1.53
35	MEKIANA, Justus	M	22	60.8	165.5	0.1185	0.2333	0.1040	0.5404	0.3317	0.2285	0.1009	1.66
	PII.IIIND, Johnny	M	22	59.0	160.0	0.1091	0.2204	0.0997	0.5492	0.3076	0.2044	0.1046	1.59
						0.1214	0.2295	0.0933	0.5681	0.3132	0.2048	0.0983	1.63

TABLE 5. SURFACE AREA OF DIFFERENT PARTS OF THE BODY, M<sup>2</sup> - ESKIMOS (Contin'd)

NAME	SEX	AGE	WEIGHT Kg	HEIGHT Cm	SURFACE AREA, M <sup>2</sup>							TOTAL
					HEAD	ARMS	HANDS	TRUNK	THIGHS	LEGS	FEET	
38 MEKIANA, Homer	M	47	72.0	168.9	0.1354	0.2395	0.1016	0.6644	0.3626	0.2356	0.1166	1.86
39 (Kotzebue) CURTIS, Dick	M	31	65.8	169.2	0.1252	0.2407	0.0857	0.6102	0.3477	0.2004	0.0993	1.71
40 GOODWIN, Willie	M	36	62.2	162.5	0.1224	0.2336	0.0881	0.5929	0.2992	0.2056	0.1088	1.65
41 SOURS, Marion	M	36	60.5	170.2	0.1215	0.2314	0.1016	0.5996	0.3222	0.2107	0.1135	1.70
42 CURTIS, John	M	35	71.7	177.8	0.1268	0.2860	0.0967	0.6419	0.3630	0.2511	0.1166	1.88
43 SOURS, Eugene	M	40	61.3	167.0	0.1243	0.2280	0.0880	0.6093	0.2982	0.2223	0.1050	1.68
44 ANALOAK, Mabel	F	24	59.0	156.2	0.1130	0.2040	0.0801	0.5627	0.3159	0.1802	0.0969	1.55
45 KAGOONA, Janet	F	24	69.7	163.2	0.1124	0.2197	0.0760	0.6009	0.3775	0.2267	0.1052	1.72
46 VESTAL, Dolly	F	53	90.6	162.6	0.1193	0.2553	0.0820	0.7673	0.4043	0.2234	0.1060	1.96
47 (Selawik) BALLOT, Oscar	M	25	70.8	168.3	0.1205	0.2559	0.0910	0.6155	0.3605	0.2217	0.1170	1.78
48 RAMOTH, Ralph	M	20	65.0	168.9	0.1304	0.2430	0.0699	0.6033	0.3408	0.2224	0.1250	1.73
49 MITCHELL, Charlie	M	22	67.4	172.7	0.1254	0.2514	0.1045	0.6209	0.3348	0.2193	0.1246	1.78
50 JONES, Jack	M	23	60.4	165.7	0.1158	0.2328	0.0938	0.5588	0.2955	0.2095	0.1072	1.61
51 SMITH, Roy	M	26	54.5	161.9	0.1104	0.2167	0.0901	0.5308	0.2904	0.1897	0.1042	1.53
52 GREIST, Stephen	M	35	63.7	162.6	0.1232	0.2344	0.0960	0.6016	0.3166	0.2174	0.1158	1.70
53 FOXGLOVE, Roy	M	22	56.9	163.2	0.1154	0.2270	0.0919	0.5516	0.2994	0.2202	0.0987	1.60
AVERAGE: All Subj.	-	28	63.2	164.0	0.1180	0.2274	0.0904	0.6013	0.3174	0.2071	0.1084	1.67
Men only	-	28	63.1	165.8	0.1191	0.2322	0.0942	0.6014	0.3164	0.2104	0.1114	1.68

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At Ladd Air Force Base

WHITES -

TABLE 4. SURFACE AREA OF DIFFERENT PARTS OF THE BODY, M<sup>2</sup>

SUBJ. NO.	NAME	SEX	AGE	WEIGHT KG	HEIGHT Cm	SURFACE AREA, M <sup>2</sup>							TOTAL
						HEAD	ARMS	HANDS	TRUNK	THIGHS	LEGS	FEET	
1.	E.F.D.B.	M	68	75.8	176.0	0.1216	0.2552	0.0918	0.6668	0.3871	0.2412	0.1500	1.91
2	K.E.B.	M	23	79.0	176.0	0.1189	0.2718	0.1054	0.6979	0.3618	0.2412	0.1316	1.93
3	H.W.	M	21	62.0	174.0	0.1298	0.2369	0.0950	0.5954	0.3394	0.2093	0.1155	1.72
4	F.L.O.	M	21	90.0	181.0	0.1280	0.2886	0.1060	0.6736	0.4253	0.2804	0.1441	2.05
5	E.E.K.	M	19	73.0	178.0	0.1130	0.3749	0.0978	0.6303	0.3480	0.2383	0.1207	1.92
6	L.C.L.	M	21	103.0	185.0	0.1365	0.3095	0.1059	0.7462	0.4541	0.2879	0.1461	2.19
7	B.R.V.	M	21	63.0	168.0	0.1079	0.2389	0.0956	0.5510	0.3206	0.2285	0.1135	1.66
	AVERAGE	-	28	78.0	176.9	0.1222	0.2823	0.0996	0.6516	0.3763	0.2467	0.1316	1.91

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TABLE 5. SURFACE AREA OF DIFFERENT PARTS OF THE BODY  
IN PERCENT OF THE TOTAL SURFACE AREA

PART OF BODY	ESKIMOS			WHITES
	Average of 53 Males and Females  Average age: 28 years	Average of 11 Females  Average age: 30 years	Average of 42 Males  Average age: 28 years	Average of 7 Males  Average age: 28 years
Head	7.1	7.1	7.1	6.4
Arms	13.6	13.0	13.8	14.8
Hands	5.4	4.7	5.6	5.2
Trunk	36.0	37.3	35.8	34.1
Thighs	19.0	19.9	18.8	19.7
Legs	12.4	12.1	12.5	12.9
Feet	6.5	6.0	6.6	6.9

necessary approval to bring Eskimo subjects to the laboratory for the purpose of this study. We are also indebted to the pilots and crews who assisted us in the transportation of personnel and laboratory equipment to and from the various remote Eskimo settlements. In particular, we wish to mention Captain J. Hammer for his outstanding services, and Capt. F. Altman who made several flights to Anaktuvuk Pass for the completion of this project.

We are greatly indebted to the members of the Department of Physiology who have aided this project in one way or another, in particular Mrs. J. Rodahl who assisted in the measurement of the Eskimo women, S/Sgt. A. W. White who assisted in the measurement of the men, and S/Sgt. R. A. Blakely for his assistance in the computations. Above all, we are indebted to the 53 Eskimo subjects for their patience and co-operation which has been essential for the completion of this study.

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Finally, we wish to extend our sincere thanks to Dr. E. F. DuBois for his kind interest and valuable criticism and advice throughout this project, and for his personal supervision during the initial measurements.

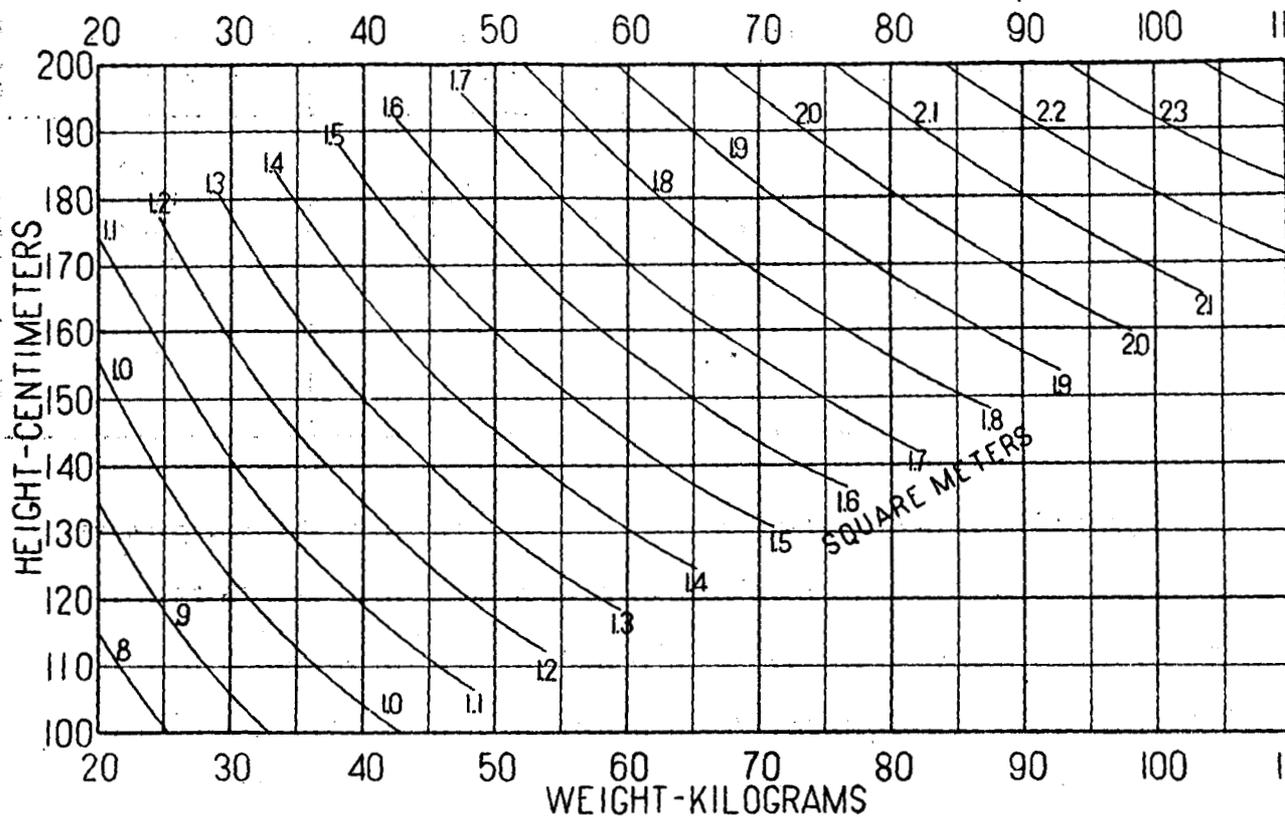
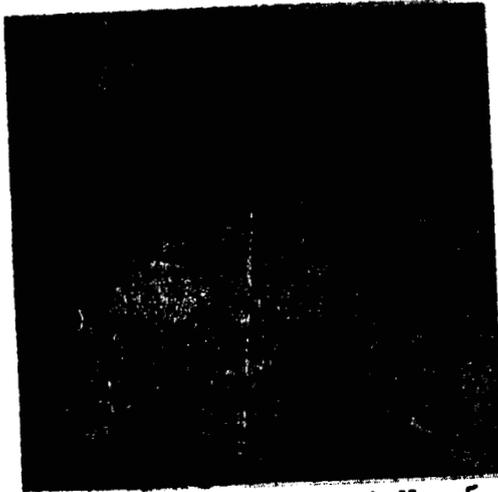


FIGURE 6

Chart for determining surface area of man in square meters from weight in kilograms (Wt.) and height in centimeters (Ht.) according to the formula:  
 Area (sq. cm.) = Wt.  $0.425$  X Ht.  $0.725$  X  $71.84$  (taken from DuBois and DuBois (7)).

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Subject No. 5. Barter Island Group.



Subject No. 40. Kotzebue Group.



Subject No. 45. Kotzebue Group.

FIGURE 7

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Subject No. 38. Full-blooded Eskimo from Anaktuvuk Pass.



Subject No. 6. Half-breed from Barter Island.

FIGURE 8

Showing typical Eskimo body type, compared with half-breed.

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