
**ANTHROPOMETRY OF
INDIAN SCHOOL CHILDREN**

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Preface

In India no anthropometric data on Indian school children are available from the view point of Ergonomics or Product design. It was the initiation by Mr.V.V.Srikantaiah, Assistant Commissioner, Kendriya Vidyalaya Sangathana, Mr.S.A.M.Hashmi, Education Officer, KVS., and their colleagues to take up this project for generating some ideas on the body dimensions of school children. This data pack is based on only 413 school children which is not statistically valid for the entire nation. This is only an humble approach by the investigators so that upto the large scale survey is done designers can have some guide lines on the children body dimensions and can utilise them for their design.

This report should be considered as a preliminary report. The final printed version of the study with in depth statistical analysis will be published by the IIT. Bombay soon.

PROJECT BACKGROUND

Kendriya Vidyalaya Sangathan is an autonomous body created by the Government of India and running about 405 schools all over the country for the benefit of the children of the transferable central government employee. The age range of the children varies from 5 to 18 yrs and most of the schools are of co-education type. Each year school authority spends a good amount of money to purchase the school furnitures but they are not happy with them due to following basic points;

1. Current furnitures are very much uncomfortable to use
2. The design of the furnitures are very age old, tradition bound and of poor quality.
3. Recurring expenditure to maintain them is high
4. As wood is becoming expensive so consideration has to be given for using other materials which should be durable, low cost and easily maintainable

KVS (IIT., Bombay) authority also expressed their willingness to redesign the following items;

1. Class room furnitures for students of different age group
2. Laboratory furnitures for physics, chemistry and niology rooms
3. Furnitures for workshops
4. Library furnitures
5. Furnitures for staffs

Based on those points the Industrial Design Centre took up an immediate investigation and following conclusions were drawn ;

1. All school furnitures either for students or for staffs are potentially hazardous from the view point of ERGONOMICS (User-Furniture-environment relationship). They require complete redesigning based on detailed in deapth scientific observations on users' body dimensions, safety, biomechanics, behaviour, comfort, aesthetics, maintanance, materials, etc.
2. In deapth study is essential to find out the optimum relationship between the furniture/fixture dimensions and space availability.
3. To have more interactions between school children, teachers and their educational environment, studies on building architectural planning, building interior, classroom layout, etc. must be performed.
4. As computers are going to be introduced at schools so special furnitures and special working environments are essential to overcome the visual and mental fatigue of the children, to eliminate the biomechanical problems at different body joints etc.
5. Redesigning the entire school system, scientifically sound and

aesthetically pleasing, is a long term serious effort. So design problems can be taken up in phasewise manner. Redesigning the classroom furnitures can be taken up as the first starting point.

Designing school furniture for the age range of 5 and 6 yrs was then taken up as a student project at post-graduate level in the month of June, 1983. The project was guided by Mr. M. Hermann, UNDP expert on furniture design from Germany. IDC students came up with four different concepts which are presented in Figure 1. The total duration of the project was one month and students had to work under several constrains (Annexure 1). The project revealed that the most vital constrain to Indian designers is the absolute lack of anthropometric data on Indian school children. Even the anthropometric data published by the Indian Standards Institution (ISI No. 4838 (P I), 1969 and ISI No. 4838 (P II), 1978) are of no use to the designers due to several drawbacks. Hence before starting any design project we must have the data pack on body dimensions of school children.

AIM OF THE STUDY

The aim of the phase I of the 'School Furniture Design' project was to generate the anthropometric data pack and to formulate anthropometric standards for the school children.

The data pack can then be presented to designers in easily understandable form for their use.

HOW THE STUDY WAS CONDUCTED

A field study team was formed with the help of about 11 school teachers deputed by the KVS. Those teachers went under vigorous training programme at IDC under the guidance and supervision of the investigators. The training programme was on how to take anthropometric measurements.

All together 154 different body dimensions were obtained from each child by using following calibrated equipment;

1. Martin type Anthropometer (Seiber & Heinger, Switzerland)
2. Spreading caliper (Seiber & Heinger)
3. Vernier caliper (Seiber & Heinger)
4. Anthropometric steel tape (Seiber & Heinger)
5. Bathroom scale
6. Cone for grip measurement (Fabricated)
7. Grip dynamometer (TKK., Japan)
8. Anthropometric Stool (Fabricated)

Figure 2(a,b,c,d,e,f,g) shows positions of different anthropometric measurements while Table 1 represents corresponding name of them.

RESULTS AND DISCUSSIONS

Before collecting sample India was divided into five different zones, east, west, north, south and centre. A small questionnaire survey was done to find out the demographic origins of each school children along with their parents. The child was considered for the respective zone according to his parents roigin. Climatic effect for staying more than 5 yrs in one place has been ignored in this study. Efforts were made to ascertain that an almost equal number of representatives come from each of the 5 different zones. The zone wise children selection were done by drawing lottery on their roll numbers.

Table 2 represents the age-wise distribution of total 413 school children distributed in five different groups.

Table 3, 4 and 5 represents the respective 5th, 50th and 95th percentile values of different body measurements of different age groups.

ACKNOWLEDGEMENT

Investigators sincerly acknowledge the co-operation extended by the Kendriya Vidyalaya Sangathan, IIT., Bombay.

We pay our gratitude to those KVS teachers who as a team members took sincer effort to make this project a success by taking the anthropometric measurements.

Our heartfelt thanks for those school children who voluntarily participated in the study as a subject and helped us to take their anthropometric measurements.

We sincerly thank IIT., Bombay and IDC to allow us to conduct the study by providing laboratory and other facilities.

Table 1. 154 different anthropometric measurements measured for school children

1.	BODY WEIGHT
2.	STATURE
3.	NASAL ROOR HEIGHT
4.	EYE HEIGHT
5.	SUPRA STERNAL HEIGHT
6.	SUB STERNAL HEIGHT
7.	BUST/NIPPLE HEIGHT
8.	ABDOMINAL EXTENSION HEIGHT
9.	CROTCH HEIGHT
10.	TRAGION HEIGHT
11.	ACROMION HEIGHT
12.	WAIST HEIGHT
13.	TROCHANTERIC HEIGHT
14.	CERVICALE HEIGHT
15.	BUTTOCK HEIGHT
16.	GLUTEAL FURROW HEIGHT
17.	ELBOW HEIGHT
18.	WRIST HEIGHT
19.	KNUCKLE HEIGHT
20.	TIBIAL HEIGHT
21.	ANKLE HEIGHT
22.	LATERAL MALLIOLUS HEIGHT
23.	MEDIAL MALLIOLUS HEIGHT
24.	MAXIMUM ARM REACH
25.	FUNCTIONAL REACH
26.	OVERHEAD GRASP
27.	SITTING HEIGHT
28.	SITTING MID SHOULDER HEIGHT
29.	SITTING UPPER LUMBER HEIGHT
30.	SITTING WAIST HEIGHT
31.	SITTING LOWER LUMBER HEIGHT
32.	SITTING ELBOW REST HEIGHT
33.	SITTING THIGH CLEARANCE HEIGHT
34.	SITTING EYE HEIGHT
35.	SITTING POPLITEAL HEIGHT
36.	SQUATTING HEIGHT
37.	SQUATTING KNEE HEIGHT MAXIMUM
38.	SQUATTING KNEE TO KNEE LENGTH
39.	SQUATTING BUTTOCK KNEE LENGTH
40.	SITTING BUTTOCK KNEE LENGTH
41.	SITTING BUTTOCK POPLITEAL LENGTH
42.	SITTING THIGH TO THIGH LENGTH
43.	SITTING KNEE TO KNEE LENGTH
44.	TOTAL SPAN
45.	BIACROMION BREADTH
46.	BIDELTOID BREADTH
47.	ELBOW TO ELBOW BREADTH
48.	CHEST BREADTH
49.	WAIST BREADTH
50.	HIP BREADTH

Table 1. 154 different anthropometric measurements measured
(Contd.) for school children

51.	BUST POINT TO BUST POINT BREADTH
52.	HEAD BREADTH
53.	CHEST DEPTH
54.	WAIST DEPTH
55.	ABDOMINAL EXTENSION DEPTH
56.	BUTTOCK DEPTH
57.	ACROMION RADIALE LENGTH
58.	RADIALE STYLION LENGTH
59.	BUTTOCK LEG LENGTH
60.	HUMERAL WIDTH RIGHT
61.	RADIO ULNAR WIDTH RIGHT
62.	FEMORAL WIDTH RIGHT
63.	HAND LENGTH
64.	PALM LENGTH
65.	HAND BREADTH AT THUMB
66.	HAND BREADTH AT METACARPLE
67.	HAND THICKNESS AT METACARPLE
68.	FIRST PHALINX III LENGTH
69.	FOOT LENGTH
70.	FOOT BREADTH
71.	HEEL BREADTH
72.	BIMALLIOLAR BREADTH
73.	HEAD CIRCUMFERENCE
74.	BITRAGON CORONAL CURVATURE
75.	SAGITTAL CURVATURE
76.	POSTERIOR ARC
77.	NECK CIRCUMFERENCE
78.	SHOULDER CIRCUMFERENCE
79.	CHEST CIRCUMFERENCE AT SCYE
80.	BUST/CHEST CIRCUMFERENCE
81.	CHEST CIRCUMFERENCE BELOW BUST
82.	WAIST CIRCUMFERENCE
83.	ABDOMINAL EXTENSION CIRCUMFERENCE
84.	HIP CIRCUMFERENCE
85.	UPPER THIGH CIRCUMFERENCE
86.	LOWER THIGH CIRCUMFERENCE
87.	KNEE CIRCUMFERENCE
88.	CALF CIRCUMFERENCE
89.	ANKLE CIRCUMFERENCE
90.	BALL OF FOOT CIRCUMFERENCE
91.	VERTICAL TRUNK CIRCUMFERENCE
92.	SCYE CIRCUMFERENCE
93.	AUXIALLARY ARM CIRCUMFERENCE
94.	BICEPS CIRCUMFERENCE RELAXED
95.	FORE ARM CIRCUMFERENCE RELAXED
96.	WRIST CIRCUMFERENCE RELAXED
97.	HAND CIRCUMFERENCE AT METACARPLE II
98.	FIST CIRCUMFERENCE
99.	BICEPS CIRCUMFERENCE FLEXED
100.	ELBOW CIRCUMFERENCE FLEXED

Table 1. 154 different anthropometric measurements measured
(Contd.) for school children

101.	FOREARM CIRCUMFERENCE FLEXED
102.	SITTING BUTTOCK CIRCUMFERENCE
103.	SITTING KNEE CIRCUMFERENCE
104.	SITTING VERTICAL TRUNK CIRCUMFERENCE
105.	NECK TO BUST POINT LENGTH
106.	INTER SCYE CURVATURE
107.	INTER SCYE CURVATURE MAXIMUM
108.	BACK CURVATURE
109.	SLEEVE INSEAM
110.	SPINE TO SCYE LENGTH
111.	SPINE TO ELBOW LENGTH
112.	SPINE TO WRIST LENGTH
113.	ANTERIOR NECK LENGTH
114.	POSTERIOR NECK LENGTH
115.	SHOULDER LENGTH
116.	WAIST BACK
117.	WAIST FRONT
118.	GLUTEAL ARC
119.	CROTCH LENGTH
120.	TRAGION TO WALL
121.	ECTOCANTHUS TO WALL
122.	PRONASALE TO WALL
123.	SUBNASALE TO WALL
124.	LIP POTRUSION TO WALL
125.	MENTON TO WALL
126.	LARYNX TO WALL
127.	TRAGION TO TOP OF HEAD
128.	ECTOCANTHUS TO TOP OF HEAD
129.	SUBNASAL TO TOP OF HEAD
130.	STOMIAN TO TOP OF HEAD
131.	MENTON TO TOP OF HEAD
132.	BI AURICULAR BREADTH
133.	BI TRAGION BREADTH
134.	BI ZYGOMATIC BREADTH
135.	BI GONIAL BREADTH
121A.	HEAD LENGTH
136.	BI OCULAR BREADTH
137.	INTER OCULAR BREADTH
138.	INTER PUPILARY DISTENCE
139.	NASAL BREADTH
140.	LIP LENGTH
141.	SUBNASAL SELLION LENGTH
142.	MENTON SUBNESAL LENGTH
143.	MENTON SELLION LENGTH.
144.	EAR LENGTH
145.	EAR LENGTH ABOVE TRAGION
146.	EAR BREADTH
147.	EAR POTRUTION
148.	NASAL ROOT BREADTH
149.	NOSE POTRUTION
150.	PHILTRUM LENGTH
151.	LIP TO LIP DISTANCE
152.	MENTON PROJECTION
153.	GRIP DIAMETER INSIDE
154.	HAND STRENGTH

Table 2. Age-wise distribution of 413 school children

GROUP	AGE RANGE (YEARS)	NUMBER OF OBSERVATIONS
GROUP 1	6 - 8	101
GROUP 2	9 - 10	93
GROUP 3	11 - 12	77
GROUP 4	13 - 14	65
GROUP 5	15 - 19	77

Table 3. 5th percentile values of different measurements for children of different age groups.

SR. NO.	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5
1.	15.1	18.2	22.2	27.2	31.5
2.	106.9	115.3	126.7	137.5	145.6
3.	98.0	106.1	118.1	127.9	136.2
4.	95.7	105.0	114.1	126.9	134.1
5.	83.7	90.8	101.4	111.8	118.4
6.	73.2	81.3	89.4	99.2	101.3
7.	76.5	83.4	91.2	101.2	106.7
8.	59.7	65.6	73.7	81.1	84.3
9.	47.0	52.4	58.6	64.9	68.2
10.	94.0	103.2	113.0	122.8	131.7
11.	83.2	91.0	99.8	110.6	118.8
12.	64.0	68.6	77.1	84.0	88.3
13.	52.6	58.4	65.1	74.8	77.3
14.	87.3	95.5	104.7	115.6	123.3
15.	51.1	57.8	63.3	72.4	74.4
16.	45.4	50.7	57.4	63.2	66.6
17.	63.4	69.4	76.9	83.0	88.5
18.	48.3	54.1	59.6	64.8	68.8
19.	43.3	47.0	52.8	56.2	60.4
20.	29.9	32.2	35.8	41.3	41.2
21.	6.9	7.6	8.3	8.7	8.0
22.	4.0	3.9	4.2	5.7	5.7
23.	5.3	5.0	5.6	6.2	6.6
24.	52.4	56.7	59.1	67.7	69.1
25.	49.5	52.8	56.1	62.4	68.8
26.	125.4	137.4	149.1	165.7	175.7
27.	57.4	60.1	65.5	69.3	72.4
28.	35.2	37.7	41.6	44.3	47.9
29.	18.1	19.0	21.3	21.3	23.4
30.	13.6	14.8	16.4	17.3	19.8
31.	10.4	10.5	10.7	10.9	10.6
32.	11.8	12.7	13.9	14.1	16.3
33.	7.2	7.4	8.8	10.4	10.7
34.	45.3	49.7	53.4	57.4	61.2
35.	26.4	28.9	31.4	35.4	35.9
36.	56.7	58.6	65.1	70.2	72.1
37.	12.4	14.5	14.8	17.3	14.6
38.	36.7	41.5	43.8	49.0	50.5
39.	31.4	35.1	36.8	41.0	45.6
40.	33.7	36.9	41.0	47.3	49.4
41.	27.5	29.9	33.7	39.0	39.1
42.	17.6	18.0	19.9	21.6	24.3
43.	12.6	13.5	14.4	15.2	16.2
44.	104.1	113.9	124.9	137.0	144.5
45.	20.9	20.5	24.8	27.7	28.9
46.	24.3	25.6	28.8	31.6	32.5
47.	24.0	25.8	28.7	30.5	33.8
48.	16.1	17.2	18.8	20.6	21.0
49.	13.9	14.2	15.9	17.6	17.7
50.	17.5	19.1	20.4	23.4	25.1

Table 3. 5th percentile values of different measurements
(Contd.) for children of different age groups.

SR. NO.	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5
51.	10.3	10.8	11.9	13.8	14.5
52.	12.6	12.6	13.1	13.4	13.2
53.	11.9	11.5	13.2	14.2	15.9
54.	10.6	10.3	12.1	12.1	13.2
55.	11.9	11.9	13.2	14.6	15.2
56.	10.9	11.4	13.5	14.7	15.2
57.	17.5	19.9	21.4	24.5	26.0
58.	14.4	15.9	18.0	20.3	21.2
59.	62.5	67.7	72.6	82.9	88.1
60.	4.2	4.6	5.1	5.4	6.0
61.	3.2	3.4	3.8	4.1	4.3
62.	6.2	6.6	7.1	7.6	7.7
63.	11.5	12.0	13.5	14.3	15.2
64.	6.6	6.7	7.6	8.1	8.1
65.	4.9	6.3	6.9	7.7	7.4
66.	4.6	5.2	5.8	6.2	6.4
67.	1.1	1.4	1.4	1.7	1.7
68.	4.0	4.3	4.6	5.2	5.4
69.	15.6	17.6	19.4	21.3	21.6
70.	5.7	6.3	7.0	7.5	7.8
71.	3.4	3.6	3.7	4.4	5.0
72.	4.8	5.1	5.4	5.6	5.8
73.	46.1	47.1	48.0	49.3	49.5
74.	29.8	30.5	30.8	30.7	30.9
75.	31.6	32.6	33.1	33.8	33.2
76.	18.9	19.2	20.1	21.1	21.3
77.	21.2	22.2	23.1	25.0	25.8
78.	60.2	64.1	70.3	75.0	79.5
79.	49.2	52.5	56.6	60.8	64.8
80.	48.6	51.0	55.2	59.5	63.7
81.	47.2	48.1	52.2	56.3	55.8
82.	42.6	43.0	46.6	49.3	51.8
83.	46.5	47.0	50.2	54.3	58.1
84.	49.7	53.9	57.4	64.7	69.1
85.	26.6	29.1	32.1	35.4	36.0
86.	20.3	22.0	24.2	26.5	27.3
87.	20.9	22.5	24.9	27.2	27.1
88.	18.5	20.0	22.3	24.2	25.0
89.	13.0	13.9	15.2	16.2	17.2
90.	14.8	15.4	17.1	18.4	19.3
91.	87.8	92.7	100.9	112.6	118.0
92.	19.7	21.2	23.9	26.4	26.3
93.	14.3	15.5	16.0	17.5	18.9
94.	13.0	13.8	14.8	16.4	17.1
95.	13.4	14.3	15.5	17.1	17.3
96.	9.7	10.3	11.2	12.1	12.4
97.	11.7	12.4	13.9	14.4	14.8
98.	16.0	17.0	18.7	20.8	20.3
99.	13.5	14.6	15.8	17.7	18.5
100.	14.9	15.3	17.4	19.7	20.4

Table 3. 5th percentile values of different measurements
(Contd.) for children of different age groups.

SR. NO.	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5
101.	13.9	14.4	16.0	17.7	18.5
102.	51.6	55.5	59.1	66.2	71.5
103.	20.2	21.7	24.7	26.3	25.8
104.	84.5	87.1	101.0	110.2	120.2
105.	11.6	12.5	13.5	16.2	17.4
106.	23.1	24.5	26.4	29.1	30.6
107.	29.9	31.5	34.4	37.3	36.9
108.	30.1	30.7	32.6	36.6	34.1
109.	28.9	31.3	34.6	39.7	40.9
110.	12.5	13.3	14.6	13.9	16.4
111.	31.5	34.1	38.1	42.3	42.6
112.	49.2	52.1	58.3	64.5	65.7
113.	4.6	4.9	5.2	6.0	6.8
114.	5.0	5.0	5.2	5.9	7.2
115.	8.0	8.5	8.8	9.8	10.9
116.	21.7	23.7	23.6	29.6	30.7
117.	18.8	20.6	20.9	23.5	25.0
118.	13.8	15.3	17.4	20.8	23.2
119.	33.2	33.5	36.6	42.5	48.9
120.	6.2	6.6	6.5	6.2	6.3
121.	12.2	11.8	12.3	12.2	12.1
122.	15.3	16.3	15.9	15.8	17.6
123.	13.5	14.2	13.8	13.5	15.6
124.	14.3	15.0	14.9	15.1	16.3
125.	12.2	13.5	13.7	14.0	14.9
126.	8.1	8.6	8.9	10.0	10.5
127.	10.9	10.4	10.8	10.7	11.0
128.	9.1	9.0	8.8	8.4	9.6
129.	12.0	12.1	12.4	12.0	13.2
130.	13.2	13.4	14.2	14.0	15.2
131.	16.2	16.6	17.1	17.5	18.7
132.	13.5	13.3	13.9	14.7	14.6
133.	10.4	10.6	11.0	11.7	11.6
134.	8.8	9.0	9.0	9.5	9.5
135.	7.2	6.8	7.2	9.0	8.5
121A	15.3	15.8	16.1	16.5	16.4
136.	7.9	8.1	8.3	8.5	8.8
137.	2.4	2.5	2.5	2.5	2.4
138.	4.9	4.9	5.3	5.8	5.7
139.	2.4	2.6	2.6	2.8	2.7
140.	3.5	3.5	3.7	3.9	4.0
141.	3.7	3.9	4.0	4.3	4.3
142.	3.9	4.0	4.4	4.4	4.9
143.	8.3	8.4	8.6	9.1	9.6
144.	4.6	4.4	4.9	5.0	5.0
145.	2.1	2.2	2.3	2.2	2.3
146.	2.5	2.7	2.6	2.7	2.9
147.	1.0	1.1	1.0	1.0	1.4
148.	1.2	1.3	1.5	1.7	1.6
149.	1.3	1.3	1.4	1.5	1.6
150.	0.8	0.8	0.8	0.9	0.9
151.	1.1	1.3	1.3	1.3	1.5
152.	3.5	3.4	3.7	3.8	3.9
153.	2.8	3.1	3.4	4.0	3.9
154.	4.9	7.3	10.0	15.1	17.3

Table 4. 50th percentile values of different measurements for children of different age groups.

SR. NO.	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5
1.	19.6	23.0	27.8	37.2	44.2
2.	118.8	128.2	136.6	151.3	158.6
3.	108.2	117.6	126.5	140.9	147.2
4.	107.5	116.6	125.6	140.3	146.5
5.	93.9	102.4	110.1	123.8	129.2
6.	82.5	90.3	96.9	108.2	112.7
7.	85.6	93.1	101.2	112.0	115.9
8.	69.2	76.2	82.4	90.5	94.6
9.	54.6	60.9	66.1	73.3	76.3
10.	105.4	114.3	123.3	137.4	144.7
11.	93.2	101.5	110.1	123.2	128.9
12.	72.7	79.8	86.2	96.9	100.7
13.	60.5	66.9	72.2	82.1	85.9
14.	97.6	107.2	114.4	128.5	134.3
15.	58.6	65.0	70.4	80.2	82.1
16.	53.0	58.5	63.2	72.3	73.7
17.	70.9	77.4	84.7	93.7	98.2
18.	55.2	59.6	65.9	72.5	76.1
19.	48.2	52.5	57.9	64.5	67.5
20.	34.0	37.1	41.0	45.7	48.3
21.	8.9	9.8	10.6	11.6	11.1
22.	5.7	6.2	6.6	7.2	6.9
23.	6.5	6.6	7.2	7.6	8.2
24.	58.4	62.8	66.9	74.1	77.8
25.	57.0	61.8	66.4	71.7	82.4
26.	140.3	153.1	166.1	185.2	190.0
27.	62.9	66.7	71.1	76.6	80.9
28.	39.8	43.1	46.3	50.7	54.6
29.	22.6	24.5	25.1	27.1	28.7
30.	17.4	18.6	19.8	21.9	23.8
31.	14.0	14.7	15.9	16.5	19.1
32.	15.4	15.8	17.5	18.2	20.7
33.	9.0	9.9	11.2	12.6	13.5
34.	51.8	55.6	59.6	64.9	69.8
35.	30.1	32.6	35.3	39.3	40.4
36.	62.3	66.2	70.5	75.7	80.6
37.	16.6	17.9	19.1	21.1	21.1
38.	44.0	48.2	51.3	57.7	59.5
39.	37.2	39.9	44.8	49.6	53.5
40.	38.4	42.2	46.0	52.2	54.2
41.	31.4	34.2	37.9	43.4	44.6
42.	19.9	20.9	23.9	26.1	30.2
43.	14.4	15.2	16.3	17.6	18.9
44.	117.4	127.2	136.2	154.4	159.9
45.	24.2	25.8	28.9	32.1	33.8
46.	27.0	29.0	31.6	35.2	37.7
47.	28.1	29.9	32.9	35.7	39.1
48.	18.2	19.2	20.7	22.9	24.9
49.	16.0	16.8	18.6	21.1	21.3
50.	20.1	21.7	23.4	26.8	29.4

Table 4. 50th percentile values of different measurements
(Contd.) for children of different age groups.

SR. NO.	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5
51.	12.6	13.1	14.5	16.5	17.2
52.	13.8	13.9	14.2	14.4	14.7
53.	13.4	13.9	15.1	17.0	18.2
54.	12.4	12.6	13.8	15.3	15.6
55.	13.6	14.2	15.6	17.6	17.8
56.	12.7	13.7	16.4	17.9	19.1
57.	21.0	23.6	24.9	28.0	29.8
58.	16.9	19.0	20.3	23.3	24.2
59.	70.9	77.9	83.7	96.4	101.2
60.	5.0	5.3	5.8	6.6	7.1
61.	3.8	4.0	4.2	4.6	4.9
62.	7.1	7.5	8.0	8.8	9.0
63.	12.9	13.8	14.9	16.6	17.0
64.	7.3	7.9	8.3	9.5	9.6
65.	6.4	7.1	7.8	8.6	9.1
66.	5.6	6.0	6.4	7.0	7.4
67.	1.6	1.7	1.8	2.1	2.3
68.	4.5	4.8	5.2	5.8	6.0
69.	18.4	20.0	21.4	23.3	23.6
70.	6.9	7.5	7.9	8.5	9.0
71.	4.2	4.6	4.6	5.2	5.7
72.	5.5	5.7	6.0	6.4	6.4
73.	49.2	50.5	50.9	52.2	52.8
74.	32.6	33.6	32.8	33.0	33.7
75.	36.5	36.9	36.7	36.6	37.1
76.	21.9	22.4	23.1	24.5	24.3
77.	23.4	24.1	25.6	27.6	29.0
78.	66.9	69.5	75.7	84.3	89.8
79.	54.8	55.8	61.0	67.6	72.5
80.	53.7	55.9	60.7	68.7	74.0
81.	50.7	52.0	56.4	62.6	62.9
82.	48.2	49.5	52.7	57.0	60.1
83.	52.2	54.3	58.9	65.8	70.6
84.	56.1	59.8	66.0	73.9	80.1
85.	31.6	33.5	36.8	40.3	44.6
86.	23.7	25.0	27.5	30.4	32.4
87.	24.1	25.4	27.6	30.7	32.1
88.	21.6	22.7	24.9	27.8	29.3
89.	15.0	15.7	16.9	18.8	19.2
90.	16.9	17.7	19.0	21.0	21.5
91.	99.9	106.5	116.5	128.6	139.0
92.	23.6	24.5	27.8	30.8	33.5
93.	16.2	17.6	19.2	21.4	23.5
94.	14.9	15.3	17.0	19.2	20.7
95.	15.1	15.6	17.3	19.3	20.8
96.	11.1	11.4	12.5	13.7	14.1
97.	13.6	14.4	15.5	17.0	17.6
98.	18.6	19.3	21.0	23.2	23.8
99.	15.7	16.5	18.2	20.1	22.3
100.	17.3	18.0	20.1	22.5	23.8

Table 4. 50th percentile values of different measurements
(Contd.) for children of different age groups.

SR. NO.	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5
101.	15.9	16.4	18.2	20.2	22.0
102.	57.5	61.3	68.3	76.4	83.0
103.	24.2	25.5	27.8	31.4	32.1
104.	97.3	103.2	113.1	125.2	133.8
105.	14.2	15.5	17.1	19.6	21.2
106.	27.5	29.1	29.9	32.4	35.3
107.	35.0	36.8	40.4	43.7	45.1
108.	33.8	36.0	39.0	41.8	43.7
109.	33.5	36.8	38.9	44.9	46.2
110.	14.6	16.4	16.7	17.7	19.5
111.	36.0	39.0	41.8	47.1	49.1
112.	54.6	59.2	63.4	71.7	74.4
113.	6.6	6.9	7.7	9.2	10.0
114.	6.8	7.3	7.6	8.8	9.1
115.	9.9	10.9	11.0	12.2	13.0
116.	26.0	27.4	30.0	33.3	35.4
117.	21.6	24.2	25.0	27.9	29.0
118.	18.1	20.5	22.0	26.3	29.2
119.	41.6	45.0	47.6	54.1	63.3
120.	8.0	8.3	8.2	8.1	8.3
121.	14.2	14.4	14.1	14.2	14.8
122.	17.7	18.4	18.1	18.6	20.0
123.	16.1	17.1	16.4	16.6	18.3
124.	17.0	17.7	17.3	17.3	18.8
125.	15.4	16.2	15.8	16.1	18.2
126.	10.6	11.3	11.3	11.8	13.2
127.	12.1	12.0	12.1	12.1	12.5
128.	10.6	10.4	10.7	10.7	11.4
129.	13.8	13.9	14.2	14.6	15.0
130.	15.4	15.5	16.0	16.5	16.8
131.	18.1	18.3	19.2	19.7	20.4
132.	14.9	15.6	15.6	16.3	16.3
133.	11.4	11.5	11.9	12.5	12.6
134.	9.9	10.0	10.3	10.7	10.7
135.	8.5	8.7	9.8	10.1	10.1
121A	16.6	17.2	17.2	17.5	17.8
136.	8.6	8.8	9.0	9.3	9.4
137.	2.8	2.9	3.0	3.0	3.1
138.	5.4	5.7	6.2	6.5	6.6
139.	2.8	3.0	3.1	3.2	3.3
140.	4.0	4.0	4.2	4.3	4.6
141.	4.4	4.6	4.6	4.9	4.9
142.	4.8	5.0	5.2	5.4	5.7
143.	9.2	9.5	9.9	10.3	10.5
144.	5.1	5.3	5.4	5.6	5.6
145.	2.8	2.7	2.6	2.7	2.7
146.	3.0	3.2	3.0	3.1	3.2
147.	1.6	1.8	1.6	1.7	1.9
148.	1.8	1.9	1.9	1.9	1.9
149.	1.6	1.7	1.7	1.9	2.1
150.	1.1	1.2	1.1	1.1	1.2
151.	1.5	1.6	1.7	1.7	1.8
152.	4.5	4.6	4.6	4.8	5.0
153.	3.4	3.7	4.1	4.5	4.7
154.	8.6	11.1	14.1	20.8	26.0

Table 5. 95th percentile values of different measurements for children of different age groups.

SR. NO.	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5
1.	26.0	32.0	41.3	51.9	66.4
2.	131.2	139.9	150.9	163.4	181.5
3.	121.9	130.0	139.3	152.4	166.8
4.	120.2	128.3	137.5	151.1	164.4
5.	105.9	114.1	123.2	133.2	145.1
6.	92.4	101.0	107.4	117.4	125.4
7.	94.8	103.4	113.3	121.1	129.8
8.	78.1	86.4	95.7	102.7	110.0
9.	63.5	69.0	78.7	80.5	83.9
10.	118.6	126.4	136.4	149.2	163.5
11.	104.6	113.0	123.5	134.4	143.2
12.	82.0	89.8	98.5	107.0	111.2
13.	68.6	77.3	83.4	89.6	95.7
14.	109.5	118.5	129.2	139.3	151.4
15.	67.4	73.9	79.8	88.1	92.7
16.	61.4	67.4	72.9	80.1	82.5
17.	80.7	86.7	94.1	101.1	109.2
18.	62.1	67.1	73.3	80.6	85.9
19.	55.4	59.5	65.3	69.8	76.0
20.	39.9	43.0	47.6	52.5	56.4
21.	11.8	12.4	13.0	14.8	14.6
22.	7.5	7.8	8.1	8.7	8.9
23.	7.9	8.7	8.2	9.5	10.2
24.	65.6	70.9	76.8	81.5	89.0
25.	68.5	73.6	80.1	88.4	100.4
26.	158.0	171.6	184.9	200.7	217.7
27.	68.5	72.2	77.2	83.4	90.1
28.	45.1	47.3	51.2	59.2	61.2
29.	27.9	31.6	31.2	35.1	34.0
30.	20.5	22.5	24.2	26.0	27.9
31.	18.3	18.0	20.0	21.3	22.7
32.	18.2	19.7	20.9	22.9	24.8
33.	11.6	12.7	14.2	15.3	16.5
34.	57.7	60.5	77.4	73.3	78.9
35.	34.0	36.5	39.6	43.4	46.1
36.	69.1	71.7	77.1	83.7	89.0
37.	20.5	21.8	23.7	26.7	28.4
38.	53.1	58.1	60.1	68.9	73.2
39.	43.0	46.3	51.9	58.6	60.6
40.	42.6	47.2	52.3	57.7	60.3
41.	35.6	39.4	42.6	50.0	54.2
42.	23.6	23.6	27.6	30.2	36.1
43.	16.9	17.5	18.8	20.0	25.2
44.	131.9	142.3	163.2	171.0	184.9
45.	27.9	30.5	33.1	36.2	38.6
46.	30.8	32.8	36.6	39.5	44.3
47.	32.1	34.4	38.6	41.0	45.2
48.	20.7	21.7	24.5	27.0	31.3
49.	18.2	19.4	22.5	26.5	27.1
50.	22.8	24.0	28.1	30.6	34.5

Table 5. 95th percentile values of different measurements
(Contd.) for children of different age groups

SR. NO.	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5
51.	14.8	15.2	18.3	20.4	20.4
52.	15.2	15.3	15.8	15.5	16.4
53.	14.9	16.3	18.6	19.9	23.7
54.	14.1	15.0	17.2	18.3	21.4
55.	15.6	16.3	18.6	22.6	22.7
56.	15.6	16.6	20.7	22.5	23.9
57.	26.0	28.1	29.0	31.5	34.5
58.	19.9	21.4	23.5	25.9	27.9
59.	80.6	89.9	97.2	109.3	111.0
60.	5.7	6.6	6.8	7.5	8.2
61.	4.3	4.5	4.8	5.3	5.5
62.	8.0	8.8	9.2	10.1	10.4
63.	14.8	15.6	17.1	18.4	19.0
64.	8.4	8.9	9.8	10.4	11.5
65.	7.7	8.2	8.6	9.8	10.3
66.	6.3	6.9	7.3	7.9	8.4
67.	2.1	2.1	2.5	2.5	2.8
68.	5.1	5.4	5.9	6.4	6.7
69.	21.4	22.8	24.3	25.7	26.6
70.	8.1	8.9	9.0	9.7	10.4
71.	5.3	5.4	5.7	6.0	6.7
72.	6.4	6.7	6.7	7.1	7.5
73.	51.6	52.9	54.3	54.2	55.6
74.	35.7	36.5	36.0	35.7	37.0
75.	39.4	39.9	40.5	39.5	39.9
76.	24.9	26.7	26.0	27.2	28.2
77.	25.7	26.7	28.0	30.0	35.2
78.	74.4	78.5	87.3	95.2	102.7
79.	63.6	60.5	72.0	82.4	82.6
80.	60.7	63.4	74.5	78.4	86.7
81.	56.8	57.1	68.8	71.2	73.2
82.	55.5	57.7	62.8	65.2	73.3
83.	60.7	63.3	75.1	81.5	89.9
84.	63.4	67.0	77.7	87.9	93.4
85.	37.2	37.9	46.3	49.2	56.4
86.	28.6	31.0	33.2	35.9	38.6
87.	27.3	29.3	32.9	34.2	35.8
88.	25.0	25.7	30.0	32.6	34.1
89.	17.6	19.3	19.9	20.9	22.6
90.	19.0	20.9	21.2	23.2	24.5
91.	116.2	122.0	141.9	144.8	157.7
92.	28.0	28.8	33.0	37.6	42.3
93.	19.9	22.7	23.9	26.2	33.3
94.	17.0	18.6	20.9	23.4	26.2
95.	16.9	18.3	20.6	21.9	24.3
96.	12.7	13.4	14.5	15.4	16.4
97.	15.6	17.3	17.7	19.0	20.3
98.	21.3	21.7	23.9	26.1	27.6
99.	18.3	20.4	22.2	24.5	29.6
100.	19.7	21.7	23.4	25.9	29.2

Table 5. 95th percentile values of different measurements
(Contd.) for children of different age groups.

SR. NO.	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5
101.	18.2	19.0	21.5	23.2	26.1
102.	68.4	70.4	80.3	91.0	95.2
103.	27.8	28.9	32.0	36.0	37.6
104.	112.8	121.6	133.0	142.4	158.3
105.	16.9	18.0	20.9	23.2	26.6
106.	37.4	36.5	36.3	37.5	41.4
107.	44.6	44.1	47.2	52.8	57.3
108.	40.2	40.6	45.0	48.6	55.6
109.	38.2	41.0	45.2	50.1	51.7
110.	20.1	20.9	19.0	22.1	22.9
111.	40.7	44.4	48.4	53.6	55.3
112.	61.6	66.8	71.7	79.4	85.0
113.	8.5	8.9	9.7	11.5	12.2
114.	8.8	10.2	10.2	10.9	13.1
115.	12.4	12.9	13.6	14.5	15.5
116.	30.7	32.8	34.8	38.0	41.6
117.	26.5	28.2	28.8	33.5	34.6
118.	24.1	27.7	30.3	32.2	36.5
119.	52.7	59.1	62.4	77.0	79.8
120.	10.0	10.4	10.5	9.9	10.8
121.	16.4	16.5	16.2	16.4	17.2
122.	19.9	20.3	19.9	20.8	22.4
123.	18.6	18.7	18.4	19.0	21.1
124.	19.1	19.5	19.4	19.9	21.4
125.	17.9	18.8	18.6	18.3	21.1
126.	12.7	13.6	13.3	14.0	16.8
127.	13.3	13.3	13.4	13.4	14.0
128.	12.3	12.8	12.9	12.7	13.0
129.	15.6	16.4	16.9	16.7	17.4
130.	17.1	17.3	18.8	18.6	19.2
131.	19.8	20.9	21.6	21.8	22.6
132.	16.7	17.2	17.5	17.6	17.8
133.	12.3	12.5	13.2	13.6	14.0
134.	10.8	11.1	11.5	11.6	12.3
135.	9.8	10.2	11.0	11.1	11.3
121A	18.0	18.2	18.7	18.8	19.3
136.	9.5	9.5	10.0	9.8	10.2
137.	3.2	3.4	3.5	3.5	3.6
138.	6.6	6.7	7.1	6.9	7.3
139.	3.3	3.3	3.5	3.8	3.9
140.	4.5	4.9	4.9	5.3	5.3
141.	5.2	5.3	5.4	5.5	5.7
142.	5.7	5.8	6.1	6.5	6.8
143.	10.2	10.5	11.1	11.2	11.8
144.	5.7	6.1	6.1	6.3	6.4
145.	3.5	3.2	3.3	3.1	3.3
146.	3.7	3.8	3.7	3.6	3.8
147.	2.3	2.6	2.4	2.3	2.5
148.	2.2	2.2	2.2	2.3	2.3
149.	2.3	2.6	2.3	2.3	2.6
150.	1.5	1.6	1.6	1.5	1.8
151.	1.9	2.1	2.2	2.2	2.4
152.	5.7	5.8	5.6	5.6	6.4
153.	4.1	4.2	4.7	5.3	5.7
154	13.6	16.5	21.4	30.2	43.0

Figure 1
Ergonomic Redesigning of
School Furniture:
4 Different Concepts

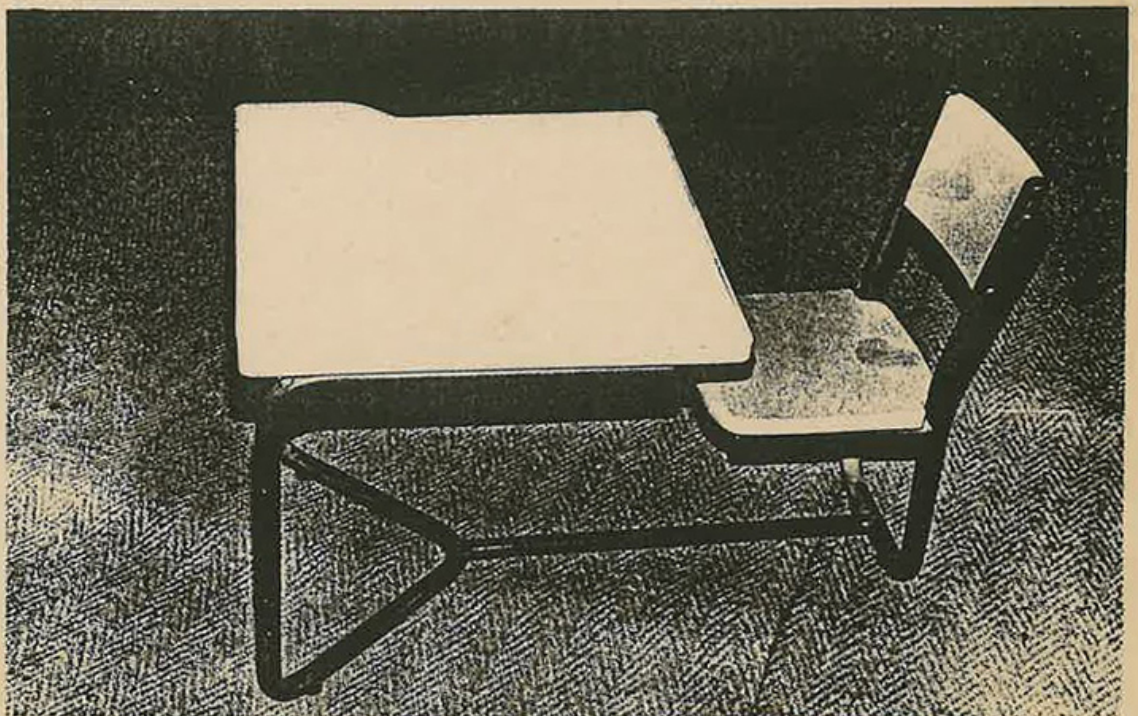
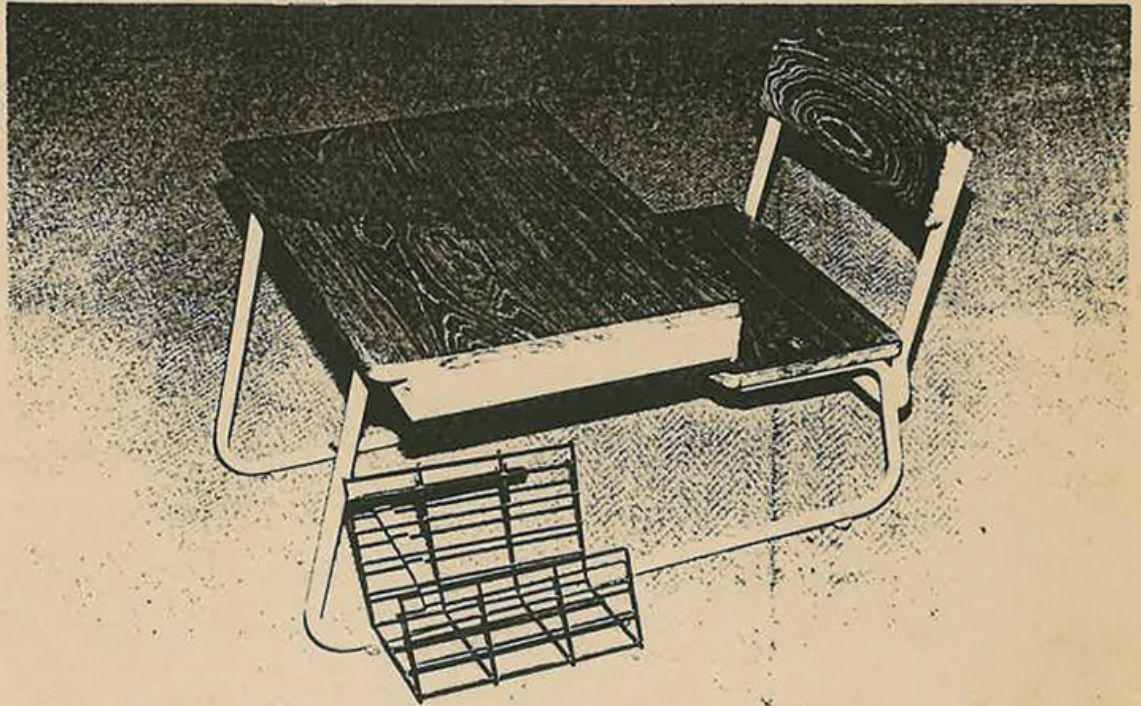


Figure 1 (Contd.)
Ergonomic Redesigning of
School Furniture:
4 Different Concepts

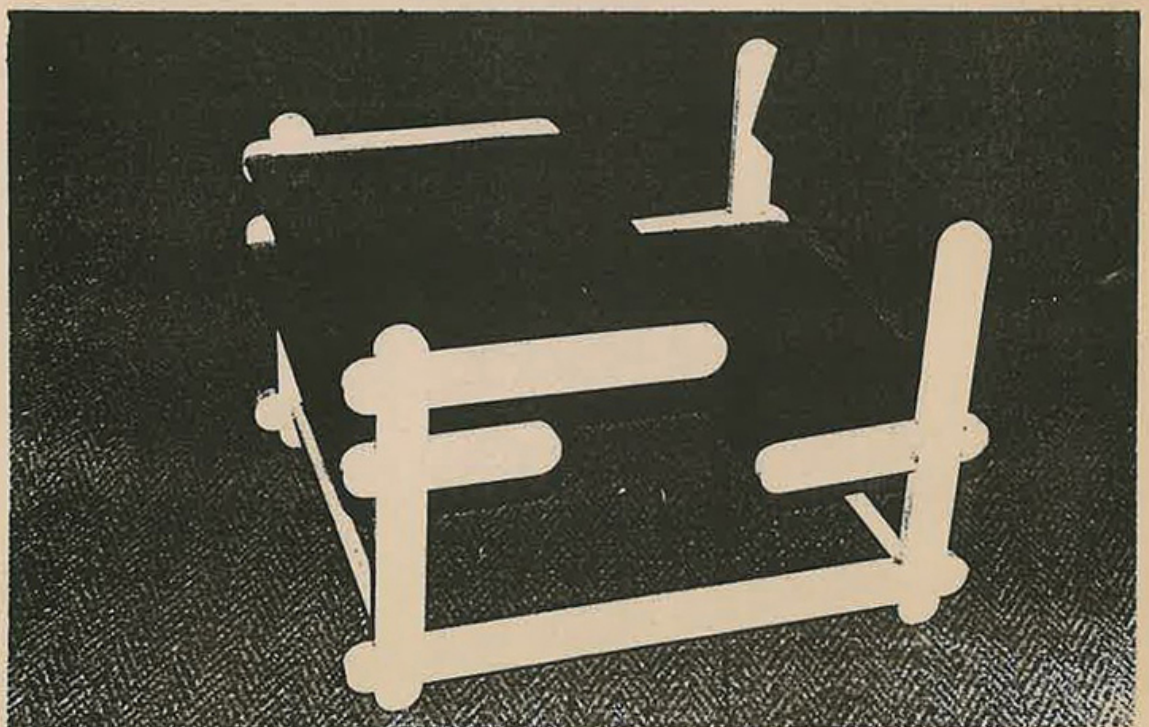
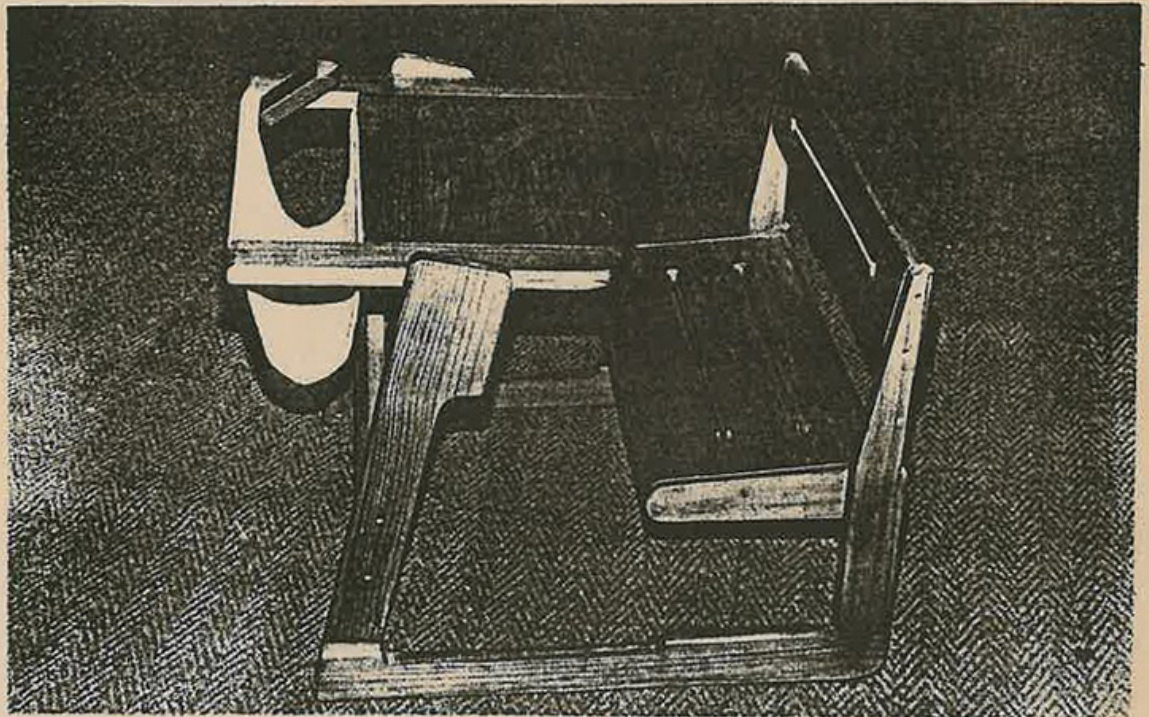


Figure 2 (a)

Different Body Dimensions Measured for School Children (Contd.)

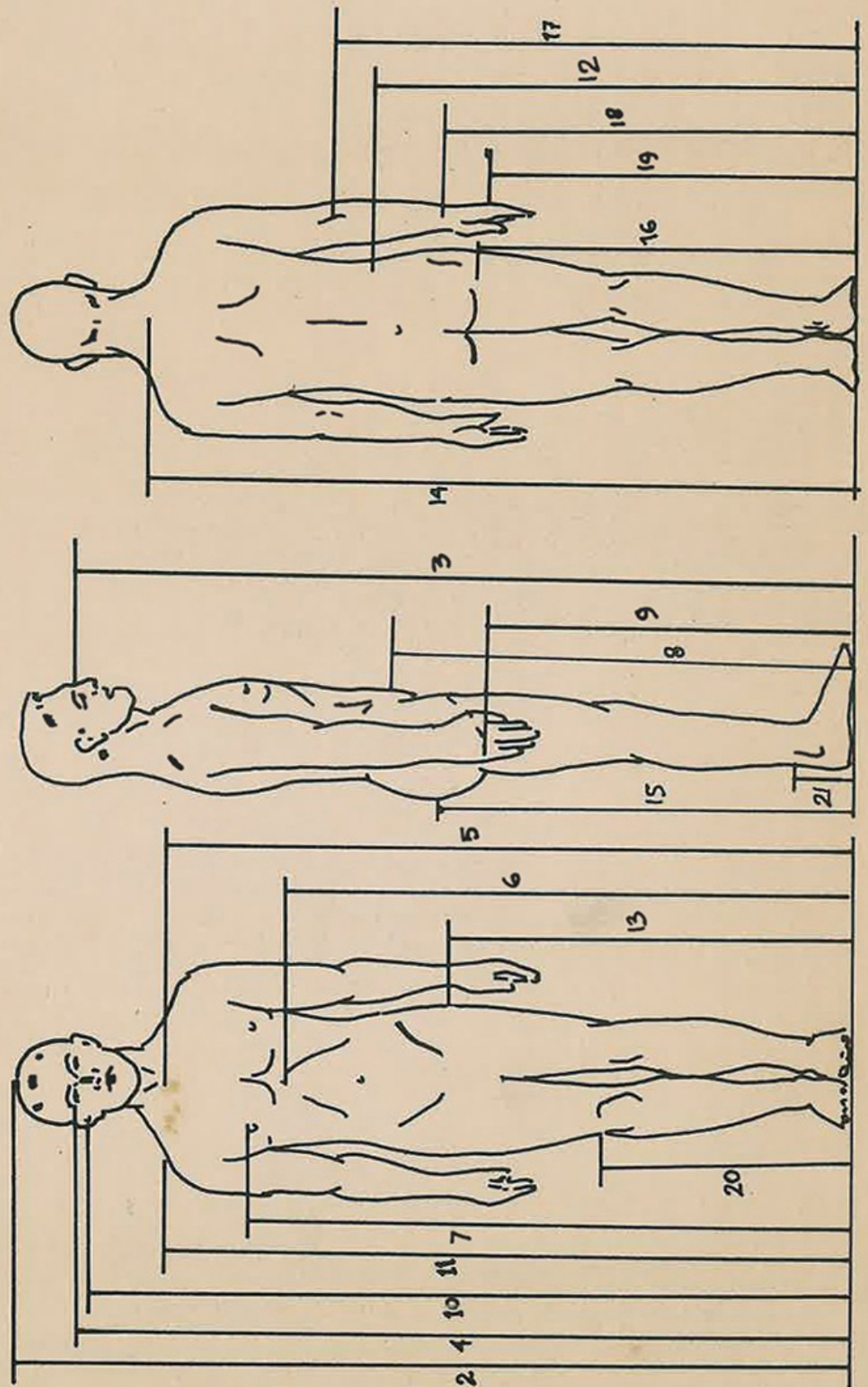


Figure 2 (b)

Different Body Dimensions Measured for School Children (Contd.)

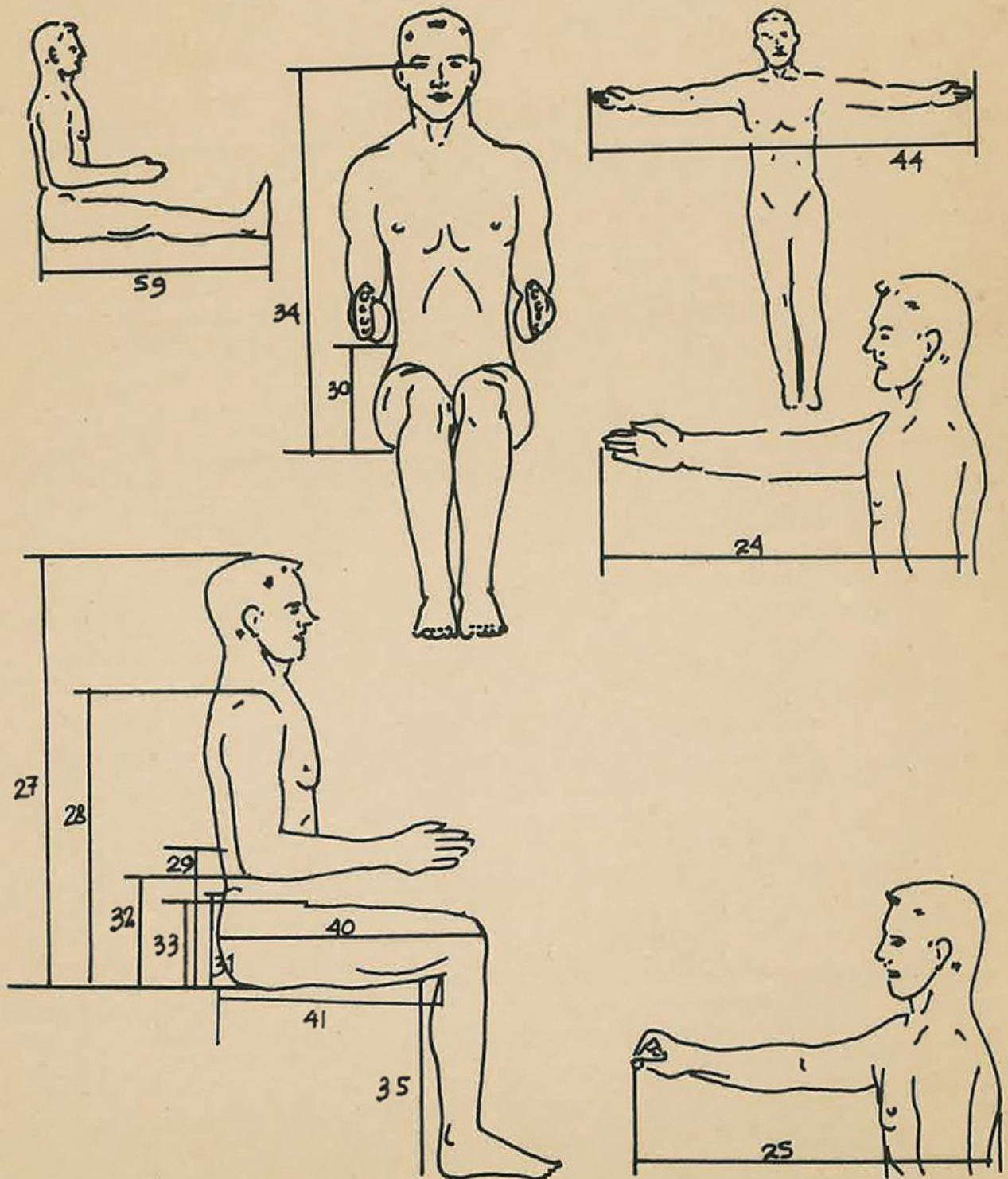


Figure 2 (c)

Different Body Dimensions Measured for School Children (Contd.)

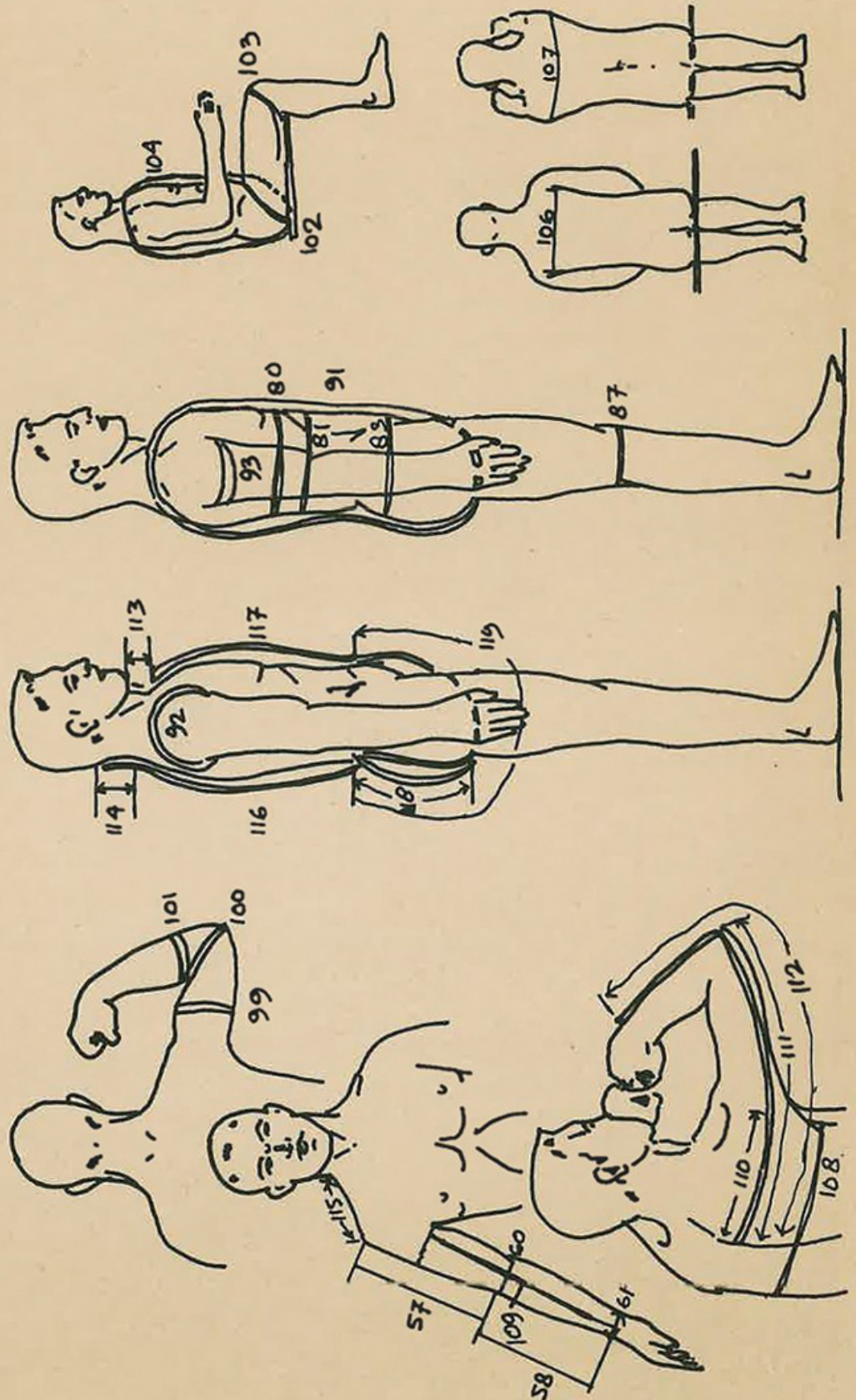


Figure 2 (d)

Different Body Dimensions Measured for School Children (Contd.)

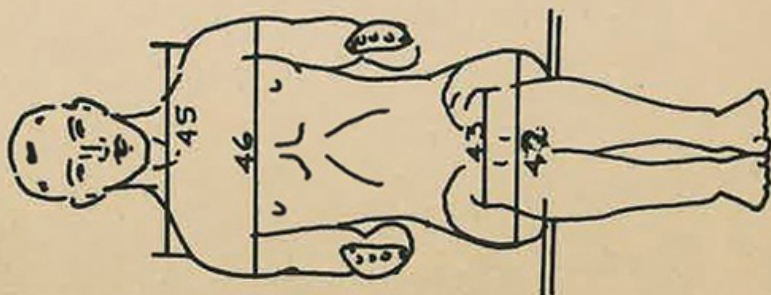
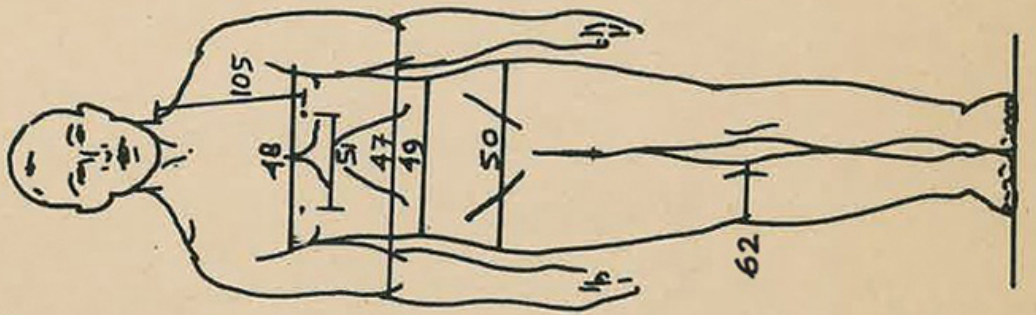
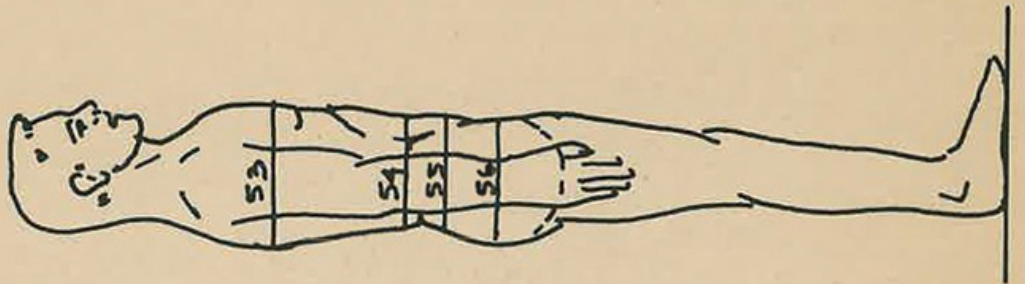
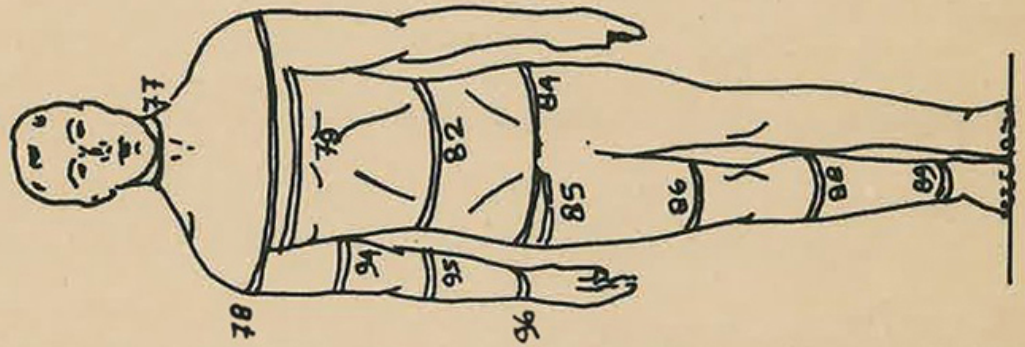


Figure (e)

Different Body Dimensions Measured for School Children (Contd.)

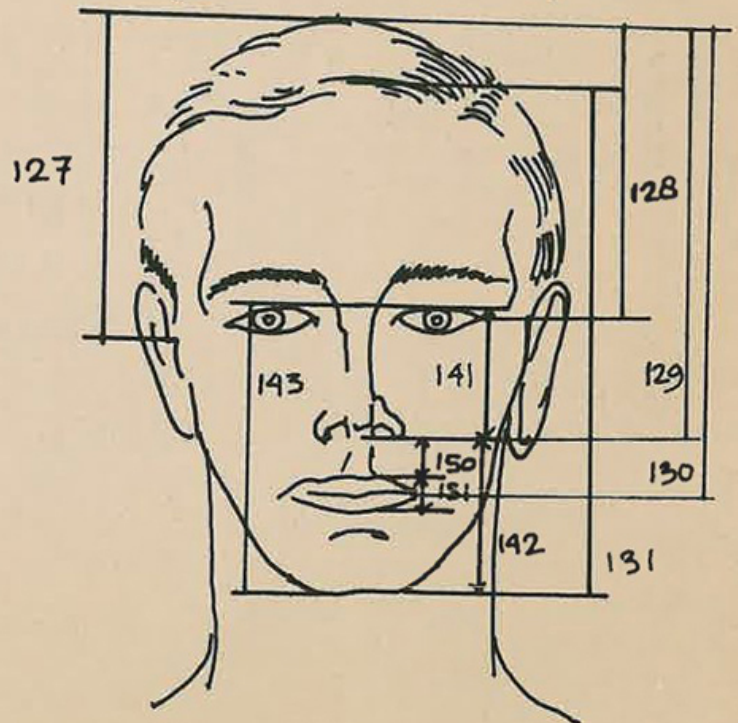
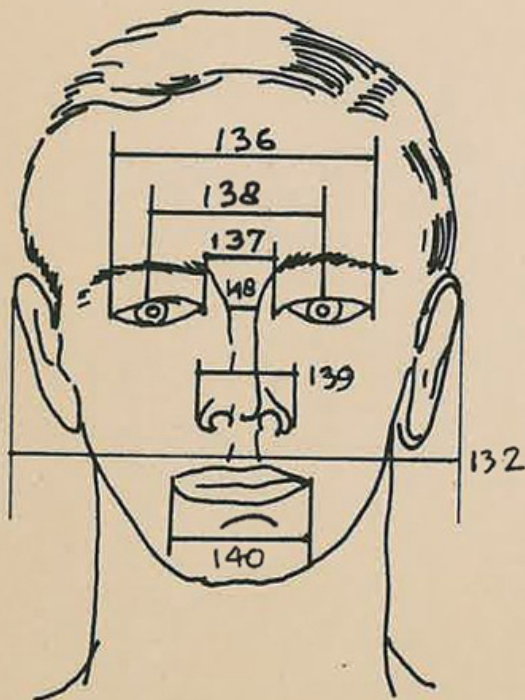
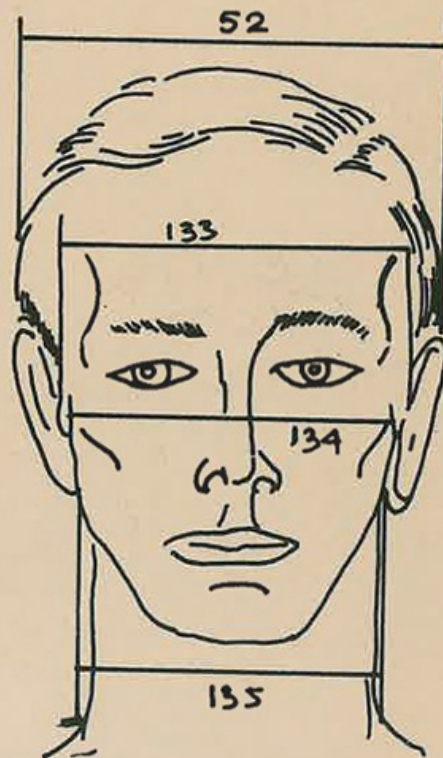
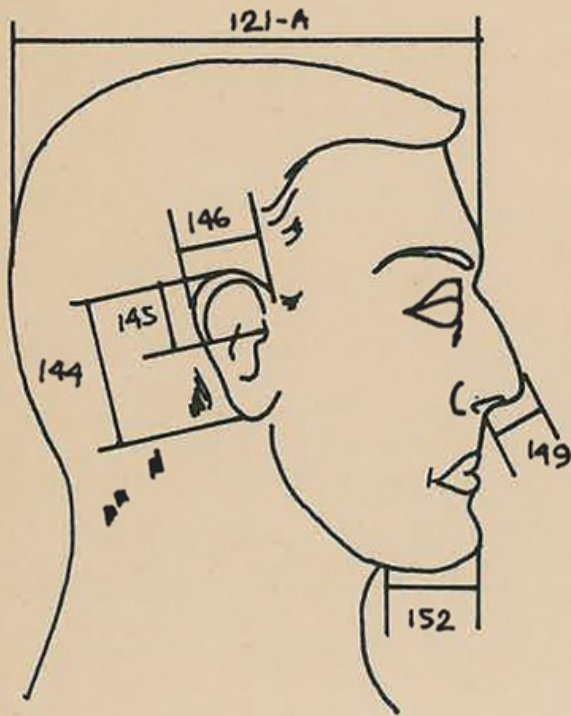
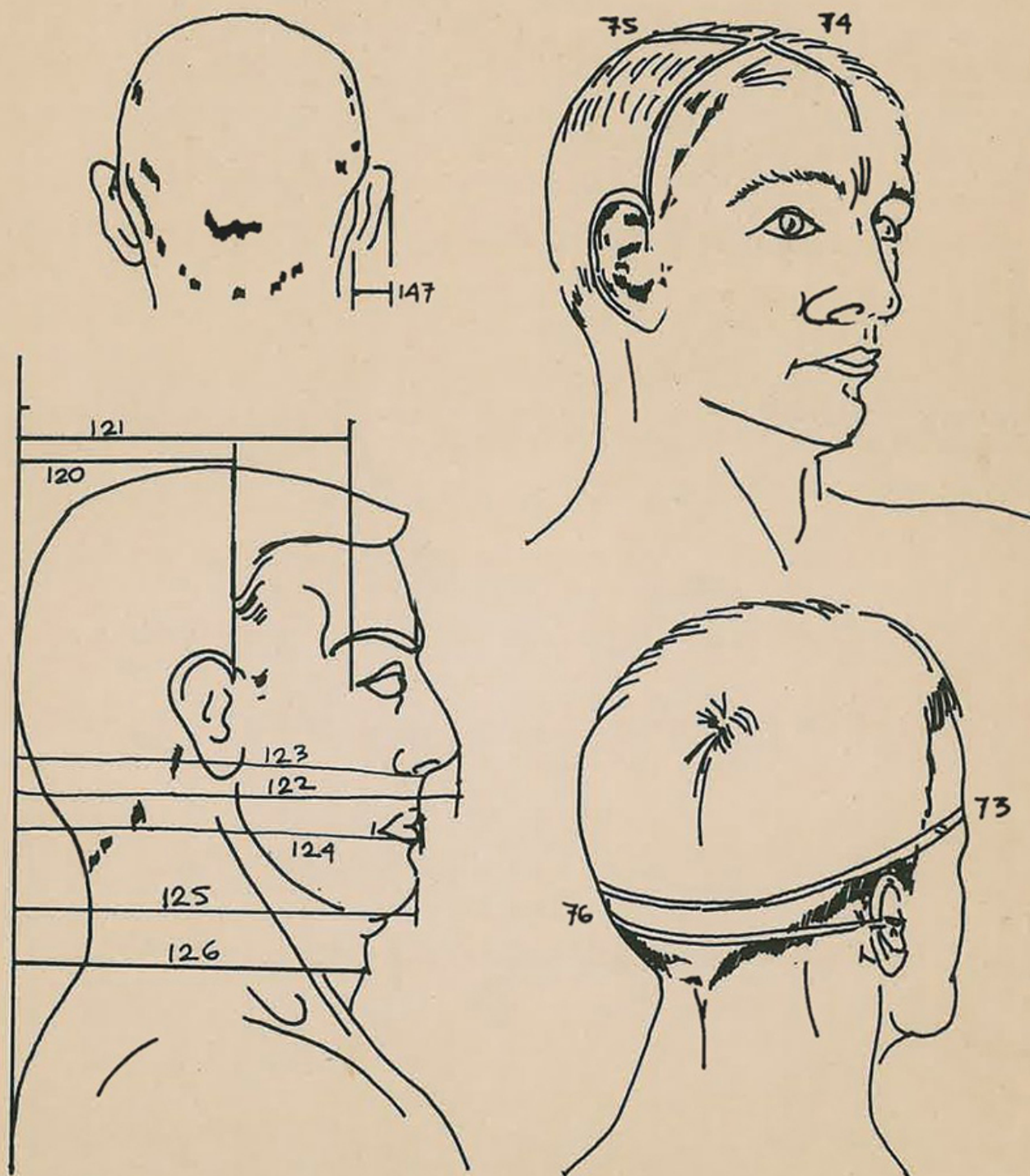


Figure 2 (f)

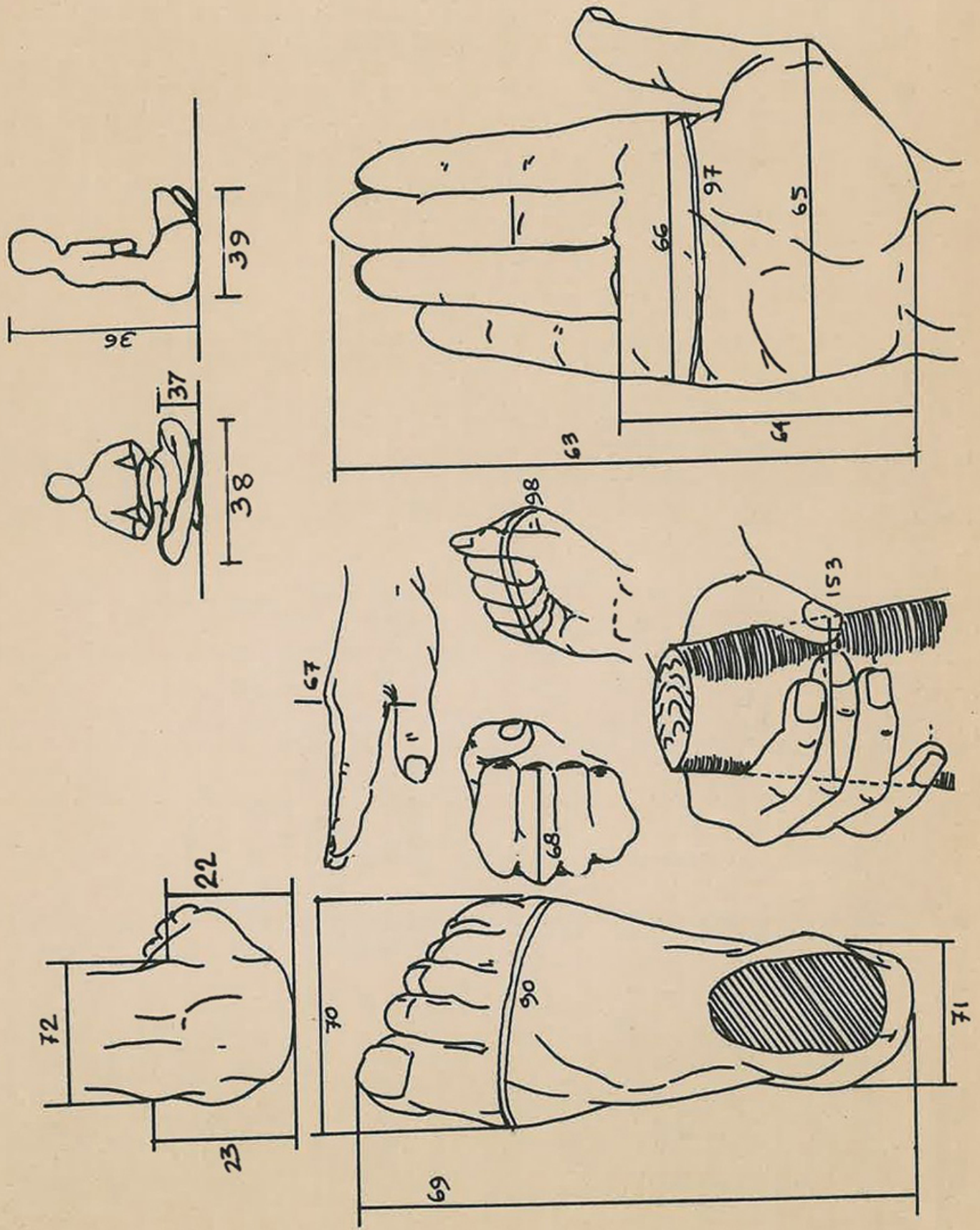
Different Body Dimensions Measured for School Children (Contd.)



All diagrams under figure 2 are reproduced from "Anthropometry of Flying Personnel-1950" by Hertzberg et al, 1954, WADC TR No.52-321

Figure 2 (g)

Different Body Dimensions Measured for School Children



Utility of Data Pack

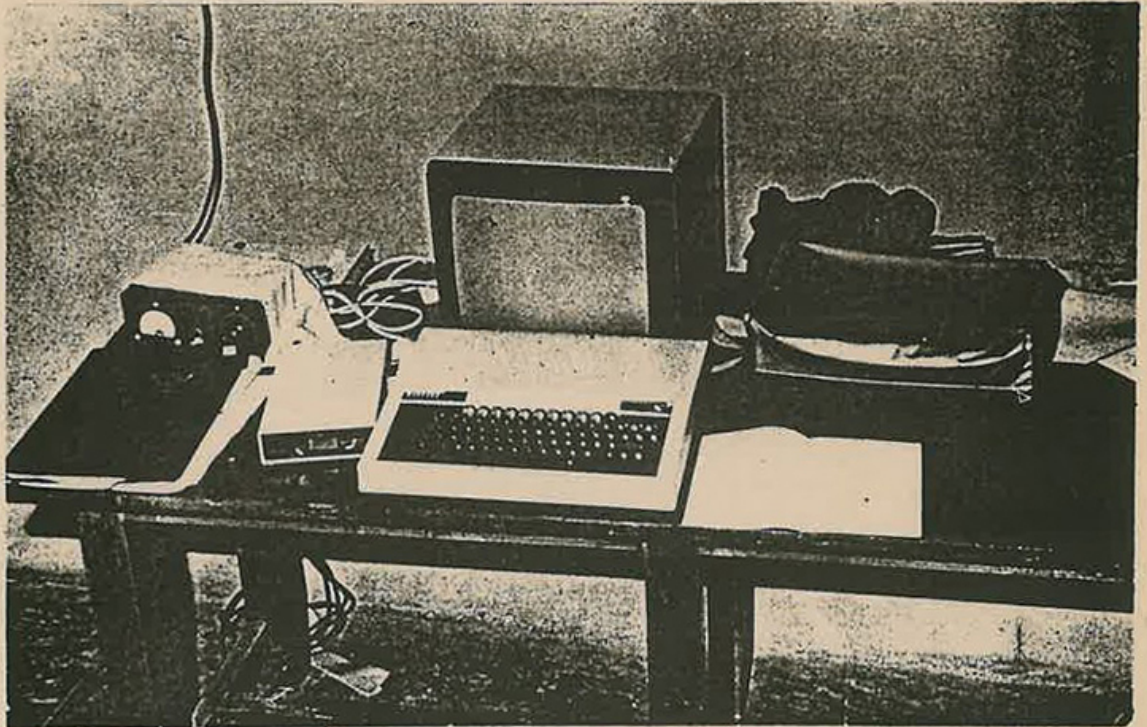
UTILITY OF DATA PACK

Figure 3 shows the conceptual design of ergonomic computer workstation for school children where anthropometric data obtained from this study has been extensively used. Until large scale survey is done, this data pack can be utilised for any product design, workspace organisation, workstation design, interior design, architectural design, furniture design, clothing and garments design, toy design etc. As this data pack is based on very limited sample size, care has to be taken while using it for Indian population.

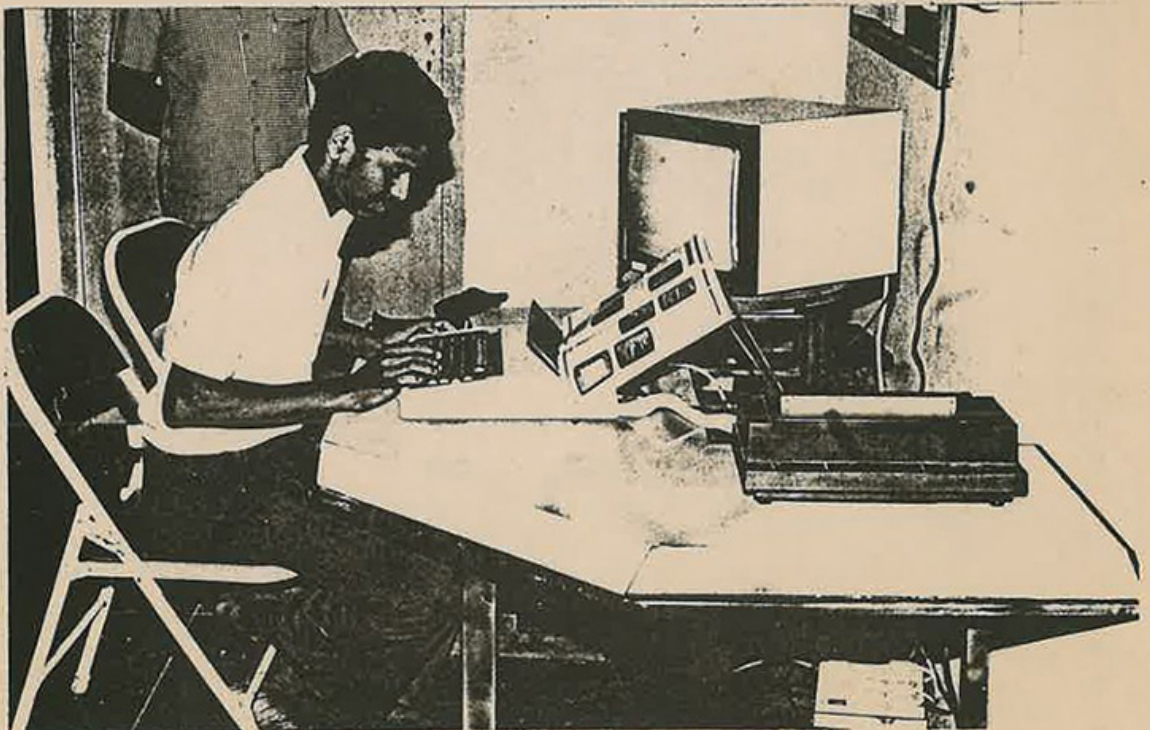
Figure 3

Ergonomic Computer Workstation for School Children

Existing Design



Proposed Design



Annexure1

Manfred Hermann Furniture Designer

Under the UNDP assistance programme, Mr. Manfred Hermann, Furniture designer, from Ulm, West Germany arrived in IDC as a visiting expert in January 1983. A graduate of Hochschule für Gestaltung, Ulm (1966); Mr. Hermann has a design office in Ulm, specialising in furniture development & design. Working for many of the major manufacturers like Lubke, Roder Sohne, DLW, Erbracher, Dunlop, Duravit, Hailo etc., he has created some of the most successful office furniture programmes in West Germany.

In IDC, Mr. Hermann's main assignment was to advise in planning IDC's proposed course in Furniture Design. During his stay here, he also designed furniture for IIT, conducted a two-months course for furniture designers from industry; and guided a one-month project for the junior batch of IDC students in designing school furniture for IIT Central school.

Four groups of students studied requirements for school furniture, developed individual concepts and fabricated prototypes. After evaluation & trials, one of the designs is likely to be adopted for use in IIT Central School.

Photographs show the auditorium chair designed by Mr. Hermann; and the students' prototypes for School furniture.

