

APPENDIX 1

The Rating System

Radiographic Technique

The correct positioning of the hand and wrist is shown in Appendix Fig. 1. It is of great importance since faulty posing causes some bones to have appearances different from those described below. The radiographer must be brought to look on this technique as an attempt to be quantitative, and the anode-film distance should be exact. The left hand is used. The palm faces downwards, in contact with the cassette, with the axis of the middle finger in direct line with the axis of the forearm; the upper arm and fore-arm should be in the same horizontal plane. The fingers are just not touching and the thumb is placed in the comfortable, natural degree of rotation with its axis making an angle of about 30 degrees with the first finger. The palm is pressed lightly downwards on the film cassette by the subject; or if the child is too young to follow these instructions the hand is secured in this position with bandage or tape.



Fig. A1. Correct positioning of hand for skeletal maturity radiograph.

The tube is centred above the head of the 3rd metacarpal, at a tube-film distance of 30 inches or 76 cm. High definition screens should be used since high quality definition is essential. The skin dose is 8–10 millirads. The X-ray table is topped with lead sheeting and a lead-material apron is attached to its edge and is pulled well up into the child's lap to shield the gonads from radiation. The development of the film should preferably be rather light.

Assigning the Ratings

The bones are shown in Appendix Fig. 2. They are rated in the order radius, ulna, metacarpals 1, 3, 5; proximal phalanges 1, 3, 5; middle phalanges 3, 5; distal phalanges 1, 3, 5; capitate, hamate, triquetral, lunate, scaphoid, trapezium, trapezoid. It is convenient to use a standard form for recording. In all drawings the hand is seen with the fingers pointing upward with the thumb on the right hand side of the viewer. Thus, the lateral side is to the viewer's right always, the medial side to his left, distal away from him (or upwards), proximal towards him (or downwards). Reference is frequently made to dorsal and palmar margins or surfaces. It is important to remember that the appearance on the film is a plan in two dimensions of a structure built in three with the added and helpful complication that two superimposed surfaces both penetrated by the X-rays produce a greater degree of whiteness than either of the surfaces penetrated alone. In general the word "margin" or "border" is used where a single line, or edge, is visible on the film: when dorsal and palmar lips become visible the wording has been changed to "surface". The only apparatus required for reading the films is a pair of dividers; these are used for making a rough comparison of diameters of bones in the cases where a criterion requires one bone to be a half or more the width of another. Finer comparisons are not required.

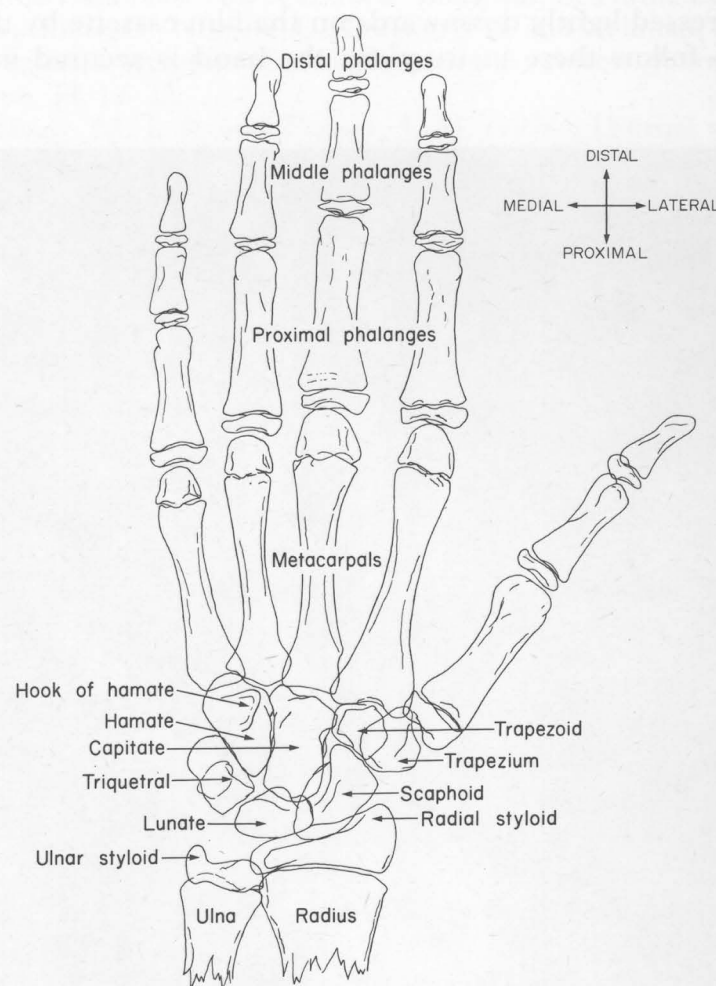


Fig. A2. Bones of the hand and wrist.

Ratings are assigned by comparing the bone in question with the descriptions and diagrams which follow: the nomenclature of the epiphyseal regions is shown in Appendix Fig. 3. If no sign of the bone is present the rating A is given. Appearances corresponding to the descriptions given of H plus or I plus should be rated H or I respectively (they are the old I and J ratings for capitate, triquetral, lunate and trapezoid bones in system TW1).

We give on pp. 44-75 a written description of the criteria for each stage together with a diagram of the typical appearance. In all cases of doubt it is the written description that should be

followed; the diagrams should serve as an aide-memoire, not as the sole means of comparison. Inevitably some individual variation of shape occurs and raters will not always find an exact match to the diagrams. For this reason we have given two radiographs as examples of each stage, indicating the range of variation within the stages. The radiographs are reproduced in all cases actual size. The diagrams of the carpal bones are of similar size; those of the radius, ulna, metacarpals and phalanges are reduced by about one-third. In some radiographs of the earlier stages the ends of the radiographers fingers appeared; to avoid confusion these have been shaded out in the reproduction (e.g. lower stage B, p. 56).

For each stage there are one two or three written criteria marked (i), (ii) and (iii). If only one criteria is given, then this must be satisfied for the stage to be taken as reached; if two criteria are given, then it is sufficient if one of them only is met: if three criteria are given, two of them must be met. Descriptions in brackets are not criteria, and are a help in assigning a rating, but a help only. If at a particular stage a feature described in brackets is not present, this does not affect the rating: if it is, this confirms, but does not diagnose, the stage in question. At each stage, in addition to the criteria for that stage, the criterion (i) for the previous stage must be satisfied, i.e. for a rating stage E to be given, criterion stage D (i) must be met.

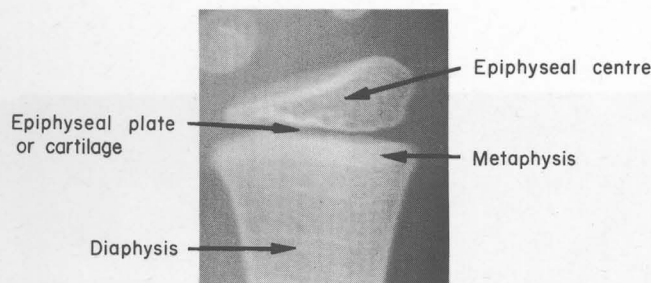


Fig. A3. Nomenclature of epiphyseal areas.

Some bones show greater variation between persons than others. The styloid process of the ulna, and to a lesser extent of the radius also, is sometimes considerably reduced in size; so that it hardly projects at all. The ratings however may still be made by the distinction of the density of the ulna or radial head contrasted with the density of the base of the styloid (ulna stage E).

The hook of the hamate varies considerably in size from person to person, and is occasionally absent. In this case, ratings have to be approximated using the remaining criteria.

The lunate sometimes develops palmar and dorsal portions separately; they then slowly fuse. This may be confusing in stage C, which should be given if the two portions though distinct are both distinct and rounded.

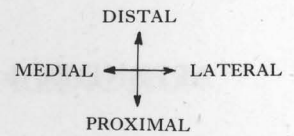
In cases where cone-shaped epiphyses develop, most usually in distal phalanx of the thumb (Iturriza and Tanner, 1969) or other fingers, or more rarely in the middle phalanges, the distal border of the epiphyses follows the shape of the developing cavity rather than being exactly as our descriptions.

In brachyphalangy of the fifth finger, the middle phalanx fuses early and this epiphysis should be given the same rating as the middle phalanx epiphysis for the third finger. Other rarer fusions are described in Hughes and Tanner (1966).

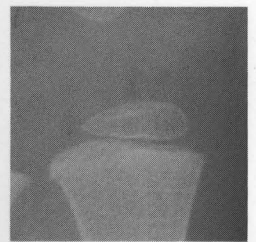
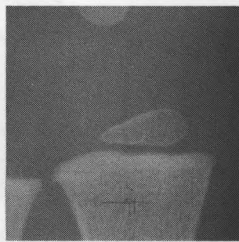
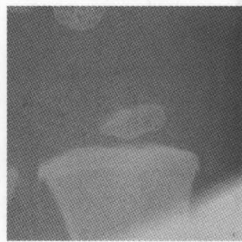
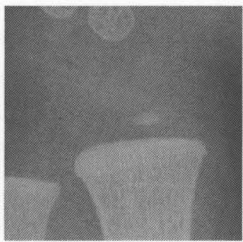
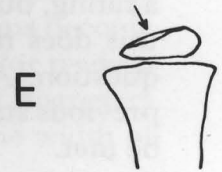
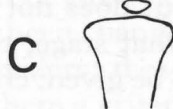
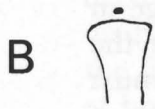
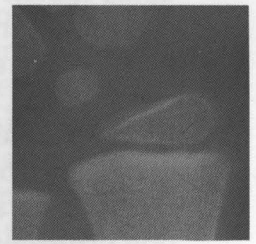
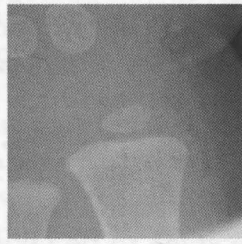
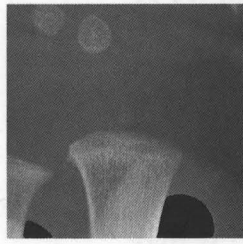
Following these descriptions there are tables for obtaining bone ages (RUS, Carpal, 20-bone) and full page charts of standards for bone maturity (Figs A4–A9) and bone age (Figs A10–A11) on which the status of a given child may be plotted. Tables of the coefficients of the prediction equations for adult height are also given.

References

- Hughes, P. C. R. and Tanner, J. M. (1966). The development of carpal bone fusion as seen in serial radiographs. *British Journal of Radiology*, **39**, 943–949.
- Iturriza, J. R. de and Tanner, J. M. (1969). Cone-shaped epiphyses and other anomalies in the hands of normal British children. *Journal of Pediatrics*, **75**, 265–272.

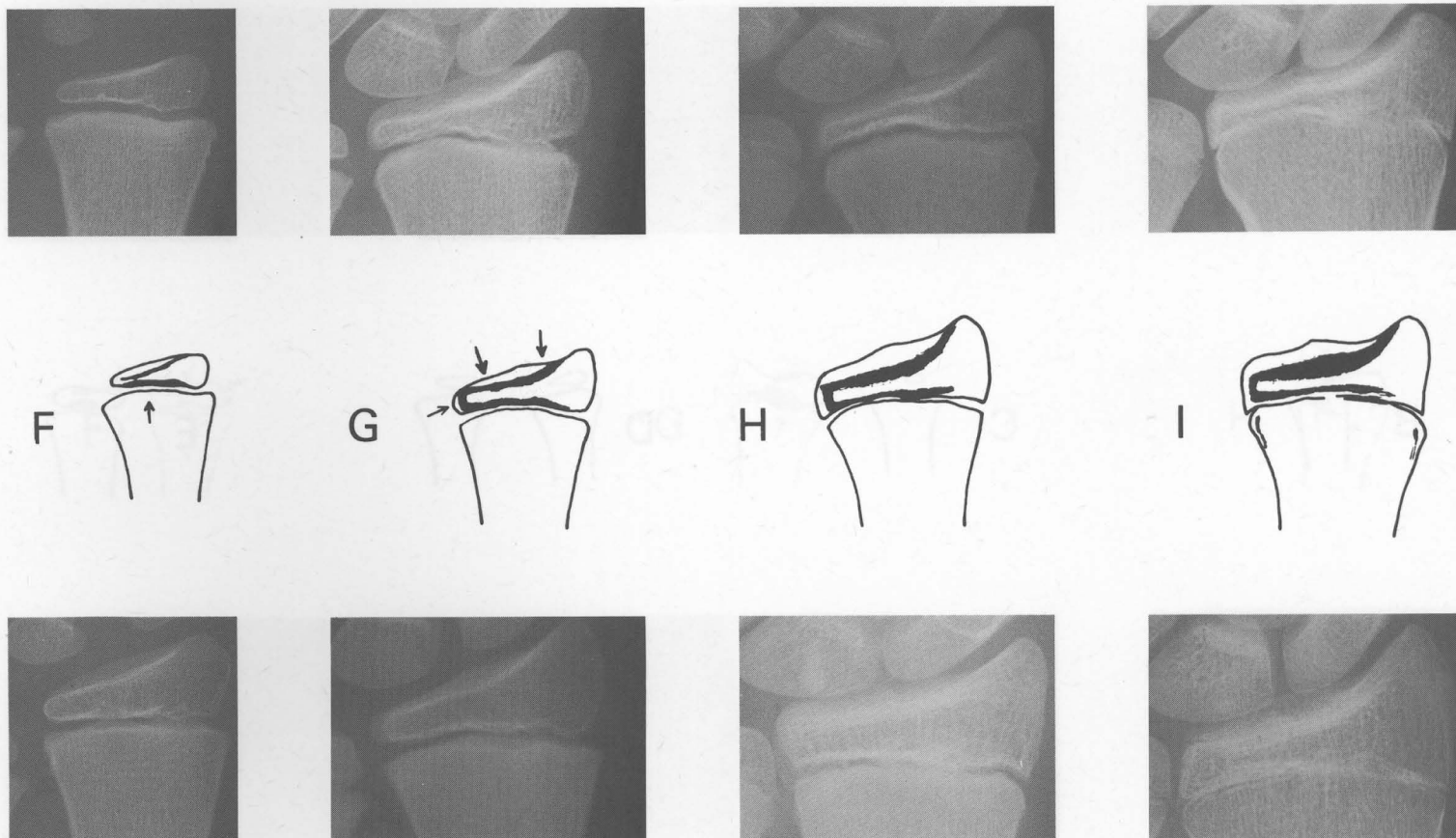


Radius



Boys' Scores		Stage B	Girls' Scores	
TW2	RUS	(i) The centre is just visible as a single deposit of calcium, or more rarely as multiple deposits. The border is frequently ill-defined.	TW2	RUS
15	16		17	23
		Stage C		
TW2	RUS	(i) The centre is distinct in appearance and oval in shape with a smooth continuous border. (The maximum diameter is less than half the width of the metaphysis.)	TW2	RUS
17	21		19	30
		Stage D		
TW2	RUS	(i) The maximum diameter is half or more the width of the metaphysis. (ii) The epiphysis has broadened chiefly at its lateral side, so that this portion is thicker and more rounded, the medial portion more tapering.	TW2	RUS
21	30	(iii) The centre third of the proximal surface is flat and slightly thickened and the gap between it and the radial metaphysis has narrowed to about a millimeter.	25	44
		Stage E		
TW2	RUS	(i) A thickened white line has appeared just inside the distal border of the epiphysis; this represents the edge of the palmar surface and the newly appeared bone distal to it is the edge of the dorsal surface.	TW2	RUS
27	39		33	56

Radius



Boys' Scores

TW2	RUS
48	59

Stage F

- (i) The proximal border of the epiphysis is now differentiated into palmar and dorsal surfaces; the palmar surface is visible as a broad irregularly thickened white line at the proximal edge of the epiphysis.
- (ii) Both ends of the epiphysis, but particularly the medial one, have grown outward and proximally since the last stage so that the proximal border now conforms to the shape of the metaphysis along most of its extent.

Girls' Scores

TW2	RUS
54	78

TW2	RUS
77	87

Stage G

- (i) The dorsal surface now has distinct lunate and scaphoid articular edges joined at a small hump. Lateral to the scaphoid surface the styloid process carries the border distally in a distinct convexity.
- (ii) The medial border of the epiphysis has developed palmar and dorsal surfaces for articulation with the ulnar epiphysis; either palmar or dorsal surface may be the one which projects medially, depending on the position of the wrist.
- (iii) The proximal border of the epiphysis is now slightly concave.

TW2	RUS
85	114

TW2	RUS
96	138

Stage H

- (i) The epiphysis now caps the metaphysis on one (usually the medial) or both sides.
(The styloid process is much further developed than in the last stage.)

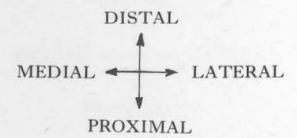
TW2	RUS
99	160

Stage I

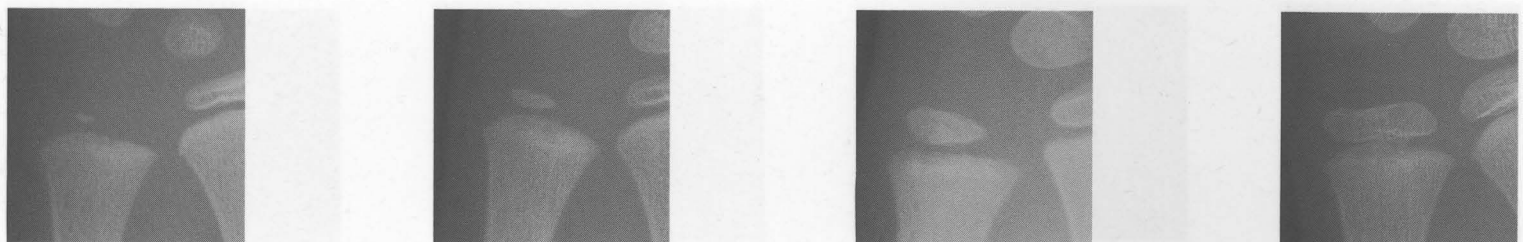
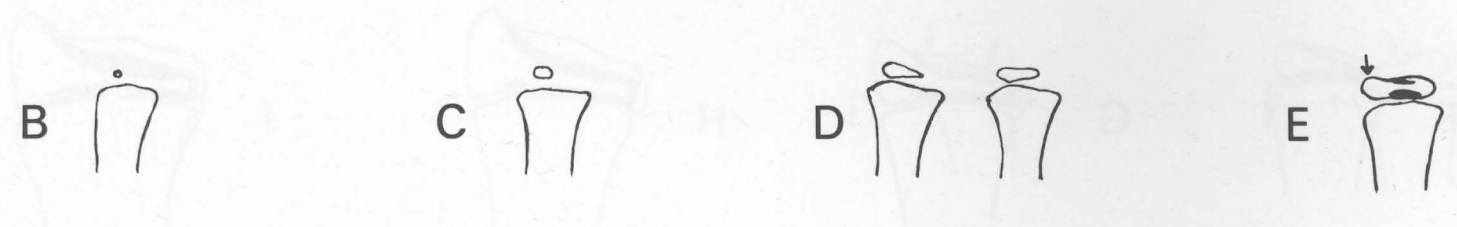
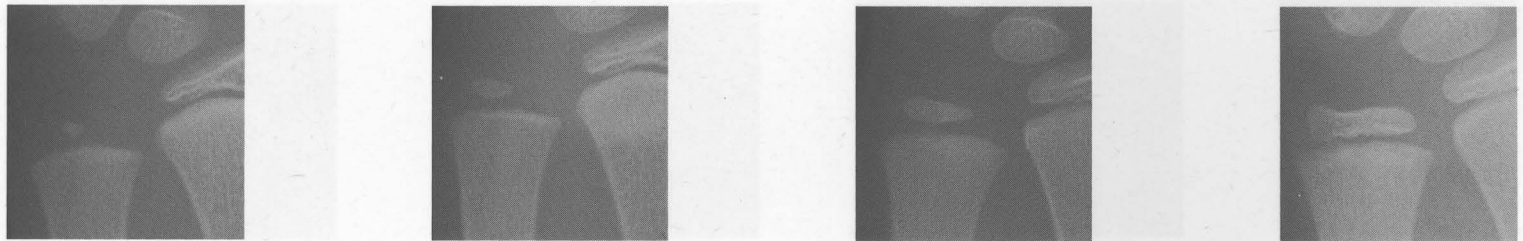
- (i) Fusion of epiphysis and metaphysis has begun. A line may still be visible composed partly of black areas where the epiphyseal cartilage remains and partly of dense white areas where fusion is proceeding; or the line may have disappeared.

TW2	RUS
106	213

TW2	RUS
106	218

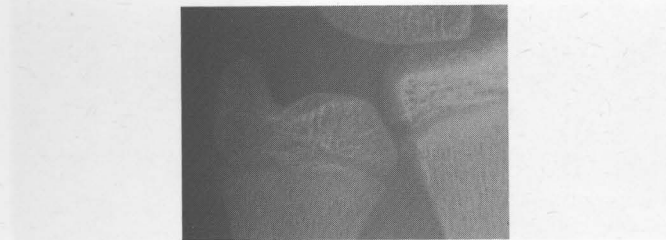
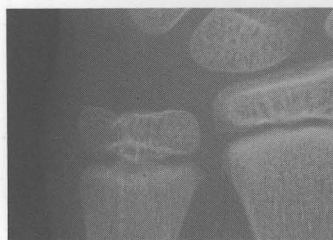


Ulna



Boys' Scores		Stage B	Girls' Scores	
TW2	RUS	(i) The centre is just visible as a single deposit of calcium, or more rarely as multiple deposits. The border is frequently ill-defined.	TW2	RUS
22	27		22	30
		Stage C		
TW2	RUS	(i) The centre is distinct in appearance, with a smooth continuous border. (The maximum diameter is less than half the width of the metaphysis.)	TW2	RUS
26	30		26	33
		Stage D		
TW2	RUS	(i) The maximum diameter is half or more the width of the metaphysis. (ii) The epiphysis is now elongated so that the transverse diameter is considerably greater than the longitudinal. (iii) Proximal and distal borders are both flattened, though not necessarily parallel. (In many children at this stage the medial half of the epiphysis has broadened in the longitudinal direction more than the lateral half, so that the epiphysis is wedge-shaped with the point facing laterally.)	TW2	RUS
30	32		30	37
		Stage E		
TW2	RUS	(i) The styloid process is now visible as a distinct though small projection. In some cases it is more clearly distinguished from the head by a difference in density than by actual projection distally. (Apart from the styloid process, the epiphysis is once more approximately symmetrical about its longitudinal axis, the wedge-shape present in many children in the previous stage now having been eliminated through growth of the lateral half of the epiphysis).	TW2	RUS
39	40		39	45

Ulna



Boys'
Scores

Stage F

- (i) The head of the ulna is now distinctly defined and denser than the styloid process. Its medial surface usually appears as a thickened white line differentiating it from the styloid process, and there is often a concavity of the proximal and or distal border of the epiphysis where the head and styloid meet.
- (ii) The border adjacent to the radial epiphysis is flattened.

TW2 RUS
56 58

Girls'
Scores

TW2 RUS
60 74

Stage G

- (i) The epiphysis is now as wide as the metaphysis.
- (ii) The proximal border of the epiphysis and the distal border of the metaphysis overlap in their central one-third. The metaphysis has a concavity or saddle into which the epiphyseal head appears to fit.

TW2 RUS
73 107

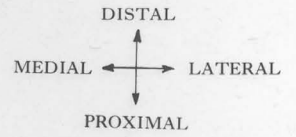
TW2 RUS
73 118

Stage H

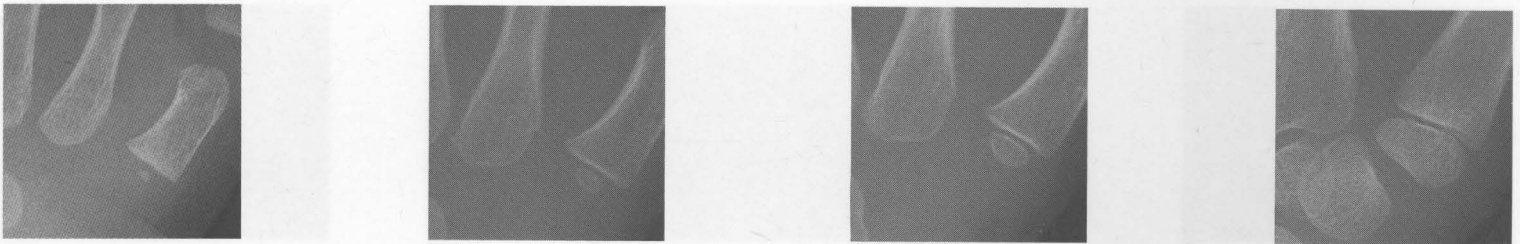
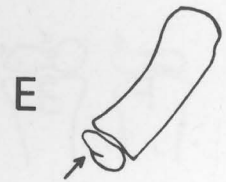
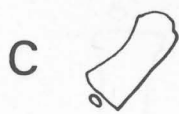
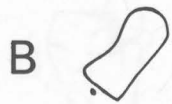
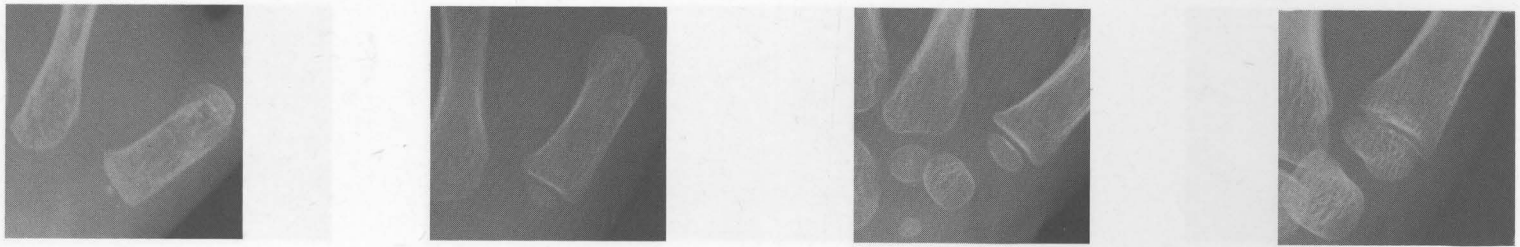
- (i) Fusion of epiphysis and metaphysis has begun. A line may be still visible composed partly of black areas where the epiphyseal cartilage remains, and partly of dense white areas where fusion is proceeding; or the line may have disappeared.

TW2 RUS
84 181

TW2 RUS
80 173



First Metacarpal



Boys' Scores
TW2 RUS
4 6

Stage B

- (i) The centre is just visible as a single deposit of calcium, or more rarely as multiple deposits. The border is frequently ill-defined.

Girls' Scores
TW2 RUS
5 8

TW2 RUS
5 9

Stage C

- (i) The epiphysis is distinct in appearance and oval in shape, with a smooth continuous border.
(The maximum diameter is less than half the width of the metaphysis.)

TW2 RUS
6 12

TW2 RUS
11 14

Stage D

- (i) The maximum diameter is half or more the width of the metaphysis.
(The distal surface has flattened so that it is less convex than the proximal surface. The base of the adjacent metaphysis has a central indentation.)

TW2 RUS
11 18

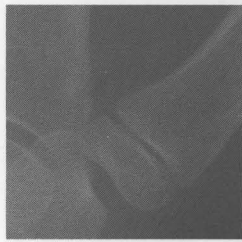
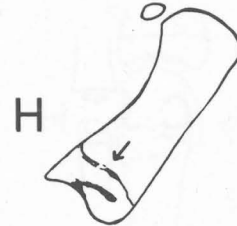
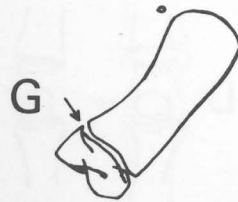
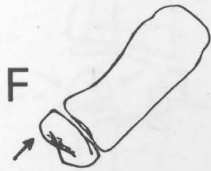
TW2 RUS
19 21

Stage E

- (i) The epiphysis is as wide as the metaphysis.
(ii) A concavity is present in the proximal border; this is due to the first appearance of palmar and dorsal surfaces of the epiphysis, though as yet these surfaces themselves are not distinct.

TW2 RUS
18 24

First Metacarpal



Boys'
Scores

Stage F

- (i) The differentiation of the proximal surface into palmar and dorsal portions is now distinct and the full extent of the dorsal surface can be made out; due to the rotation of the thumb in its position on the film, these surfaces appear as latero-dorsal and medio-palmar. The saddle formed by these surfaces conforms to the adjacent border of the trapezium bone.

(Towards the end of this stage the medial border of the epiphysis changes from a rounded shape to a flat distinct border.)

Girls'
Scores

TW2 RUS
24 26

TW2 RUS
24 31

Stage G

- (i) The epiphysis caps the metaphysis on one or both sides; the capping is usually seen better on the medial than on the lateral side, due to the rotation of the thumb in positioning the hand.

(The medial border of the epiphysis usually overlaps the base of the second metacarpal at their point of articulation.)

TW2 RUS
28 36

TW2 RUS
29 43

Stage H

- (i) Fusion of epiphysis and metaphysis has begun. (A line is still visible, composed partly of black areas where the epiphyseal cartilage remains and partly of dense white areas where fusion is proceeding.)

TW2 RUS
30 49

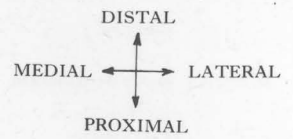
TW2 RUS
31 53

Stage I

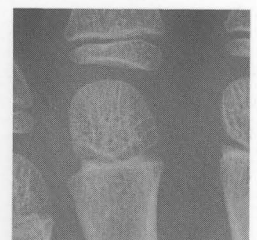
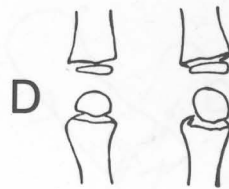
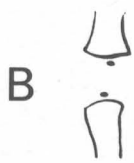
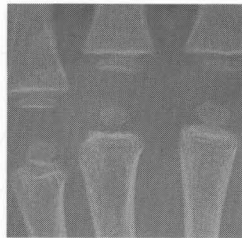
- (i) Fusion of epiphysis and metaphysis is completed. (Over the majority of its length the line of fusion has entirely disappeared, but some thickened remnant of it may still be visible.)

TW2 RUS
32 67

TW2 RUS
33 67

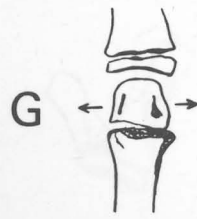
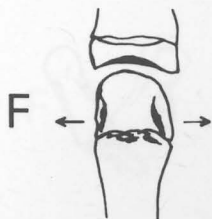


Third (III) and Fifth (V) Metacarpals



Boys' Scores			Girls' Scores	
		Stage B		
		(i) The centre is just visible as a single deposit of calcium, or more rarely as multiple deposits. The border is frequently ill-defined.		
TW2	RUS		TW2	RUS
III	3		3	5
V	3		3	6
		Stage C		
		(i) The epiphysis is distinct in appearance and rounded in shape with a smooth continuous border. (The transverse diameter is less than half the width of the metaphysis.)		
TW2	RUS		TW2	RUS
III	4		5	8
V	3		4	9
		Stage D		
		(i) The transverse diameter is half or more the width of the metaphysis. (The proximal border may or may not have begun to flatten, but the lateral and medial borders seen in the next stage are not yet visible.)		
TW2	RUS		TW2	RUS
III	6		7	12
V	6		7	12
		Stage E		
		(i) Since the last stage the shape of the epiphysis has changed from being an oval or semicircle to that of a spade or finger-nail. This occurs by virtue of the lateral, medial and proximal borders of the epiphysis becoming distinct one from another. (The palmar and dorsal surfaces are not yet differentiated.)		
TW2	RUS		TW2	RUS
III	10		11	16
V	12		12	17

Third (III) and Fifth (V) Metacarpals



Boys' Scores	
TW2	RUS
III 16	19
V 17	18

Stage F

- (i) It is now possible, in a good film, to distinguish the palmar from the dorsal surface of the epiphysis. Since the last stage the medial and or lateral edges of the dorsal surface have grown outwards to overlap the palmar surface of the epiphysis. The outlines of the palmar edges now appear as longitudinal thickened white lines.

(The epiphysis is not yet as wide as the metaphysis.)

Girls' Scores		
TW2	RUS	
17	23	III
18	23	V

Stage G

- (i) The epiphysis is as wide as, or wider than, the metaphysis. (This stage would seem to be the equivalent of the stage of capping in the epiphysis of the phalanges.)

(The longitudinal white lines that signify the edges of the palmar surface now curve outwards to the proximal corners.)

(A translucent line of cartilage still remains, but due to positioning of the hand it does not usually extend right across the bone; it should, however, be visible over at least three-quarters of the bone's breadth.)

TW2	RUS
III 22	31
V 21	29

TW2	RUS	
23	37	III
22	35	V

Stage H

TW2	RUS
III 23	43
V 23	43

- (i) Fusion of epiphysis and metaphysis has begun. (The dark line of cartilage extends over less than three-quarters of the bone's breadth, but is not entirely obliterated.)

TW2	RUS	
24	47	III
24	48	V

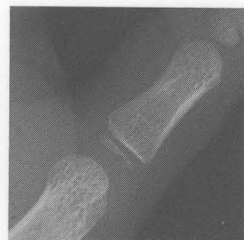
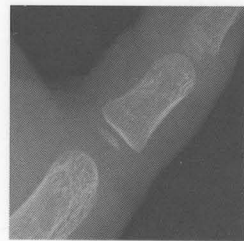
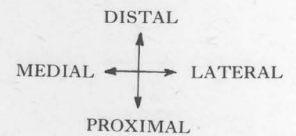
Stage I

TW2	RUS
III 25	52
V 25	52

- (i) Fusion of epiphysis and metaphysis is completed. (Over the majority of its length the line of fusion has entirely disappeared, but some thickened remnant of it may still be visible.)

TW2	RUS	
26	53	III
25	52	V

Proximal Phalanx of the Thumb



Boys'
Scores
TW2 RUS
4 7

Stage B

- (i) The centre is just visible as a single deposit of calcium or more rarely as multiple deposits. The border is frequently ill-defined.

Girls'
Scores
TW2 RUS
5 9

TW2 RUS
5 8

Stage C

- (i) The centre is distinct in appearance and disc-shaped, with a smooth continuous border.
(The maximum diameter is less than half the width of the metaphysis.)
(Multiple centres may occur whose summed maximum diameters exceed half the width of the metaphysis, they should however be rated stage C.)

TW2 RUS
5 11

TW2 RUS
8 11

Stage D

- (i) The maximum diameter is half or more the width of the metaphysis.
(The epiphysis has acquired distinct blunt medial and lateral ends and has the appearance of a broad ring; the borders may or may not show slight thickening.)

TW2 RUS
8 14

TW2 RUS
15 17

Stage E

- (i) The proximal border is concave and usually thickened, which is a forerunner of its differentiation into palmar and dorsal surfaces seen in the next stage.
(ii) The medial side is longer than the lateral, giving a wedge-shaped appearance.
(The epiphysis is very nearly as wide as the metaphysis.)

TW2 RUS
14 20

Proximal Phalanx of the Thumb



Boys'
Scores

Stage F

- (i) The epiphysis is distinctly wider than the metaphysis, particularly at the medial side; it follows closely its shape although it does not yet cap it at the edges.

(Further development of the metacarpal articular surfaces has produced a differentiation of palmar and dorsal edges, which are now visible. The dorsal edge is represented by a thickened white line, which runs in an arc concentric with the end of the metacarpal head, from one proximal corner of the epiphysis to the other. The palmar surface is visible as the proximal border of the epiphysis.)

TW2 RUS
23 26

Girls'
Scores

TW2 RUS
24 31

Stage G

- (i) The epiphysis caps the metaphysis; the capping is seen better on the medial than on the lateral side.

TW2 RUS
28 38

TW2 RUS
29 44

Stage H

- (i) Fusion of epiphysis and metaphysis has begun. (A line is still visible, composed partly of black areas where the epiphyseal cartilage remains and partly of dense white areas where fusion is proceeding.)

TW2 RUS
30 52

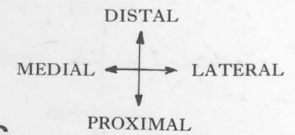
TW2 RUS
30 56

Stage I

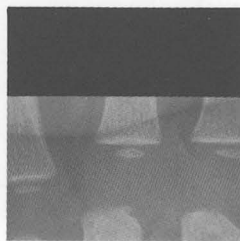
- (i) Fusion of epiphysis and metaphysis is completed. (Over the majority of its length the line of fusion has entirely disappeared, but some thickened remnant of it may still be visible.)


TW2 RUS
32 67


TW2 RUS
32 67



Proximal Phalanges of Third (III) and Fifth (V) Fingers

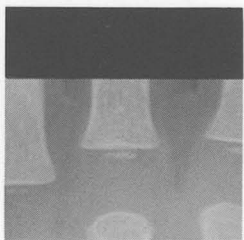


B 

C 

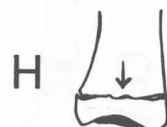
D 

E 



Boys' Scores		Stage B	Girls' Scores	
	TW2	RUS		
III	3	4	(i) The centre is just visible as a single deposit of calcium, or more rarely as multiple deposits. The border is frequently ill-defined.	TW2 RUS 4 5 III
V	3	4		4 6 V
Boys' Scores		Stage C	Girls' Scores	
	TW2	RUS		
III	4	4	(i) The centre is distinct in appearance and disc-shaped, with a smooth continuous border. (The maximum diameter is less than half the width of the metaphysis.)	TW2 RUS 4 7 III
V	3	5		4 7 V
Boys' Scores		Stage D	Girls' Scores	
	TW2	RUS		
III	6	9	(i) The epiphysis is half or more the width of the metaphysis.	TW2 RUS 7 12 III
V	6	9		7 12 V
Boys' Scores		Stage E	Girls' Scores	
	TW2	RUS		
III	13	15	(i) The proximal border of the epiphysis is concave and distinctly thickened. (This is the forerunner of the development of the metacarpal articular surface, which usually takes place only in the next stage. Sometimes in stage E, however, some differentiation into palmar and dorsal surfaces, as described in stage F, can be seen.)	TW2 RUS 13 19 III
V	13	15	(The epiphysis is not yet as wide as the metaphysis.)	13 18 V

Proximal Phalanges of Third (III) and Fifth (V) Fingers



Boys'
Scores

Girls'
Scores

Stage F

- (i) The epiphysis is as wide as the metaphysis and follows closely its shape, although it does not yet cap it at the edges.

(Further development of the metacarpal articular surface has taken place since the last stage and, at least on the third metacarpal at this stage, although not always on the fifth, a distinct differentiation of palmar and dorsal edges can be seen. The palmar surface is visible as the proximal border of the epiphysis. The dorsal edge is represented by the thickened white line which runs in an arc concentric with the end of the metacarpal head from one proximal corner of the epiphysis to the other. In some positions of the hand, however, the palmar edge may coincide with the dorsal, and the dorsal thickened concave white line is all that can be seen.)

	TW2	RUS
III	20	23
V	19	21

	TW2	RUS	
III	20	27	III
V	19	26	V

Stage G

- (i) The epiphysis caps the metaphysis.

	TW2	RUS
III	23	31
V	22	30

	TW2	RUS	
III	24	37	III
V	23	35	V

Stage H

- (i) Fusion of epiphysis and metaphysis has now begun. (A line is still visible composed partly of black areas where the epiphyseal cartilage remains and partly of dense white areas where fusion is proceeding.)

	TW2	RUS
III	24	40
V	23	39

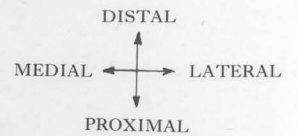
	TW2	RUS	
III	25	44	III
V	24	42	V

Stage I

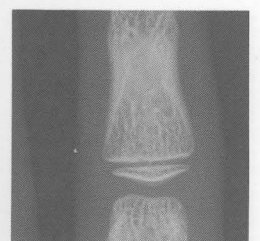
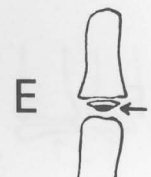
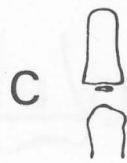
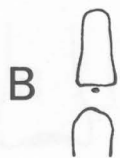
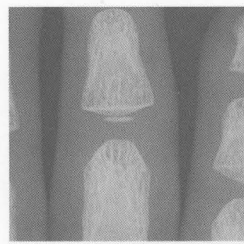
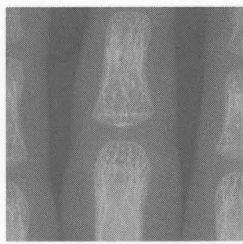
- (i) Fusion of epiphysis and metaphysis is completed. (Over the majority of its length the line of fusion has entirely disappeared, but some thickened remnant of it may still be visible.)

	TW2	RUS
III	26	53
V	25	51

	TW2	RUS	
III	26	54	III
V	25	51	V



Middle Phalanges of Third (III) and Fifth (V) Fingers



Boys' Scores	
TW2	RUS
III	3 4
V	4 6

Stage B

(i) The centre is just visible as a single deposit of calcium, or more rarely as multiple deposits. The border is frequently ill-defined.

Girls' Scores	
TW2	RUS
III	4 6 III
V	4 7 V

TW2	RUS
III	4 6
V	4 7

Stage C

(i) The centre is distinct in appearance and disc-shaped, with a smooth continuous border.
(The maximum diameter is less than half the width of the metaphysis.)

TW2	RUS
III	4 8 III
V	5 8 V

TW2	RUS
III	7 9
V	8 9

Stage D

(i) The maximum diameter is half or more the width of the metaphysis.
(The borders are slightly thickened, and the proximal border somewhat convex.)

TW2	RUS
III	7 12 III
V	8 12 V

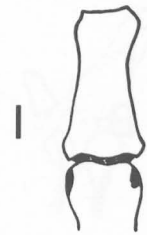
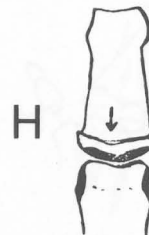
TW2	RUS
III	13 15
V	14 15

Stage E

(i) The central portion of the proximal border has thickened and grown towards the end of the adjacent phalanx, shaping to its trochlear surface.
(This thickened white line represents the dorsal surface of the epiphysis; proximal to it the palmar surface is usually visible on one or both sides as a convex projection. In some positions of the hand, however, these proximal edges of palmar and dorsal surfaces appear superimposed.)
(The distal border of the proximal phalanx shows a small concavity.)

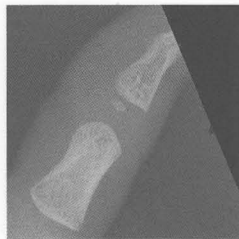
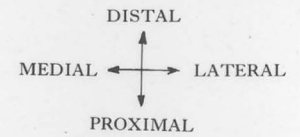
TW2	RUS
III	13 18 III
V	14 18 V

Middle Phalanges of Third (III) and Fifth (V) Fingers



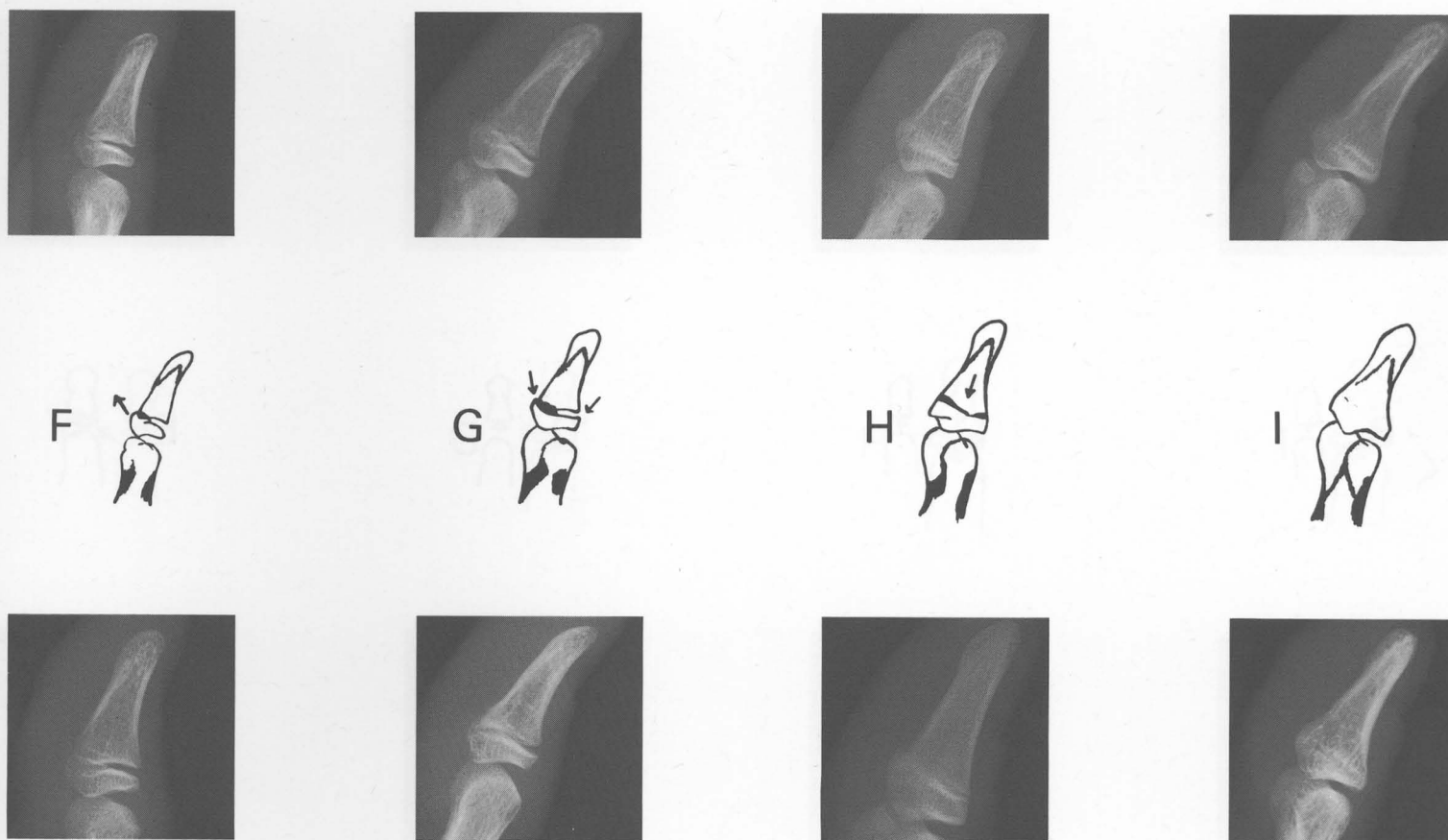
Boys' Scores		Stage F	Girls' Scores	
		(i) The epiphysis is as wide as the metaphysis. (The thickened dorsal proximal surface shows an out-growth at its centre to fit into the now well marked concavity at the distal border of the proximal phalanx.)		
III	TW2 19 RUS 22		TW2 20 RUS 27	III
V	TW2 19 RUS 23		TW2 20 RUS 28	V
		Stage G		
		(i) The epiphysis caps the metaphysis. (The facets for the collateral ligaments are now visible on either side of the head of the proximal phalanx. This is largely a result of the outward growth of the sides of the phalanx in its terminal portion, which creates the appearance of a distinct head.)		
III	TW2 22 RUS 32		TW2 23 RUS 36	III
V	TW2 21 RUS 32		TW2 22 RUS 35	V
		Stage H		
		(i) Fusion of epiphysis and metaphysis has begun. A line is still visible, composed partly of black areas where the epiphyseal cartilage remains and partly of dense white areas where fusion is proceeding. (The facets for the collateral ligaments on the head of the proximal phalanx have developed further since the last stage so that their palmar and dorsal borders can often be distinguished.)		
III	TW2 23 RUS 43		TW2 24 RUS 45	III
V	TW2 22 RUS 42		TW2 22 RUS 43	V
		Stage I		
		(i) Fusion of epiphysis and metaphysis is completed. (Over the majority of its length the line of fusion has entirely disappeared, but some thickened remnant of it may still be visible.)		
III	TW2 25 RUS 52		TW2 25 RUS 52	III
V	TW2 23 RUS 49		TW2 23 RUS 49	V

Distal Phalanx of the Thumb

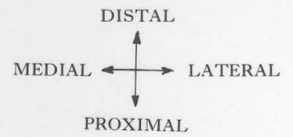


Boys' Scores		Stage B	Girls' Scores	
TW2	RUS	(i) The centre is just visible as a single deposit of calcium, or more rarely as multiple deposits. The border is frequently ill-defined.	TW2	RUS
4	5		5	7
		Stage C		
TW2	RUS	(i) The centre is distinct in appearance and disc-shaped, with a smooth continuous border. (The maximum diameter is less than half the width of the metaphysis.)	TW2	RUS
4	6		5	9
		Stage D		
TW2	RUS	(i) The maximum diameter is half or more the width of the metaphysis. (The epiphysis is oval in shape.)	TW2	RUS
7	11		8	15
		Stage E		
TW2	RUS	(i) The epiphysis is as wide as the metaphysis. (ii) The shape has changed, so that there is now a somewhat flattened distal border and an angulated proximal border. (The change in shape of the proximal border comes about through a down-growth similar to that seen at this stage in the epiphysis of the middle and distal phalanges of the fingers in their central axis. Due to the rotation of the thumb in its position on the film, however, this down-growth appears usually at the proximo-medial edge, although sometimes it may be nearly central.)	TW2	RUS
14	17		15	22

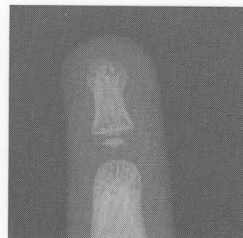
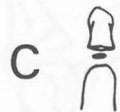
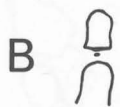
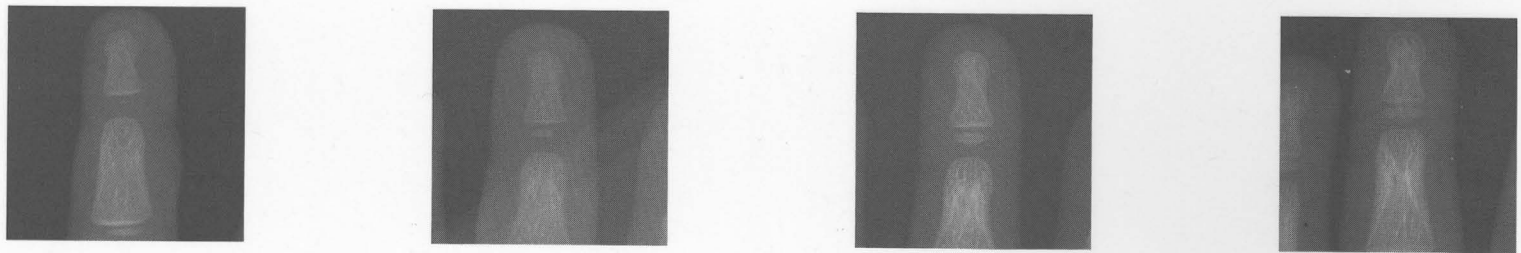
Distal Phalanx of the Thumb



Boys' Scores	Stage F	Girls' Scores
TW2 RUS 23 26	<p>(i) The proximo-lateral border of the epiphysis is now concave and shapes to the head of the proximal phalanx. (In some positions of the thumb this border is not visible as such. Instead the articular surface of the epiphysis can be seen shaping to the trochlear head of the proximal phalanx.)</p> <p>(ii) On the distal border the medial and lateral surfaces can both be seen, with the base of the terminal phalanx conforming to the saddle shape between them.</p> <p>(iii) The epiphysis is now considerably wider than the metaphysis.</p>	TW2 RUS 24 33
TW2 RUS 30 38	<p>Stage G</p> <p>(i) The epiphysis caps the metaphysis; because of the position of the thumb this is better seen on the medial side. (The head of the proximal phalanx has developed its saddle shape into which the medio-proximal projection of the epiphysis fits.)</p>	TW2 RUS 31 48
TW2 RUS 31 46	<p>Stage H</p> <p>(i) Fusion of the epiphysis and metaphysis has begun. (A line is still visible, composed partly of black areas where the epiphyseal cartilage remains, and partly of dense white areas where fusion is proceeding.) (Differentiation of the head of the proximal phalanx has progressed so that its medial and lateral enlargements can be clearly seen, being medio-dorsal and latero-palmar in this projection.)</p>	TW2 RUS 32 51
TW2 RUS 33 66	<p>Stage I</p> <p>(i) Fusion of epiphysis and metaphysis is completed. (Over the majority of its length the line of fusion has entirely disappeared, but some thickened remnant of it may still be visible.)</p>	TW2 RUS 34 68

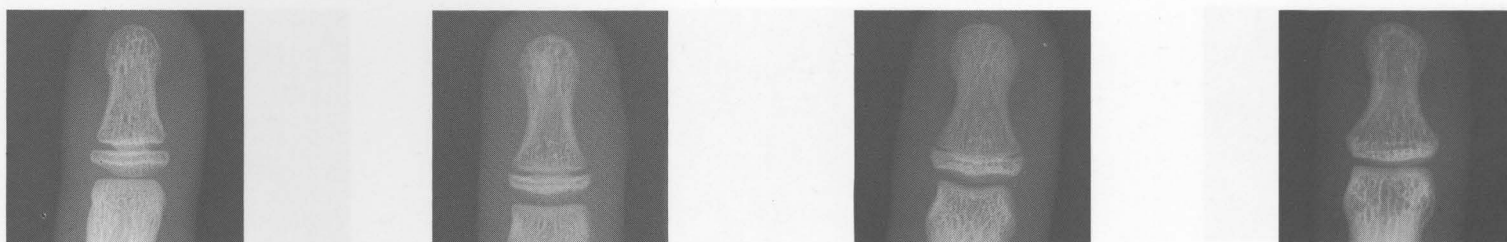
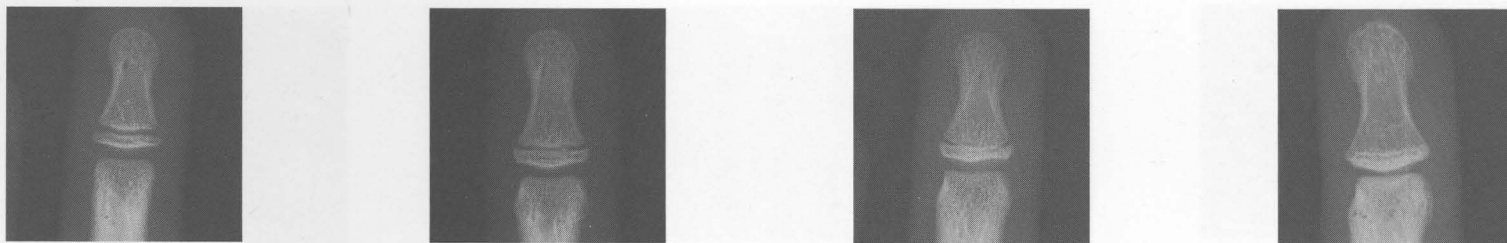


Distal Phalanges of Third (III) and Fifth (V) Fingers



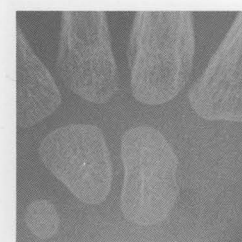
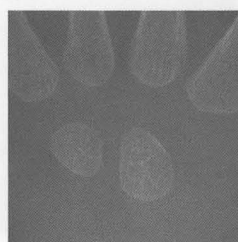
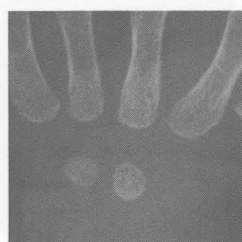
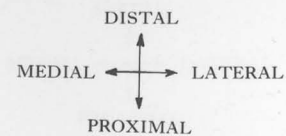
Boys' Scores		Stage B	Girls' Scores	
	TW2		TW2	RUS
III	3	(i) The centre is just visible as a single deposit of calcium, or more rarely as multiple deposits. The border is frequently ill-defined.	3	7
V	3		3	7
		Stage C		
	TW2	(i) The centre is distinct in appearance and disc-shaped, with a smooth continuous border.	TW2	RUS
III	4	(The maximum diameter is less than half the width of the metaphysis.)	4	8
V	4		4	8
		Stage D		
	TW2	(i) The maximum diameter is half or more the width of the metaphysis.	TW2	RUS
III	6	(The borders are slightly thickened, and the proximal border somewhat convex.)	6	11
V	7		7	11
		Stage E		
	TW2	(i) The epiphysis is as wide as the metaphysis.	TW2	RUS
III	10	(ii) The central portion of the proximal border has grown towards the end of the middle phalanx, so that the proximal border no longer consists of a single convex surface; no differentiation into palmar and dorsal surfaces, however, can yet be seen.	10	15
V	11	(The distal border of the head of the middle phalanx is flat or still slightly convex.)	11	15

Distal Phalanges of Third (III) and Fifth (V) Fingers



Boys' Scores		Stage F	Girls' Scores	
		(i) Palmar and dorsal proximal surfaces are distinct, and each has shaped to the trochlear articulation of the middle phalanx. The palmar surface appears as a projection proximal to the thickened white line representing the dorsal surface. (The distal border of the middle phalanx is flat or slightly concave.)		
TW2	RUS		TW2	RUS
III	16 18		17	22 III
V	16 18		17	22 V
<div style="display: flex; justify-content: space-between;"> <div style="width: 20%;"></div> <div style="width: 60%;"> <p style="text-align: center;">Stage G</p> <p>(i) The epiphysis caps the metaphysis. (The facets for the collateral ligaments are now visible on either side of the head of the middle phalanx. This is largely a result of the outward growth of the sides of the phalanx in its distal portion, which creates the appearance of a distinct head.)</p> </div> <div style="width: 20%; text-align: right;"> <p style="text-align: center;">TW2 RUS</p> <p>22 33 III</p> <p>21 32 V</p> </div> </div>				
<div style="display: flex; justify-content: space-between;"> <div style="width: 20%;"></div> <div style="width: 60%;"> <p style="text-align: center;">Stage H</p> <p>(i) Fusion of epiphysis and metaphysis has begun. (A line is still visible, composed partly of black areas where the epiphyseal cartilage remains and partly of dense white areas where fusion is proceeding.) (The facets for the collateral ligaments on the head of the middle phalanx have developed further since the last stage so that their palmar and dorsal surfaces can often be distinguished.)</p> </div> <div style="width: 20%; text-align: right;"> <p style="text-align: center;">TW2 RUS</p> <p>23 37 III</p> <p>22 36 V</p> </div> </div>				
<div style="display: flex; justify-content: space-between;"> <div style="width: 20%;"></div> <div style="width: 60%;"> <p style="text-align: center;">Stage I</p> <p>(i) Fusion of epiphysis and metaphysis is completed. (Over the majority of its length the line of fusion has entirely disappeared, but some thickened remnant of it may still be visible.)</p> </div> <div style="width: 20%; text-align: right;"> <p style="text-align: center;">TW2 RUS</p> <p>24 49 III</p> <p>23 47 V</p> </div> </div>				

Capitate

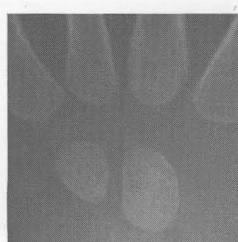


B •

C ○

D → ○ ↙

E → ○



Boys' Scores
TW2 Carp
60 100

Stage B

- (i) The centre is just visible as a single deposit of calcium, or more rarely as multiple deposits. The border is frequently ill-defined.

Girls' Scores
TW2 Carp
53 84

TW2 Carp
62 104

Stage C

- (i) The centre is distinct in appearance and oval in shape, with a smooth continuous border.
(The maximum diameter is less than half the width of the radial metaphysis.)

TW2 Carp
56 88

TW2 Carp
65 106

Stage D

- (i) The maximum diameter is half or more the width of the radial metaphysis.
- (ii) The border adjacent to the hamate is now flat or only slightly convex.
- (iii) The border adjacent to the second metacarpal is also beginning to become distinct so that the centre now appears somewhat D-shaped.

TW2 Carp
61 91

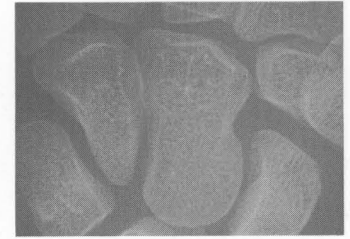
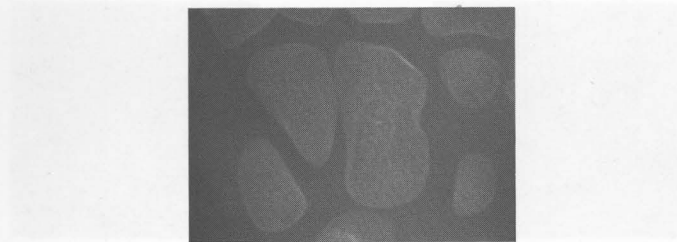
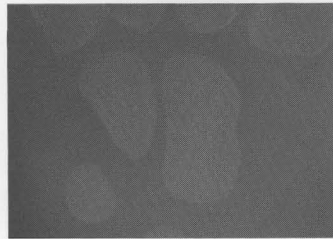
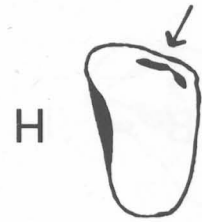
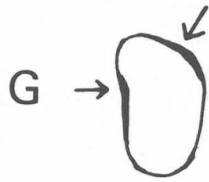
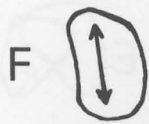
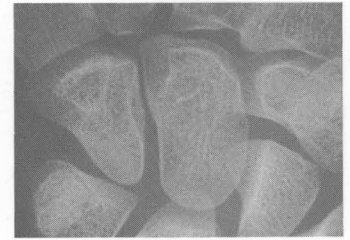
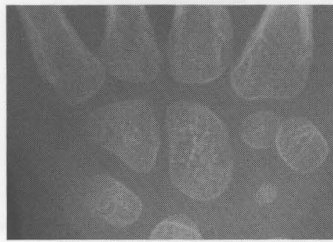
TW2 Carp
71 113

Stage E

- (i) The hamate border is now concave and slightly thickened.
- (ii) The bone has lengthened, so that the longitudinal diameter is distinctly greater than the transverse.
(The longitudinal diameter is however less than the distance from its proximal border to the radial metaphysis.)

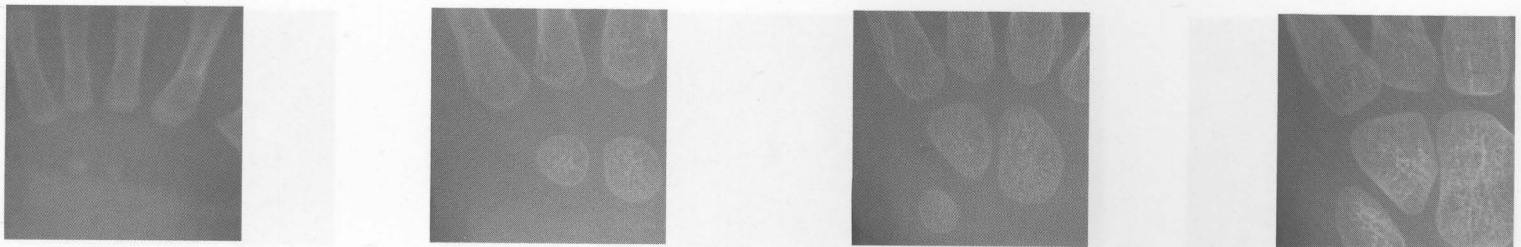
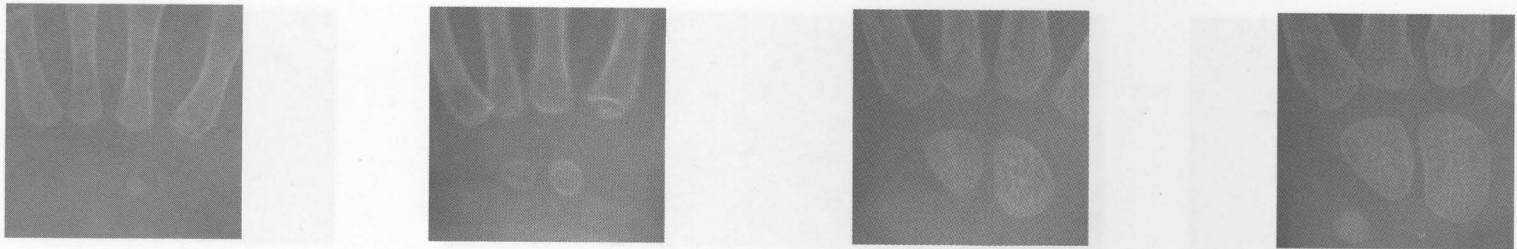
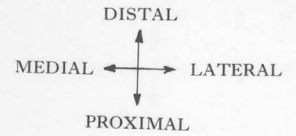
TW2 Carp
67 99

Capitate



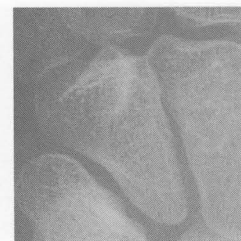
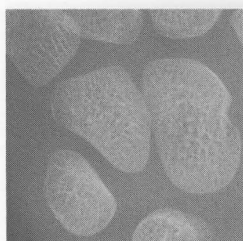
Boys' Scores		Stage F	Girls' Scores	
TW2	Carp	(i) The longitudinal diameter is now equal to or greater than the distance from its proximal border to the radial metaphysis. (Apart from this lengthening, the main features of the bone are unchanged since the last stage.)	TW2	Carp
79	133		76	121
		Stage G		
TW2	Carp	(i) The articular facets with the second and third metacarpals have begun to form, causing the appearance of a thickened white line along the latero-distal border of the bone.	TW2	Carp
89	160	(ii) The articular facet with the hamate has just begun to form and may be seen at the middle of the concavity of the hamate border.	85	149
		Stage H		
TW2	Carp	(i) The articular facets for the second and third metacarpals have now developed so that both palmar and dorsal surfaces are visible. The thickened white line seen along the border of the bone in the last stage is now placed inside the bone's outer margin, because of the growth of the dorsal surface out beyond it.	TW2	Carp
116	214	(ii) The spur towards the fourth metacarpal may be such that the bone now overlaps and articulates with the hamate, and usually, the bases of the third and fourth metacarpals (H+).	113	203

Hamate



Boys' Scores			Girls' Scores	
TW2	Carp	Stage B	TW2	Carp
42	73	(i) The centre is just visible as a single deposit of calcium, or more rarely as multiple deposits. The border is frequently ill-defined.	44	72
		Stage C		
TW2	Carp	(i) The centre is distinct in appearance and round in shape, with a smooth continuous border. (The maximum diameter is less than half the width of the radial metaphysis.)	TW2	Carp
44	75		47	74
		Stage D		
TW2	Carp	(i) The maximum diameter is half or more the width of the radial metaphysis. (ii) The surface that later articulates with the triquetral has flattened so that the appearance of the hamate (like that of the capitate at the same stage) is D-shaped, with the straight side running diagonally to the long axis of the hand.	TW2	Carp
49	79		53	78
		Stage E		
TW2	Carp	(i) The capitate border has now begun to shape to the hamate indentation of the capitate. This shaping usually takes the form of a slight bulge appearing about half to two-thirds of the way down the border, with somewhat flattened edges proximal and distal to it. (ii) The metacarpal and capitate borders have become differentiated so that the shape has changed from a D to a three-sided figure.	TW2	Carp
59	100		64	102

Hamate



Boys'
Scores
TW2 Carp
70 128

Stage F

- (i) A concavity is now present in the triquetral border (because of considerable growth upwards towards the base of the fifth metacarpal since the last stage).

Girls'
Scores
TW2 Carp
74 131

TW2 Carp
81 159

Stage G

- (i) The articular facet for the fourth metacarpal has now begun to form and differentiation into palmar and dorsal surfaces can be seen as a thickening running along or inside the distal border of the bone.
(Palmar and dorsal surfaces of the articulation with the capitate are visible.)

TW2 Carp
85 161

TW2 Carp
92 181

Stage H

- (i) The hook of the hamate has begun to appear as a white line (to be distinguished from the articular surfaces adjacent to metacarpals four and five, described below.)
- (ii) The articulations with the fourth and fifth metacarpals have now progressed so that there are two distinct surfaces at the distal edge of the bone, one running transversely and the other, on the medial side, running diagonally to the axis of the hand.
(The triquetral articulation has also advanced so that the proximal part of the hamate is now triangular in shape with a pointed apex proximally.)

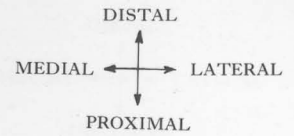
TW2 Carp
97 183

TW2 Carp
106 194

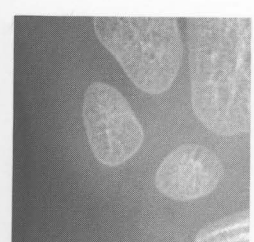
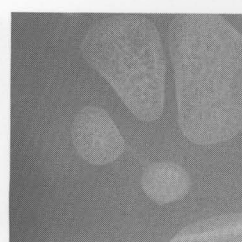
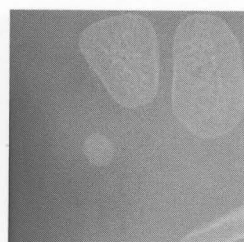
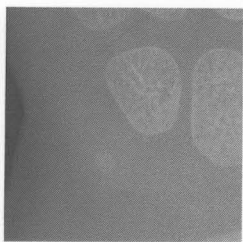
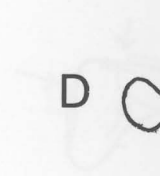
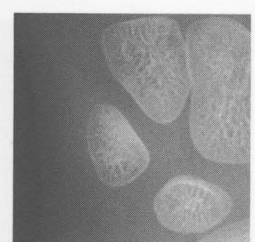
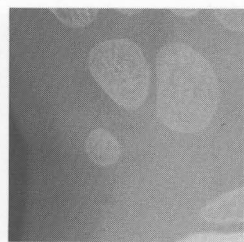
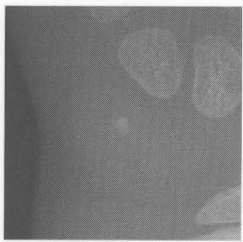
Stage I

- (i) The hook of the hamate is now visible throughout its entire outline.
- (ii) The spaces between the hamate and the capitate and between the hamate and the triquetral are now reduced to a thin black line or entirely obliterated by overlapping.

TW2 Carp
109 194



Triquetral



Boys' Scores
TW2 Carp
7 10

Stage B

- (i) The centre is just visible as a single deposit of calcium, or more rarely as multiple deposits. The border is frequently ill-defined.

Girls' Scores
TW2 Carp
8 11

TW2 Carp
10 13

Stage C

- (i) The centre is distinct in appearance and round in shape with a smooth continuous border.
(The maximum diameter is less than half the width of the ulnar metaphysis.)

TW2 Carp
12 16

TW2 Carp
17 28

Stage D

- (i) The maximum diameter is half or more the width of the ulnar metaphysis.
- (ii) The border adjacent to the hamate has flattened.
(The bone is still D-shaped, not elongated; no one diameter is much larger than any other.)

TW2 Carp
19 31

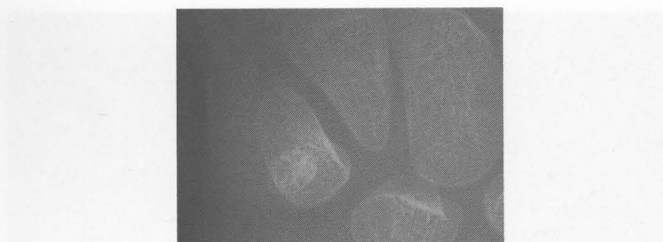
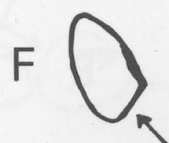
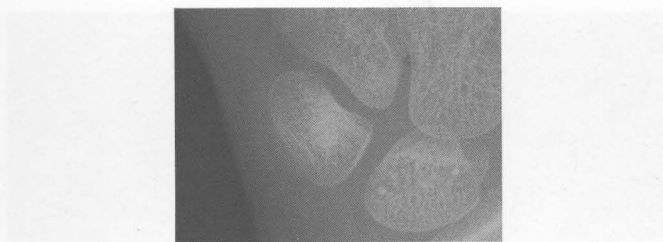
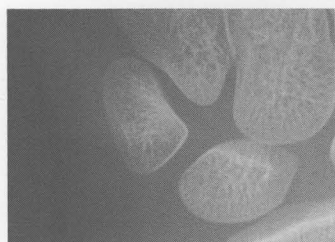
TW2 Carp
28 57

Stage E

- (i) The bone is elongated in shape with the longitudinal diameter distinctly greater than the transverse; this is due to growth since the last stage having been relatively greatest at the medio-distal border.

TW2 Carp
28 56

Triquetral



Boys'
Scores

Girls'
Scores

Stage F

- (i) The lunate border has now become flat and distinct and forms a sharp angle of a little over 90 degrees with the hamate border. One or both borders show slight thickening as the articular facets begin to form.
(Growth of the bone has been relatively greatest in the direction of the base of the fifth metacarpal, so that the distal border, instead of being round as in the last stage, is now peaked with the tip extending towards the most medial point of the hamate.)

TW2 Carp
38 84

TW2 Carp
36 80

Stage G

- (i) Palmar and dorsal surfaces are now visible on the hamate and or lunate borders so that the white lines seen in the last stage at the borders of the bone are now slightly inside the borders.
(There is still considerable separation between the borders of triquetral and hamate, in particular medio-distally.)

TW2 Carp
45 102

TW2 Carp
46 104

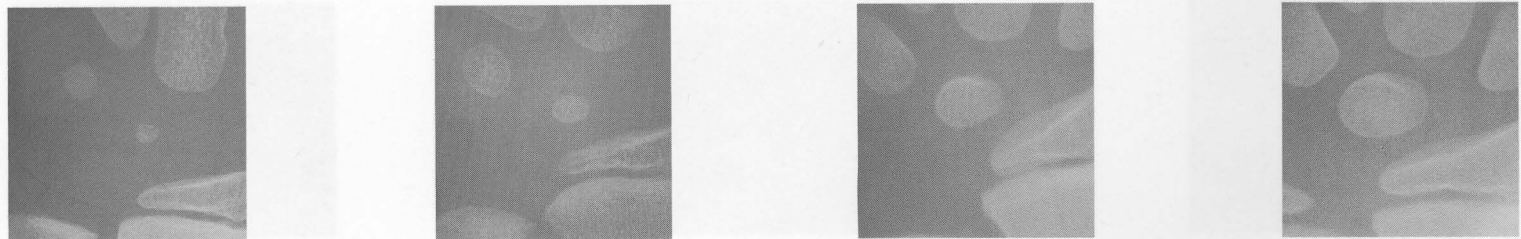
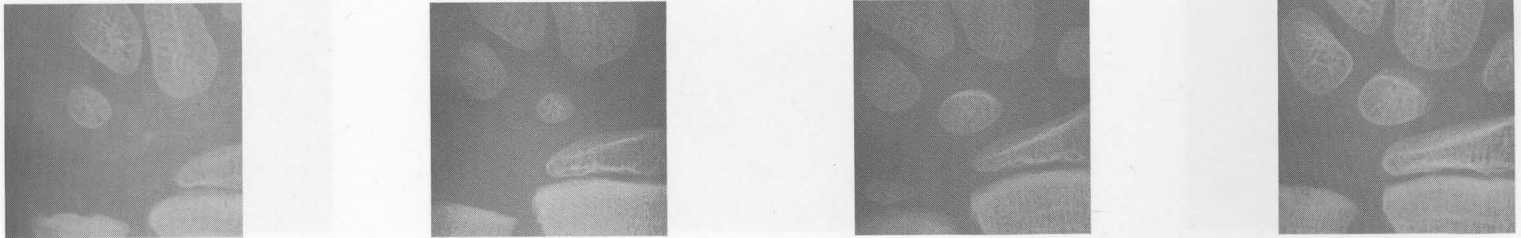
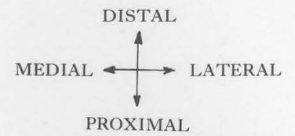
Stage H

- (i) The broadening, chiefly of the distal half of the bone, since the last stage has caused a concavity to appear in the medial border.
(The contour of the bone now follows the outline of the hamate all the way to the hamate's most medial point.)
(ii) The distal portion of the bone has broadened so that it is nearly or quite as wide as the proximal portion. There may be overlapping between the edges of the triquetral and the hamate (H+).

TW2 Carp
62 124

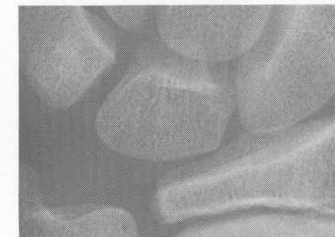
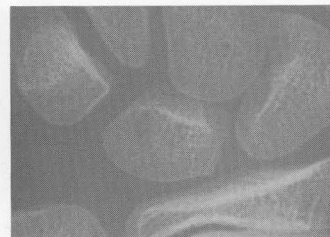
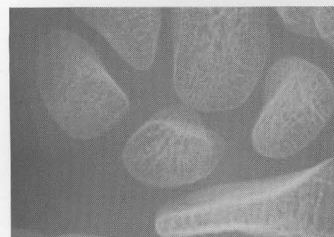
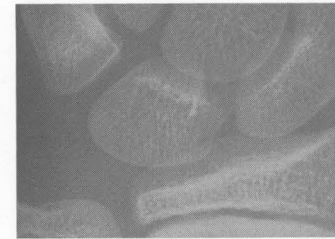
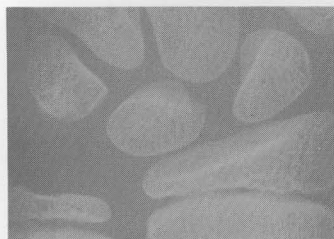
TW2 Carp
63 126

Lunate



Boys' Scores			Girls' Scores	
TW2	Carp	Stage B	TW2	Carp
10	14	(i) The centre is just visible as a single deposit of calcium, or more rarely as multiple deposits. The border is frequently ill-defined.	10	16
		Stage C		
TW2	Carp	(i) The centre is distinct in appearance and oval in shape, with a smooth continuous border. (The maximum diameter is less than half the width of the ulnar metaphysis.)	TW2	Carp
13	22		14	24
		Stage D		
TW2	Carp	(i) The maximum diameter is half or more the width of the ulnar metaphysis.	TW2	Carp
20	39	(ii) The distal border of the bone is now thickened (but palmar and dorsal surfaces there are not yet visible.)	20	40
		Stage E		
TW2	Carp	(i) The palmar and dorsal surfaces of the distal part of the bone are now clearly defined with one of the other, or both, projecting distal to the thickened white line which marks their area of confluence. The dorsal surface may project towards the scaphoid but no proper saddle, as in the next stage, is yet formed.	TW2	Carp
27	58	(ii) There is flattening of the border adjacent to the radius.	27	59

Lunate



Boys'
Scores

Stage F

- (i) The distal surface now forms a definite saddle for articulation with the capitate, due chiefly to an out-growth of its dorsal part towards the scaphoid. This dorsal part extends out beyond the lateral edge of the palmar (thickened) part of the saddle, but less than half way from the palmar edge to the edge of the scaphoid.
- (ii) The scaphoid and triquetral borders are now flat and slightly thickened.

TW2 Carp
36 84

Girls'
Scores

TW2 Carp
35 84

Stage G

- (i) The dorsal surface of the capitate saddle has further enlarged since the last stage and now covers more than half the distance from the palmar edge of the saddle to the scaphoid.
- (ii) There is a definite angle between the scaphoid border (which is still straight) and the radial border.

TW2 Carp
44 101

TW2 Carp
46 106

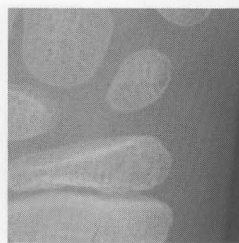
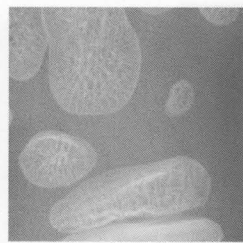
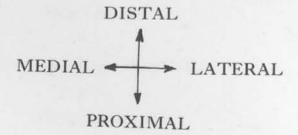
Stage H

- (i) The dorsal surface of the capitate saddle now extends laterally to touch or overlap the edge of the scaphoid.
(Either palmar or dorsal surface, or both, depending on individual shape and positioning, touch or overlap the capitate.)
- (ii) The scaphoid border is now concave.
(There is now a definite projection in the direction of the ulnar styloid process culminating in a relatively sharp point. The gap between lunate and scaphoid is often almost or entirely obliterated (H+).)

TW2 Carp
60 120

TW2 Carp
60 122

Scaphoid

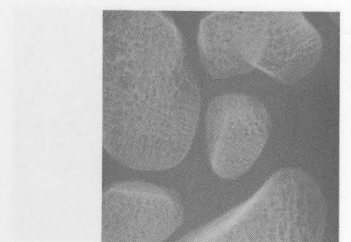
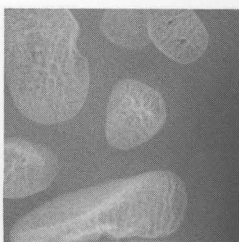
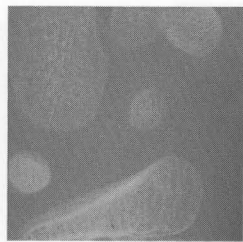
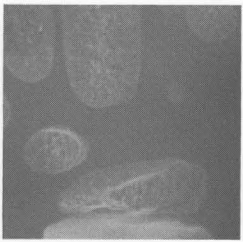


B •

C ○

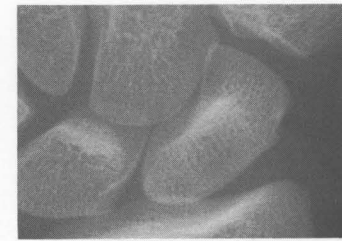
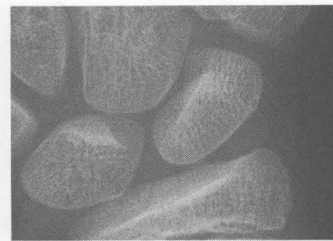
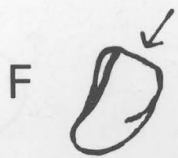
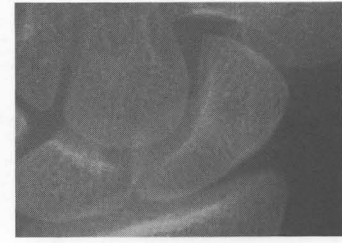
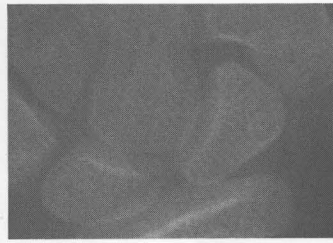
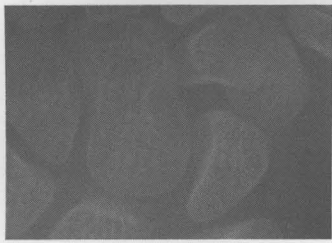
D → ↗

E → ↗

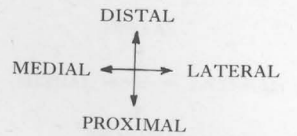


Boys' Scores		Stage B	Girls' Scores	
TW2	Carp	(i) The centre is just visible as a single deposit of calcium, or more rarely as multiple deposits. The border is frequently ill-defined.	TW2	Carp
14	26		13	24
		Stage C		
TW2	Carp	(i) The centre is distinct in appearance and round in shape with a smooth continuous border. (The maximum diameter is less than half the width of the ulnar metaphysis.)	TW2	Carp
18	36		17	35
		Stage D		
TW2	Carp	(i) The maximum diameter is half or more the width of the ulnar metaphysis. (The capitate border is flattened and may show slight thickening.) (The border adjacent to the radial epiphysis is well defined and runs parallel to it, making the shape of the bone like that of a sector of a circle, with capitate and radial-epiphyseal borders as the radii.)	TW2	Carp
23	52		23	51
		Stage E		
TW2	Carp	(i) The dorsal surface of the capitate articulation is visible outside the thickened white line, which represents the palmar articular surface. (Since the last stage the bone has elongated so that its longitudinal is now considerably greater than its transverse diameter.)	TW2	Carp
30	71		29	71

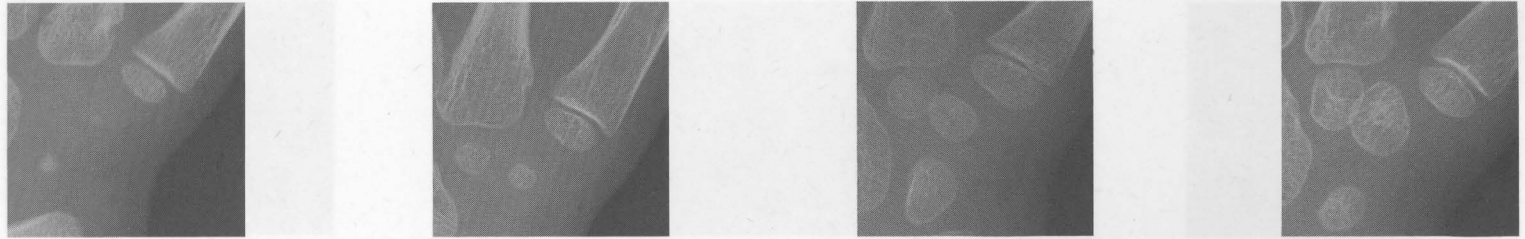
Scaphoid



Boys' Scores		Stage F	Girls' Scores	
TW2	Carp	(i) The capitate surface is concave in both its palmar and dorsal aspects.	TW2	Carp
35	85	(ii) The border adjacent to the trapezium and trapezoid is flat.	36	88
		Stage G		
TW2	Carp	(i) The bone has grown chiefly in a proximal and medial direction, so that its dorsal surface now extends beyond the thickened white line over towards the lunate and the proximal part of the capitate.	TW2	Carp
42	100	(ii) There is now a distinct border running adjacent to the lunate, its direction such that its capitate end is nearer the midline than its radial-epiphyseal end. The border is as yet in contact with the lunate only at the capitate end.	44	104
		Stage H		
TW2	Carp	(i) The capitate surface conforms closely to the capitate bone throughout the whole of its extent.	TW2	Carp
58	116	(The distal border meets or overlaps the edge of the capitate at the angle on the capitate formed by the junction of the trapezoid and scaphoid borders.)	57	118
		(ii) The lunate border has changed its direction so that now its radial-epiphyseal end is as near or nearer the midline than the capitate end. The border is now in contact with the lunate bone over most of its distal portion.		
		(iii) Lateral enlargement of the distal portion of the bone and differentiation of the radial styloid articular surface has resulted either in a concavity appearing in the distal part of its lateral border, or in the appearance of a distinct distal head.		



Trapezium

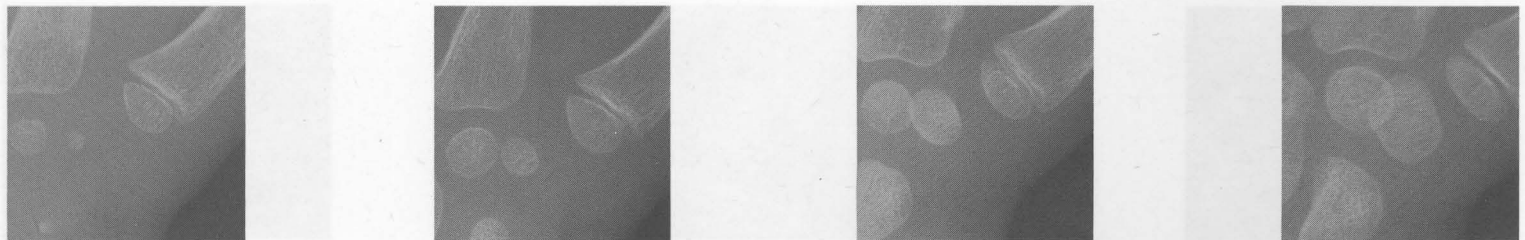


B •

C ○

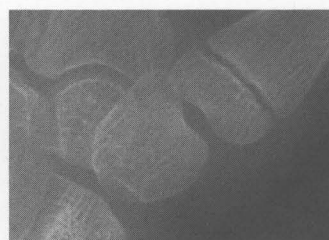
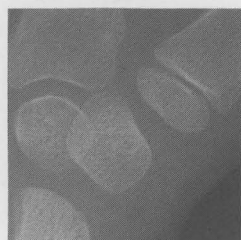
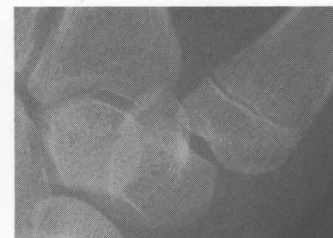
D

E



Boys' Scores		Stage B	Girls' Scores	
TW2	Carp	(i) The centre is just visible as a single deposit of calcium, or more rarely as multiple deposits. The border is frequently ill-defined.	TW2	Carp
12	23		12	20
		Stage C		
TW2	Carp	(i) The centre is distinct in appearance and round in shape with a smooth continuous border. (The maximum diameter of the bone is less than half the width of the first metacarpal metaphysis.)	TW2	Carp
15	31		14	27
		Stage D		
TW2	Carp	(i) The maximum diameter is half or more the width of the first metacarpal metaphysis.	TW2	Carp
21	46	(ii) There is flattening of the border adjacent to the first metacarpal and/or of the scaphoid border; the distance between these two borders is now distinctly less than the diameter at right-angles to them. (The gap between the base of the second metacarpal and the trapezium is still one-third or more the maximum diameter of the bone.)	20	42
		Stage E		
TW2	Carp	(i) Since the last stage, the bone has grown chiefly upwards towards the base of the second metacarpal, so that the gap between the two is less than one-third the maximum diameter of the trapezium.	TW2	Carp
28	66		25	60

Trapezium



Boys'
Scores

TW2 Carp
34 83

Stage F

- (i) The first metacarpal border is now distinctly concave and slightly thickened at about its central portion. The concavity is due to growth since the last stage being chiefly in the direction of the lateral edge of the base of the first metacarpal.

Girls'
Scores

TW2 Carp
32 80

Stage G

- (i) The distal edge of the bone now overlaps slightly the lateral tip of the base of the second metacarpal.
- (ii) The scaphoid border is now flat and thickened and, in a good film, palmar and dorsal articular surfaces of this border can just be made out in the area beyond the overlapping edge of the trapezoid.

TW2 Carp
39 95

TW2 Carp
39 95

Stage H

- (i) There is a newly-appeared straight border forming the distal part of the radial side of the bone; the first metacarpal surface meets this border at a sharp point.

(Since the last stage, there has been further growth of the projection between the bases of the first and second metacarpal, so that the maximum concavity of the first metacarpal surface is now usually about two-thirds the way below the distal tip of the bone.)

TW2 Carp
47 108

TW2 Carp
49 111

- (ii) The first metacarpal surface conforms to the saddle shape of the epiphysis of the first metacarpal with palmar and dorsal surfaces now differentiated.

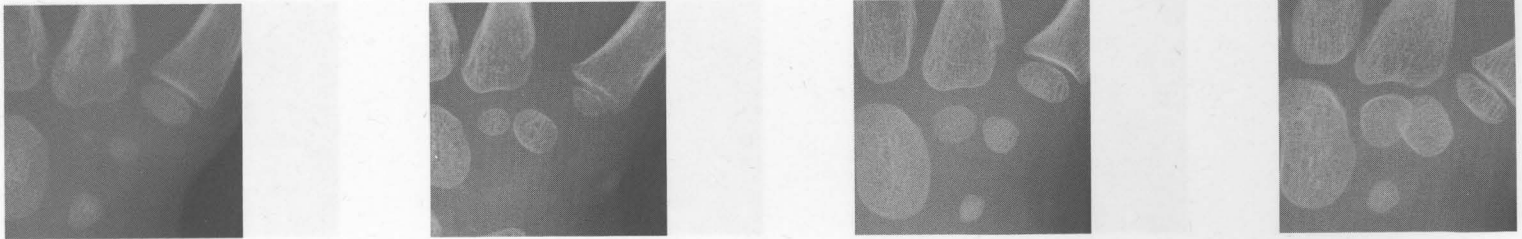
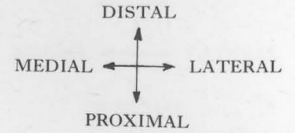
Stage I

- (i) Since the last stage the radial border has further bulged outward so that it has two distinct portions, the distal facing laterally and the proximal facing the radial styloid; this proximal portion is now flat or, as a rule, slightly concave.

TW2 Carp
59 117

TW2 Carp
59 119

Trapezoid

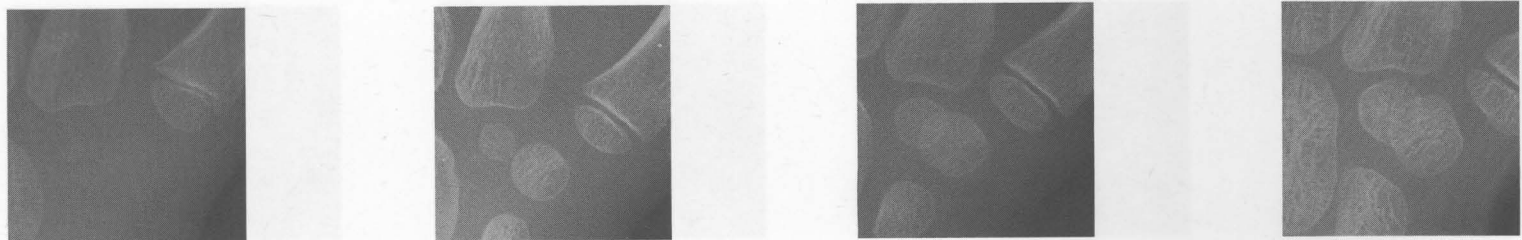
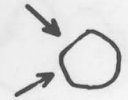


B

C

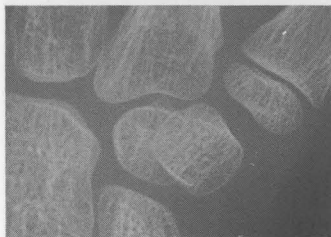
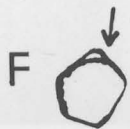
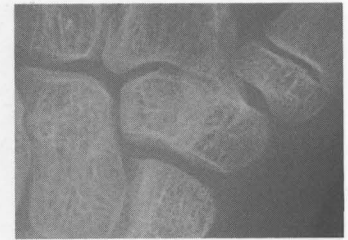
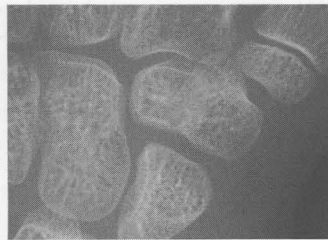
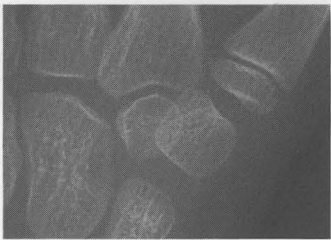
D

E



Boys' Scores			Girls' Scores	
TW2	Carp	Stage B	TW2	Carp
14	27	(i) The centre is just visible as a single deposit of calcium, or more rarely as multiple deposits. The border is frequently ill-defined.	13	21
		Stage C		
TW2	Carp	(i) The centre is distinct in appearance and round in shape with a smooth continuous border. (The maximum diameter is less than half the width of the first metacarpal metaphysis.)	TW2	Carp
16	32		16	30
		Stage D		
TW2	Carp	(i) The maximum diameter is half or more the width of the first metacarpal metaphysis. (The bone is still round in shape.)	TW2	Carp
20	42		20	43
		Stage E		
TW2	Carp	(i) There is now flattening of the capitae border and or of the border which lies at right-angles to it and which will eventually articulate with the medial side of the base of the second metacarpal.	TW2	Carp
23	51		24	53

Trapezoid



Boys'
Scores

Stage F

- (i) Thickened white lines have appeared along the capitate and or medial second metacarpal borders. Differentiation of one but not both of these borders into palmar and dorsal surfaces may have taken place.
- (ii) The distal edge of the bone has grown since the last stage and now forms a rounded peak which will later articulate with the central indentation of the second metacarpal base. Though this peak is part of the future dorsal surface and may appear as such, there is at this stage no very clear differentiation into palmar and dorsal surfaces.

(The scaphoid surface is flattened.)

TW2 Carp
32 77

Girls'
Scores

TW2 Carp
31 77

Stage G

- (i) The dorsal surface of the articulation with the second metacarpal is now visible distal to the thickened white line which marks the edge of the palmar surface. The dorsal surface of the capitate articulation is also now visible. These dorsal outgrowths have developed so as nearly or quite to overlap the edges of the second metacarpal and capitate.

TW2 Carp
39 93

TW2 Carp
40 97

Stage H

- (i) The dorsal proximal border of the bone is concave, although the palmar aspect of this border, which shows as a thickened line, remains straight.
- (ii) The lateral border has enlarged so that it is now distinctly convex. The outlines of the trapezoid may no longer be clearly visible over their whole extent (H+).

TW2 Carp
56 115

TW2 Carp
57 118

Maturation of the Hand and Wrist



CA 0.5 years



CA 1.5 years



CA 2.5 years



CA 6.5 years



CA 7.5 years



CA 8.5 years



CA 12.5 years



CA 13.5 years



CA 14.5 years

Radiographs of a girl followed 1950–1967: note the erroneous positioning at age 13.5 years.

in a Girl Followed Longitudinally



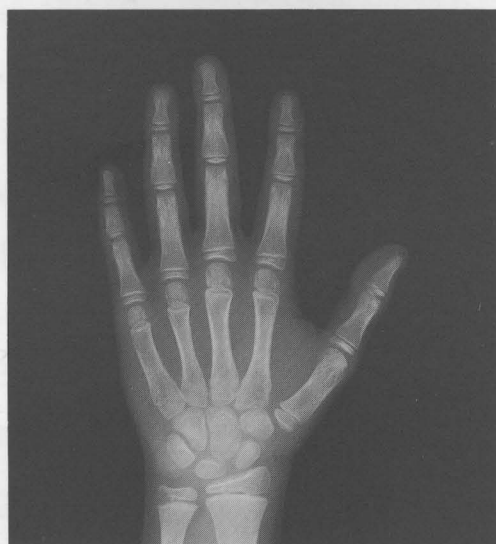
CA 3·5 years



CA 4·5 years



CA 5·5 years



CA 9·5 years



CA 10·5 years



CA 11·5 years



CA 15·5 years



CA 16·5 years



CA 17·5 years

Table A1
 RUS (TW2) Bone Age for Given Maturity Score
BOYS

Maturity score	Bone "age"	Maturity score	Bone "age"	Maturity score	Bone "age"	Maturity score	Bone "age"
—	1·0	189	6·0	330	11·0	744	16·0
—	·1	192	·1	334	·1	762	·1
—	·2	194	·2	337	·2	780	·2
—	·3	197	·3	340	·3	798	·3
—	·4	199	·4	342	·4	816	·4
—	·5	202	·5	346	·5	833	·5
26	·6	204	·6	349	·6	850	·6
32	·7	207	·7	352	·7	867	·7
38	·8	209	·8	354	·8	883	·8
43	·9	212	·9	358	·9	899	·9
49	2·0	215	7·0	361	12·0	915	17·0
55	·1	218	·1	365	·1	928	·1
61	·2	222	·2	369	·2	940	·2
65	·3	224	·3	373	·3	951	·3
70	·4	227	·4	378	·4	962	·4
75	·5	230	·5	382	·5	971	·5
80	·6	233	·6	386	·6	980	·6
84	·7	235	·7	391	·7	986	·7
89	·8	238	·8	395	·8	992	·8
93	·9	240	·9	400	·9	995	·9
98	3·0	243	8·0	405	13·0	997	18·0
101	·1	245	·1	410	·1	999	·1
105	·2	248	·2	416	·2	1000	ADULT
108	·3	251	·3	422	·3		
112	·4	253	·4	427	·4		
115	·5	257	·5	434	·5		
118	·6	260	·6	440	·6		
122	·7	263	·7	447	·7		
125	·8	266	·8	454	·8		
128	·9	269	·9	463	·9		
132	4·0	272	9·0	472	14·0		
135	·1	275	·1	481	·1		
138	·2	278	·2	490	·2		
141	·3	281	·3	501	·3		
144	·4	283	·4	512	·4		
147	·5	286	·5	524	·5		
150	·6	289	·6	536	·6		
153	·7	292	·7	548	·7		
156	·8	295	·8	560	·8		
159	·9	297	·9	574	·9		
162	5·0	300	10·0	588	15·0		
165	·1	303	·1	602	·1		
168	·2	306	·2	616	·2		
171	·3	309	·3	630	·3		
173	·4	312	·4	645	·4		
177	·5	316	·5	660	·5		
180	·6	319	·6	675	·6		
182	·7	321	·7	692	·7		
185	·8	325	·8	708	·8		
187	·9	328	·9	726	·9		

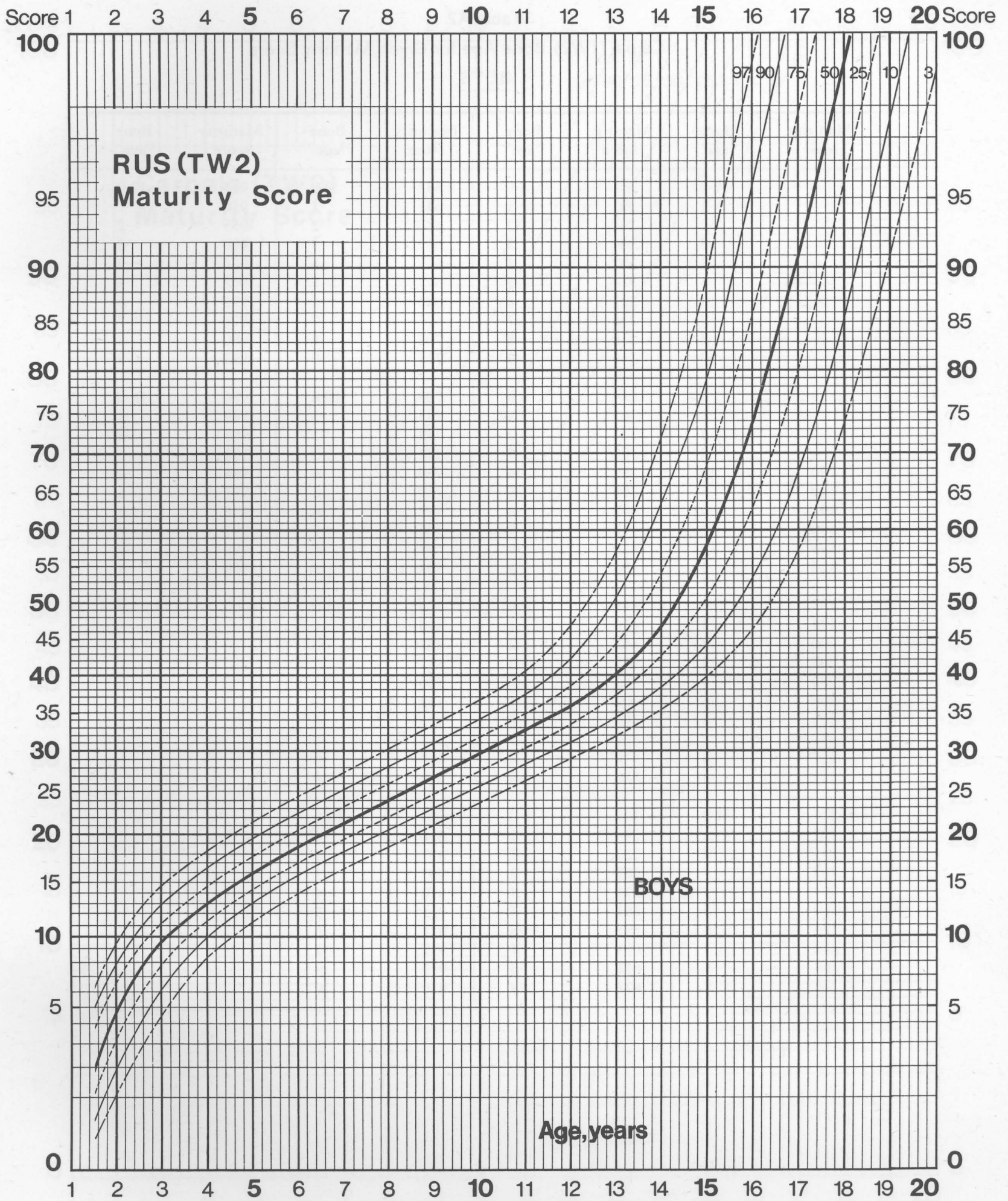


Fig. A4. Standards for RUS skeletal maturity score: boys.

Table A2
 Carpal (TW2) Bone Age for Given Maturity Score
BOYS

Maturity score	Bone "age"	Maturity score	Bone "age"	Maturity score	Bone "age"	Maturity score	Bone "age"
—	1·0	281	5·0	632	9·0	944	13·0
—	·1	287	·1	641	·1	950	·1
—	·2	294	·2	650	·2	955	·2
—	·3	300	·3	659	·3	960	·3
—	·4	307	·4	668	·4	964	·4
—	·5	314	·5	677	·5	968	·5
—	·6	322	·6	686	·6	972	·6
—	·7	330	·7	695	·7	976	·7
—	·8	338	·8	705	·8	980	·8
—	·9	346	·9	715	·9	983	·9
—	2·0	354	6·0	724	10·0	986	14·0
—	·1	362	·1	733	·1	989	·1
—	·2	371	·2	742	·2	991	·2
—	·3	380	·3	751	·3	992	·3
190	·4	389	·4	760	·4	994	·4
190	·5	398	·5	769	·5	995	·5
191	·6	407	·6	777	·6	996	·6
192	·7	417	·7	786	·7	997	·7
194	·8	426	·8	794	·8	998	·8
195	·9	436	·9	802	·9	999	·9
197	3·0	445	7·0	810	11·0	1000	ADULT
198	·1	454	·1	818	·1		
200	·2	463	·2	825	·2		
202	·3	472	·3	833	·3		
203	·4	481	·4	840	·4		
206	·5	491	·5	848	·5		
209	·6	500	·6	856	·6		
213	·7	509	·7	863	·7		
217	·8	518	·8	870	·8		
221	·9	526	·9	877	·9		
225	4·0	535	8·0	884	12·0		
229	·1	544	·1	890	·1		
234	·2	552	·2	897	·2		
239	·3	562	·3	903	·3		
244	·4	571	·4	910	·4		
250	·5	581	·5	915	·5		
256	·6	591	·6	921	·6		
262	·7	601	·7	927	·7		
268	·8	611	·8	933	·8		
274	·9	621	·9	939	·9		

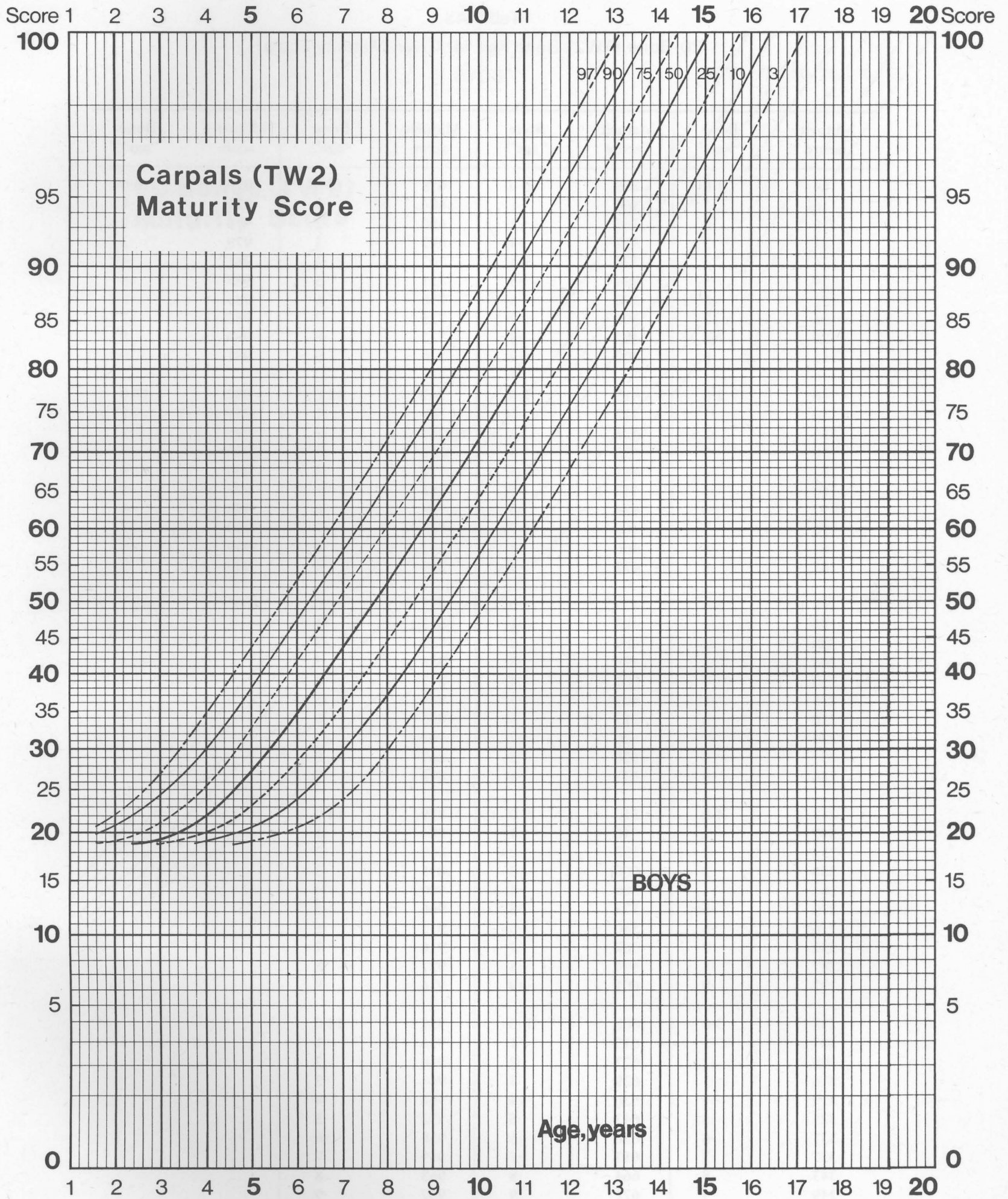


Fig. A5. Standards for Carpal skeletal maturity score: boys.

Table A3

20-Bone (TW2) Bone Age for Given Maturity Score

BOYS

Maturity score	Bone "age"	Maturity score	Bone "age"	Maturity score	Bone "age"	Maturity score	Bone "age"
114	1.0	355	6.0	678	11.0	970	16.0
116	.1	360	.1	684	.1	973	.1
119	.2	366	.2	690	.2	976	.2
123	.3	372	.3	697	.3	979	.3
126	.4	378	.4	703	.4	981	.4
129	.5	384	.5	711	.5	983	.5
133	.6	390	.6	718	.6	985	.6
136	.7	396	.7	725	.7	987	.7
139	.8	402	.8	732	.8	989	.8
142	.9	409	.9	740	.9	991	.9
146	2.0	415	7.0	747	12.0	992	17.0
150	.1	422	.1	754	.1	994	.1
154	.2	428	.2	761	.2	995	.2
159	.3	435	.3	768	.3	996	.3
163	.4	441	.4	774	.4	996	.4
168	.5	447	.5	781	.5	997	.5
172	.6	454	.6	788	.6	998	.6
176	.7	460	.7	795	.7	999	.7
181	.8	466	.8	802	.8	999	.8
185	.9	472	.9	809	.9	999	.9
190	3.0	477	8.0	817	13.0	1000	ADULT
195	.1	483	.1	823	.1		
200	.2	489	.2	830	.2		
205	.3	495	.3	836	.3		
210	.4	501	.4	842	.4		
215	.5	507	.5	849	.5		
220	.6	513	.6	855	.6		
226	.7	520	.7	861	.7		
231	.8	526	.8	867	.8		
236	.9	533	.9	873	.9		
242	4.0	540	9.0	879	14.0		
247	.1	546	.1	884	.1		
252	.2	553	.2	889	.2		
258	.3	560	.3	895	.3		
264	.4	566	.4	900	.4		
270	.5	573	.5	906	.5		
276	.6	580	.6	911	.6		
282	.7	587	.7	916	.7		
287	.8	594	.8	921	.8		
292	.9	601	.9	926	.9		
298	5.0	608	10.0	931	15.0		
303	.1	615	.1	936	.1		
308	.2	622	.2	940	.2		
314	.3	629	.3	944	.3		
319	.4	636	.4	948	.4		
325	.5	643	.5	952	.5		
331	.6	650	.6	956	.6		
337	.7	657	.7	959	.7		
343	.8	664	.8	963	.8		
349	.9	671	.9	967	.9		

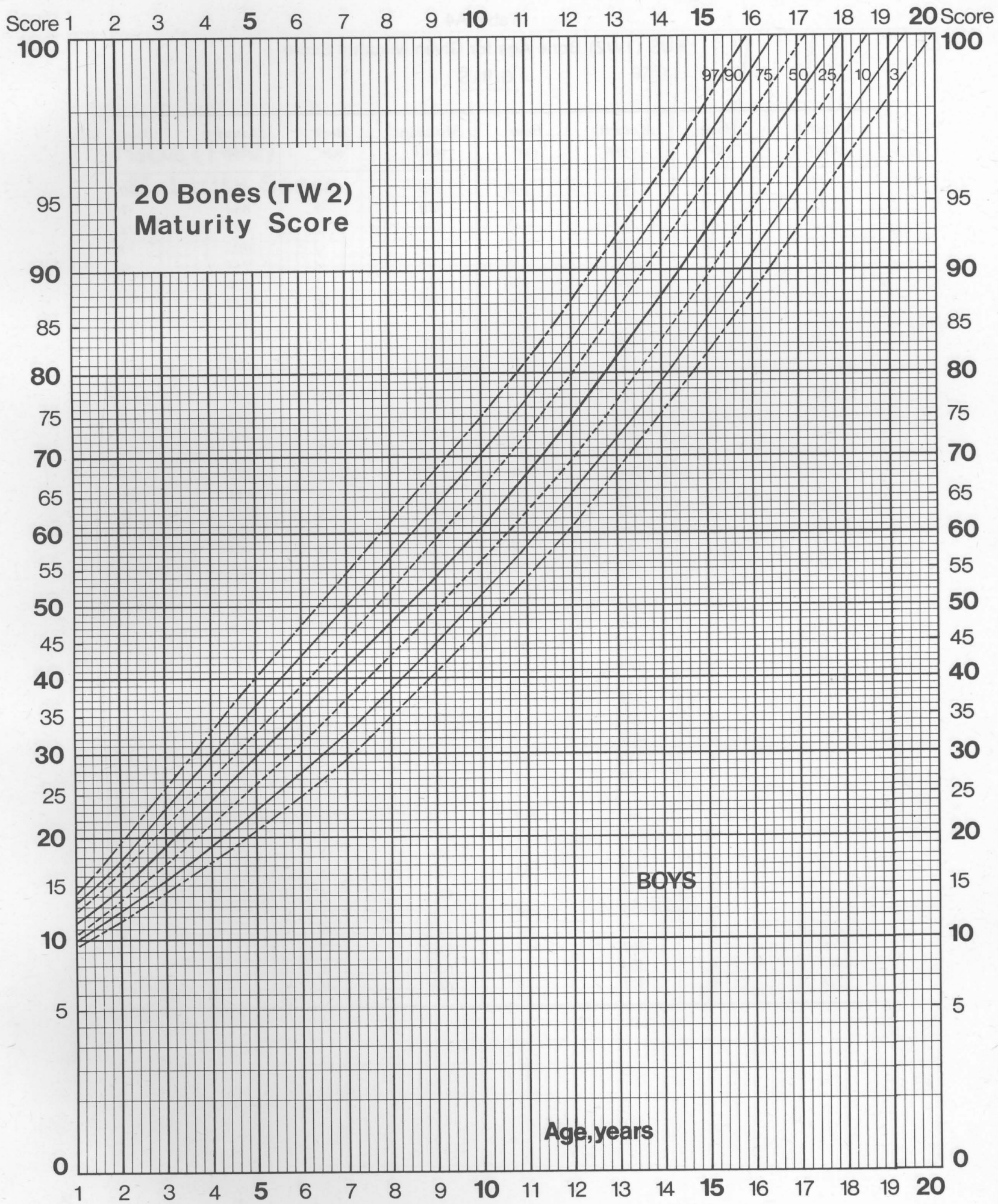


Fig. A6. Standards for 20-bone (TW2) skeletal maturity score: boys.