A Comparison Of Cephalofacial Relationships*

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Orthodontists are greatly interested in the facial contours of their patients. This is especially true of the dental area. This paper is a report on the study of the cephalofacial relationship of a group of North American Negro children with normal occlusion of their teeth. This data should be useful to the practice of clinical orthodontics. An important part of treatment planning in clinical orthodontics is an understanding of what is normal. The theory of the "individual normal" has been recognized and accepted for many years. This theory emphasizes the infinite variety of faces which exist in any particular racial group within a range that can be called normal. If infinite variety exists within any single racial group, what must be the possibilities of individual differences between two or more racial groups? An important part of orthodontic treatment consists of changing facial features to improve them, especially in the dental area of the face. The modern orthodontist does not try to fit all of his patients into a single mold, in fact he has found that he cannot do so. Instead he seeks to reach the optimum esthetic result consistent with good function. We shall attempt to supply him with some of the knowledge necessary to assist in his decisions as to what is optimum for North American Negro children.

The foundation of any study must rest on a firm knowledge of what is normal. Therefore our initial efforts shall be to determine what is normal for the heads and faces of these children. As this is a study by an orthodontist and primarily for the use of orthodontists, we have decided to use the teeth of these children as our criteria in the determination of normal. A mass survey was conducted in four junior and senior high schools of the District of Columbia. The purpose of this survey was to determine the frequency of the incidence of malocclusion in North American Negro children. The findings of this survey have been reported.[1] The children who were examined in the mass survey and found to have normal occlusion of their teeth were further examined at the College of Dentistry, Howard University. These examinations were as follows:

1. Heights and weights
2. Hand x-rays
3. Dental models
4. Cephalometric x-rays.

From the group of children with normal occlusion who were examined at the College of Dentistry, a further selection was made. Eighty children, forty boys and forty girls of Hellman's dental age IV A, i.e., their permanent dentitions were complete except for the third molars, were selected.[7] Their chronologic ages were from twelve to sixteen years. This gave a specific sample for further study and analysis

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and is specific for dental age and occlusion of the teeth. Data are to be presented from a study of this selected group because it is felt that they are representative of a very stable period in the growth and development of the head and face. The dentitions of this selected group are also stable, i.e., they are beyond the variability seen during the period of the mixed dentition and ahead of the possible influences of the third molars on the occlusion.

The techniques of roentgenographic cephalometry as originated by Broadbent[2] and refined by many outstanding researchers have become one of the most useful methods of studying the head and face. The literature contains a vast amount of information utilizing these methods.

The cephalometric roentgenograms used in this study were taken in a Margolis cephalostat. Standard procedures of head positioning and exposure were used. The lateral or profile view alone was taken. The roentgenograms were traced and the analyses of Downs[5] and Sassouni[10] were used. Downs' analysis gives a series of measurements that can be used to appraise the relationships of the various parts of the facial skeleton and the relationships of the teeth to the facial skeleton. Sassouni's analysis gives a method of comparing the basic architecture of the head and face and the relative proportions of the various parts.

Presentation of Data

The data gathered during the progress of this study will be presented in the following manner: firstly, the information obtained from the study of the heads and faces of Negro children, henceforth to be referred to as the Howard group; secondly, the information especially selected as representative for the heads and faces of North American Caucasian children; thirdly, comparisons will be made of similar data gathered by similar methods on Negro children and other North American racial or ethnic groups.

Downs Analysis

The cephalometric x-rays of the selected normal group were traced in the standard manner and a Downs analysis done on each tracing. This analysis was chosen as representative for this area of the study because of its wide use and acceptance. The data gathered on the heads and faces of the eighty boys and girls of the Howard group are presented in Table I. The numerical values for the means, ranges and standard deviations are given. Vorhies and Adams[12] have devised a graphic means of presenting the values of Downs analysis and this is shown in Figure I. The means and ranges for Caucasian and Negro children are compared using these polygons.

Downs' analysis has been used so widely that comparisons will be made here of four North American racial or ethnic groups: Caucasian, Negro, Chinese and Japanese. These ethnic groups have been previously studied by

TABLE I. HOWARD GROUP
DOWNS ANALYSIS

Value	Mean	Range	S.D.
Skeletal Pattern			
Facial Plane	85.7	77 to 94.5	3.35
Convexity	9.7	23.5 to —5	4.80
A B Plane	—6.3	—12 to +5.5	2.68
Mandibular Plane	28.8	42.5 to 12	5.99
Y Axis	63.4	72 to 51.5	4.92
Dental Pattern			
Occlusal Plane	10.7	20.5 to —3	3.93
Interincisal	119.2	99.5 to 141.5	8 69
$\bar{1}$ to Occlusal Plane	27.3	39.5 to 12	5.66
$\bar{1}$ to Mandibular Plane	9.8	24.5 to —5.5	5.94
$\underline{1}$ to A-P (mm.)	10.4	19 to 3	2.75

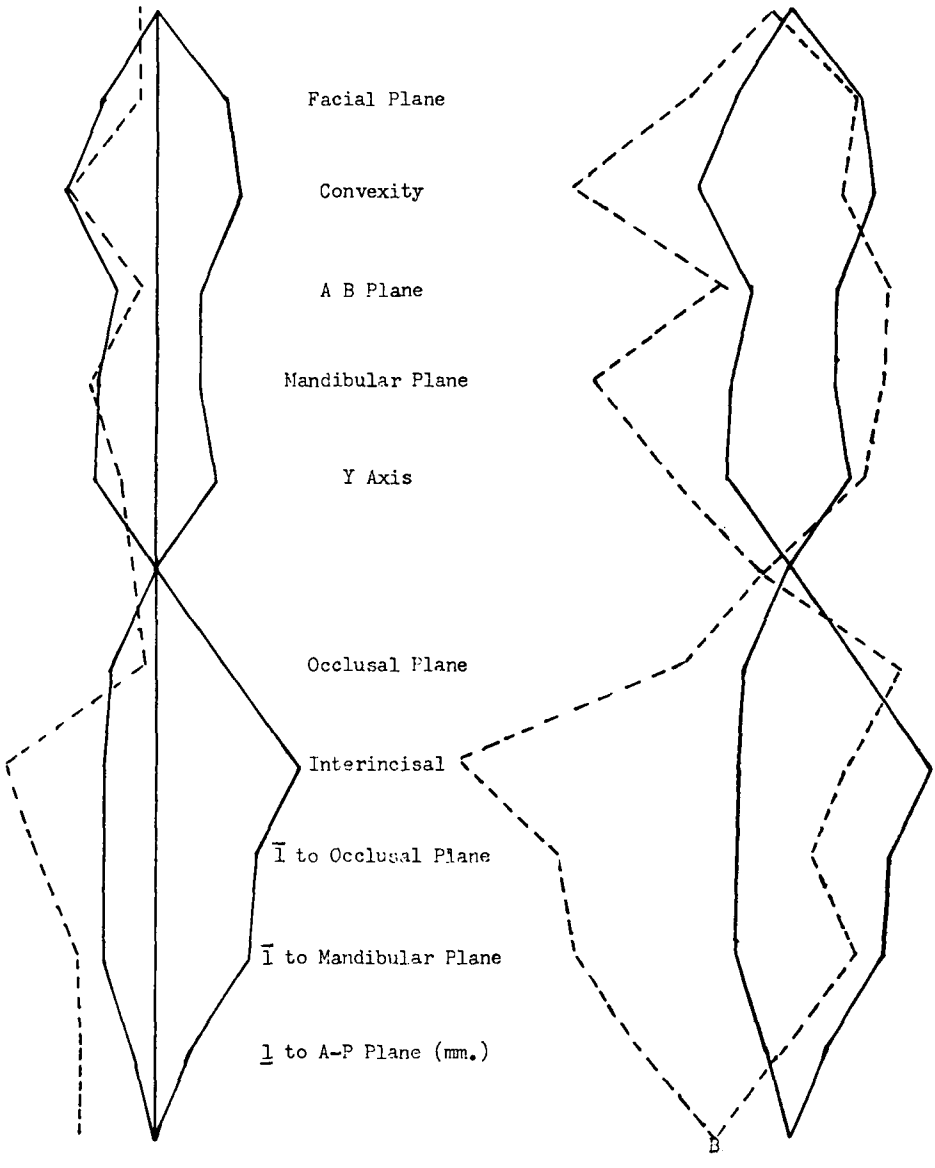


Fig.1 Left polygon — the broken line depicts the mean values for American Negro children on the Downs' analysis. Right polygon — the broken lines show the range for American Negro children.

TABLE II. COMPARISONS OF CEPHALOFACIAL RELATIONSHIPS OF VARIOUS AMERICAN RACIAL GROUPS (AFTER DOWNS)

SKELETAL PATTERN

	Facial Plane		Convexity		A B Plane		Mandibular Plane		Y Axis	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Caucasian (Downs)	87.8	82 to 95	0.0	+10 to -8.5	-4.6	0 to -9	21.9	17 to 28	59.4	53 to 66
Negro (Howard)	85.7	77 to 94.5	+9.7	+23.5 to -5	-6.3	+5.5 to -12	28.8	12 to 42.5	63.4	51.5 to 72
Negro (Cotton)	87.25	80 to 91	+9.6	+20 to +4	-7.7	-3 to -15	27.25	17 to 35	63.3	57 to 69
Chinese (Wong)	77.5	73 to 89	+7.5	+14 to +1.5	-5.7	-2 to -10	32.4	22 to 44	67.1	59 to 75
Japanese (Takano)	88.25	83 to 94	3.65	+12 to -1	-4.35	-1 to -7	24.3	14 to 33	62.1	56 to 68

DENTAL PATTERN

	Occlusal Plane		Interincisal		$\overline{1}$ to Occlusal		$\overline{1}$ to Mandibular		$\underline{1}$ to A-P (mm.)	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Caucasian (Downs)	9.3	1.5 to 14	135.4	130 to 150.5	14.5	3.5 to 20	+1.4	-8.5 to +7	2.7	-1 to +5
Negro (Howard)	+10.7	-3 to +20.5	119.2	99.5 to 141.5	27.3	12 to 39.5	+9.8	-5.5 to +24.5	10.4	3 to 19
Negro (Cotton)	11.8	+8 to +17	123.0	105 to 144	22.5	12 to 35	+6.6	-3.5 to +22	8.5	6 to 11
Chinese (Wong)	+16.9	+8 to +25	120.8	105 to 137	22.2	13 to 29	+7.8	0.0 to +18.0	7.6	3 to 12
Japanese (Takano)	9.65	2 to 19	126.4	114 to 152	21.5	8 to 31	+6.55	-6 to +13	6.6	2 to 10

the following individuals: Caucasian by Downs; Negro by Cotton; Chinese by Wong and Japanese by Takano. A comparison was made of the four studies listed above by Wylie[4] and we shall repeat some of his work. Table II lists the means and ranges for these four groups. We shall substitute the values obtained for the Howard group of North American Negro children for the values obtained by Cotton. We shall do this because we feel that our sample is more specific for this group. Cotton's group consisted of twenty Negroes of the San Francisco Bay area of California, ten males and ten females, ranging in age from eleven to thirty-four years. Cotton describes his sample as follows: "the occlusal relationships were not perfect but no real malocclusions were included." Because of the wide age span and small size of Cotton's sample as well as the uncertainty as to the occlusion of the teeth of his sample, it is felt that the Howard group will be more representative. Although the above statements are true, a close study of the two groups show them to be very similar. The mean values are presented side by side in Table II. Comparisons of these values show the following differences between the Cotton group and the Howard group: The skeletal patterns as seen in both groups are almost identical; a somewhat larger variation seems to exist between the dental patterns of the two groups, but the differences are not felt to be significant as they are all small, i.e., the mean values vary within a range of from 1° to 5° and approximately two millimeters in the measurement of the upper incisor to the A-P plane. When the differences in the size and makeup of the samples are considered, the over-all similarity is extremely close.

The skeletal pattern of the two groups, Negro and Caucasian, compare as follows. The mean values for the facial plane angle, a measure of the chin position, are similar 85.7°, for the Howard group and 87.8° for the Downs group; the ranges for these groups show the Howard group to be more retrusive and the protrusive extreme to be similar for both groups; the values are 77° to 94.5° for Howard and 82° to 95° for Downs. The mean values for the angle of convexity, a measure of the protrusiveness of the maxillary part of the face, indicate the Howard group to be more protrusive in this area. The mean values are 9.7° for the Howard group and 0° for the Downs group; the ranges give values of 23.5° to 5° for Howard and 10° to -8.5° for Downs. The mean values for the A B plane, a measure of the relationships of the denture bases to the profile and to each other, are similar for the two groups. The mean values are -6.3° for the Howard group and -4.6° for the Downs group; the ranges show values of 5.5° to -12° for Howard and 0° to -9 for Downs. The mean values for the mandibular plane angle, a measure of the relationship between the Frankfort plane and a tangent to the lower border of the mandible, demonstrate the Howard group has larger mandibular plane angles. The mean values are 28.8° for the Howard group and 21.9° for the Downs group; the ranges indicate values of 12° to 42.5° for Howard and 17° to 28° for Downs. The mean values for the angle for the Y axis, a measure of the direction of downward and forward growth, show the Howard group to have large Y axis angles. The mean values are 63.4° for the Howard group and 59.4° for the Downs group; the ranges give values of 51.5° to 72° for Howard and 53° to 66° for Downs.

The dental patterns of the two groups compare as now observed. The

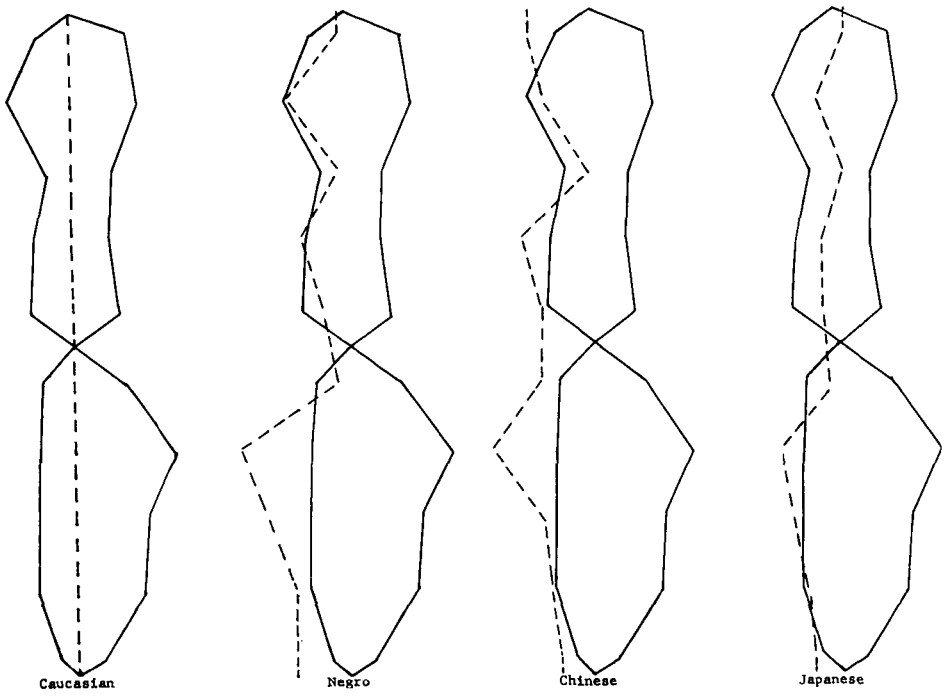


Fig. 2 Comparisons of four American racial groups on the Downs' analysis. The broken lines illustrate the means for each of the groups; the solid lines are the ranges for Caucasians.

mean values for the occlusal plane angle, a measure of the relative positions of the teeth in occlusion, are similar for the two groups, 10.7° for Howard and 9.3° for Downs; the ranges denote values of -3° to 20.5° for Howard and 1.5° to 14° for Downs. The mean values for the interincisal angle, a measure of the inclination of the upper to the lower teeth, show the Howard group to have more protusive teeth. The mean values are 119.2° for the Howard group and 135.4° for the Downs group; the ranges demonstrate values of 99.5° to 141.5° for Howard and 130° to 150.5° for Downs. The mean values for $\overline{1}$ to occlusal plane, the angles of the axial inclination of the lower incisors to the occlusal plane are larger for the Howard group than for the Downs group. The mean values are 27.3° for Howard and 14.5° for Downs; the ranges show values of 12° to 39.5 for the Howard group and 3.5° to 20° for the Downs group. The mean values for $\overline{1}$ to mandibular plane, the angles of the axial inclination of the mandibular incisors to the mandibular plane are larger for the Howard group. The mean values are -9.8° for the Howard group and 1.4° for the Downs group; the ranges give values of -5.5° to 24.5° for Howard and -8.5 to 7° for Downs. The mean values for $\underline{1}$ to A-P plane, a measure of the protrusiveness of the maxillary incisors expressed in millimeters, show the Howard group to be more protrusive. The mean values are 10.4 millimeters for the Howard group and 2.7 millimeters for the Downs group; the ranges indicate values of 3 to 19 millimeters for Howard and -1 to 5 millimeters for Downs.

Some of the data presented numerically in Table II and graphically in Figure 2 for four North American racial groups have been discussed in detail, specifically, the comparison of the data for Negroes and Caucasians using Downs' analysis. The data representing the other racial groups will not be given in as great detail, only the outstanding differences will be presented. A study of Table II and Figure 2 will show the following: The mean facial plane angle is similar for all of the groups except the Chinese. It is smaller for this group, which is an indication of a more receding chin. The mean angle of convexity is similar for Negroes and Chinese with Japanese nearly approaching the straightness of the Caucasian in the maxillary part of the face. The mean A-B plane angle, the relationship of the denture bases, is very similar for all groups. This observation had been made previously by Wylie, who further stated that a good relationship in this area was a prerequisite for normal occlusion of the teeth. The mean mandibular plane angle is smallest in the Caucasian group and largest in the Chinese group. This is to be expected for, as the facial plane angle decreases with a more posterior chin as has been previously noted for the Chinese group, the mandibular plane angle increases. The mean Y axis angle is greater in the Chinese group for the same reason as explained above — a more retrusive chin. Comparisons of the skeletal patterns of the four racial groups show considerable similarity in most of the areas measured.

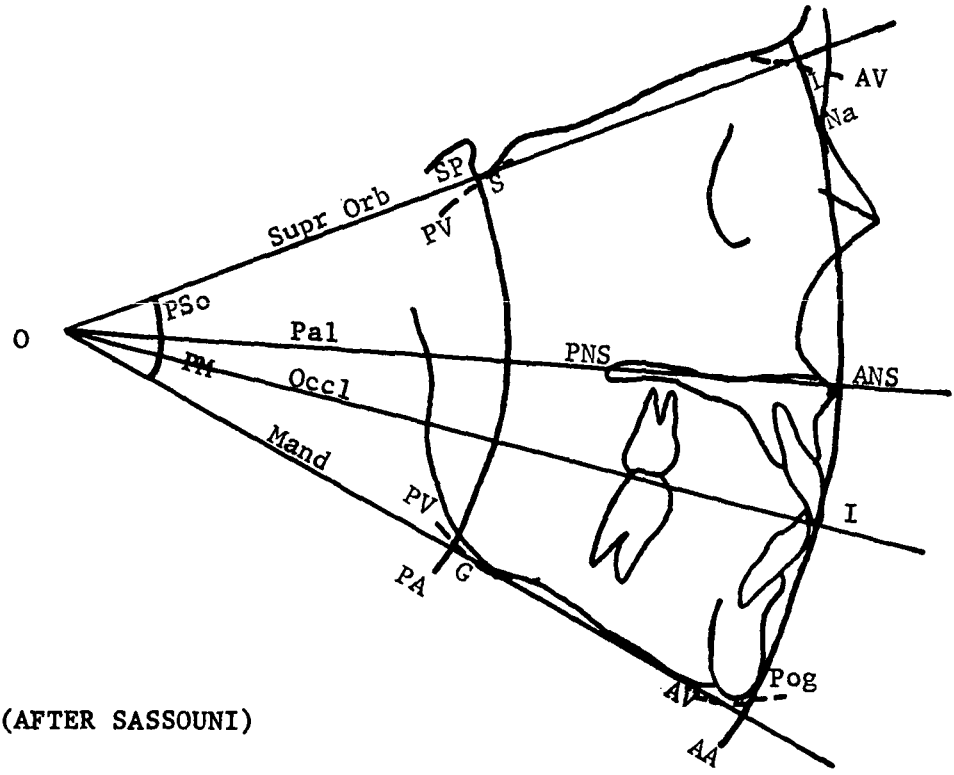
The measurements to indicate the dental patterns are compared as follows. The mean occlusal plane angles are similar for Caucasians, Negroes and Japanese. The Chinese have the largest mean occlusal plane angles — this is expected because of the retrusiveness of their chins. The mean interincisal angles are relatively similar for Negroes and Chinese with the Japanese being somewhat closer to the straightness of the Caucasian. The mean axial inclination of the lower incisors to the occlusal plane show that the lower incisors are inclined more in Negroes with the inclination of Chinese and Japanese being similar and with considerably less inclination of lower incisors in Caucasians. The mean axial inclination of the lower incisors to the mandibular plane shows a somewhat different pattern than the inclination of the incisors to the occlusal plane. The mean angle with the mandibular plane is similar in Negroes, Chinese and Japanese and much less, or more nearly at right angles, for Caucasians. The final mean measurement in the dental area is the distance in millimeters of the upper incisor from the A-P plane. All of the groups except the Caucasian have upper incisors some distance forward of this plane. It is felt that the significant differences between the parts of the heads and faces of these groups that we have studied using Downs' analysis occur in the dental areas mostly, the exception being the retrusiveness of the chin in the Chinese group.

Sassouni Analysis

The cephalometric x-rays of the selected normal group were traced a second time and a Sassouni analysis done on each tracing. This was done to check the relationships of the various parts of the heads and faces to each other, i.e., the proportionality of these heads and faces. The data gathered from Sassouni's analysis will be presented somewhat differently than the data for the Downs analysis, namely, the Howard data will be presented, then comparisons made with data published by Sassouni,[10] and finally data will be

presented that were suggested by the results of the investigation. A full explanation will be given of this approach. Appreciation is hereby expressed to Dr. Sassouni for reviewing the data and offering helpful suggestions for its analysis. The anatomical landmarks, planes, arcs and angles used in our discussion of this analysis are presented in Figure 3.

Sassouni adds the concept of proportionality to that of a norm or standard. He defines a well-proportioned face as one which has the following proportional relationships: (1) the four facial planes meet at the same point *O*, (2) the skeletal profile is archial, (3) the anterior upper and lower facial heights are equal, (4) the posterior upper and lower facial heights are equal, (5) the corpus of the mandible is equal in size and position to the anterior cranial base, and (6) the palatosupraorbital and palatomandib-



(AFTER SASSOUNI)

Fig. 3 Anatomical landmarks, planes, arcs, and angles used in this analysis:

Landmarks: O — center of the focal area where the four horizontal planes of the face converge; S — lowermost point on sella turcica; Sp — most posterior point on sella turcica; G — gonion; Pog — pogonion; I — incisal edge of upper central incisor; ANS — anterior nasal spine; PNS — posterior nasal spine; Na — nasion; L — the junction of the supraorbital plane and the anterior arc.

Planes: OSL — supraorbital or anterior cranial base plane; Pal — palatal plane; Occl — occlusal plane; Mand — mandibular plane.

Arcs: AA — anterior arc; PA — posterior arc; AV — anterior vertical arc; PV — posterior vertical arc.

Angles: PSo — palatal supraorbital angle; PM — palatal mandibular angle.

ular angles are equal. We shall present data relative to each of the above criteria for a well-proportioned face.

The four facial planes that should meet at a common point *0* are the anterior cranial base plane, the palatal plane, the occlusal plane and the mandibular plane. He thereby classifies faces with varying degrees or patterns of proportionality as follows: *Type I,* wherein the anterior cranial base plane does not meet the other three planes at common point *0*; *Type II,* wherein the palatal plane does not meet the other three planes at common point *0*; *Type III,* wherein the occlusal plane does not meet the other three planes at common point *0*; and *Type IV,* wherein the mandibular plane does not meet the other three planes at common point *0*. The above types are further classified into subdivisions depending on whether they pass above point *0,* subdivision A, or below point *0,* subdivision B. Table III presents the number of the Howard group found in each classification. The totals for Sassouni's group with normal occlusion of their teeth are also presented.

Before making any comparisons between the Howard and Sassouni data the following explanation is offered. Sassouni's sample consisted of 100 North American Caucasian children, 51 girls, 49 boys, 7 to 15 years of age; 50 children, 24 boys and 26 girls, had normal occlusion, and of this number 31 children, 15 boys and 16 girls, were of Hellman's dental age IV A: the remaining 19 children were in Hellman's dental ages III A, III B and III C. These children had been studied and their records were on file at the *Philadelphia Growth Center.* Sassouni combined his data for both sexes and all dental ages for his group with normal occlusion. The data for the Howard group will be compared with this combined data. It will be noticed that the totals in the Howard group equal eighty-nine whereas only eighty tracings were studied. Nine of the tracings had two possible classifications.

TABLE III. CLASSIFICATON OF CRANIOFACIAL TYPES

Facial Patterns	Howard No.	Howard %	Sassouni No.	Sassouni %
Well-proportioned	3	3.4	16	32
IA	28	31.5	4	8
IB	0	0.0	5	10
IIA	10	11.2	4	8
IIB	11	12.4	9	18
IIIA	1	1.1	3	6
IIIB	20	22.5	4	8
IVA	15	16.8	3	6
IVB	1	1.1	2	4
	89*		50	

*The total of 89 reflects the double classification of nine of the tracings.

A study of Table III shows a wide diversification of facial patterns when classified in this manner. This diversification exists in both groups. Sassouni found 16 or 32% of his faces to be well-proportioned whereas only 3 or 3.4% of the Howard group were so classified. The largest classes for the Howard group are IA with 28 or 31.5%; IIA and IIB had 10 and 11 or 11.2% and 12.4% respectively; IIIB with 20 or 22.5% and IVA with 15 or 16.8%. The very high incidence of variability of the patterns or degrees of proportionality of the Howard group using this classification raises the question of its usefulness as a means for classifying facial patterns, i.e., the proportionality thereof, for Negro children.

We shall next present data from Sassouni's analysis relative to classification of the dentofacial skeletal profile. Sassouni bases his classification on the position of the anterior arc relative to the following points of reference on the profile; nasion, anterior nasal spine,

upper incisor and pogonion. The skeletal profile types are called *Archial*: where the anterior arc passes through Na, ANS, upper incisor edge and pogonion (all of Sassouni's well-proportioned faces were archial); *Prearchial*: where ANS and pogonion are situated anterior to the anterior arc passing through Na; *Postarchial*: where ANS, upper incisor and pogonion are situated posterior to the anterior arch passing through Na; *Convex*: where ANS is situated anterior to the anterior arc and pogonion is either on the arc or posterior to it; *Concave*: where ANS is situated posterior to the anterior arc and pogonion is either on the arc or anterior to it. In studying the data gathered on the Howard group it was found that a large number, thirty-four in all, did not fit any of the above profile types. This matter was discussed with Dr. Sassouni who suggested the following additional classifications: *Mandibular protrusion*: where ANS is on the anterior arc and pogonion is anterior to this arc; *Mandibular retrusion*: where ANS is on the anterior arc and pogonion is posterior to this arc; *Archial except for teeth*: where the anterior arc passed through Na, ANS and pogonion (all of the points in the archial type profile except the edge of the upper incisor). In this type the teeth were always anterior to the anterior arc.

The totals of the dentofacial skeletal profile types for the Howard and Sassouni groups are presented in Table IV. An analysis of the data presented in Table IV shows that only 4 or 5% of the profiles in the Howard group were archial whereas 19 or 38% were archial in Sassouni's group. But, if we add the eleven who were archial except for their teeth in the Howard group, we have 15 or approximately 19%; we find 7 or 8.75% for the Howard group compared to 6 or 12% for the Sassouni group having prearchial profile types; postarchial profile types found in 17 or 21.25% of the Howard group and 11 or 22% of the Sassouni group; convex profile types were disclosed in 4 or 5% of the Howard group and 3 or 6% of the Sassouni group; concave profile types were revealed in 14 or 17.5% of the Howard group and 11 or 22% of the Sassouni group; mandibular protrusion was found in 12 or 15% of the Howard group; mandibular retrusion was discovered in 11 or 13.75% of the Howard group. There are no comparative data for the Sassouni group for the last two types.

TABLE IV. CLASSIFICATION OF DENTOFACIAL SKELETAL PROFILE TYPES

	Howard		Sassouni	
	No.	%	No.	%
Archial	4	5.00	19	38
Archial except for Teeth*	11	13.75		
Prearchial	7	8.75	6	12
Postarchial	17	21.25	11	22
Convex	4	5.00	3	6
Concave	14	17.50	11	22
Mandibular Protrusion*	12	15.00		
Mandibular Retrusion*	11	13.75		
	80		50	

*Not observed in Sassouni series.

A study of Table IV shows a wide diversification of skeletal profile types when classified in this manner. Here again the usefulness of this classification as a means of defining a certain type of profile is questioned, but the value of relating the contributions of the various parts of the face to the total dentofacial skeletal profile is very helpful. It is felt that Sassouni did not intend that tracings as suggested by his analysis be made to compare one with the

TABLE V. DENTAL ANALYSIS
(Howard Group)

	No.	%
Equal	4	5.00
Plus	59	73.75
Minus	17	21.25
Total:	80	

other, but rather that there be found proportionality within each individual tracing. With this thought we wish to point out several observations relative to this classification — when applied to Negro children. The teeth protrude beyond the anterior arc in the great majority of these children. The number of children and the amount of the protrusion is shown in Table V. Those whose teeth fell on the arc were called *Equal,* only 4 or 5.0% were in this group; those whose teeth were anterior to the arc were said to be *Plus,* 59 or 73.75% were in this group; those whose teeth were posterior to the anterior arc were said to be *Minus,* 17 or 21.25% were in this group. The mean distance anterior of the arc was found to be 5.92 millimeters with a range from -3 to 14 millimeters. The standard deviation was 2.58 millimeters. Sassouni does not consider the positions of the anterior teeth except in the archial classification. The postarchial, concave, and mandibular retrusion profile types compose approximately 52% of the Howard group; these relationships tend to indicate retrusiveness in the faces of this group which have been reported as having protrusive faces; using this method there seemed to be as many retrusive chins as protrusive, 13.75% and 15% respectively. These indications will be further studied as the horizontal and vertical proportions of various parts of the face are related.

The vertical proportions of the face were studied using Sassouni's analysis and the data are presented in Table VI. The lower facial heights were said to be *Equal* when the upper facial heights, the distance between the cranial base plane and the palatal plane, were equal to the distances from the palatal plane to the mandibular plane; *Minus* when the lower face was smaller than the upper face; and *Plus* when the lower face was larger than the upper face. ANS and the anterior arc were used for the anterior proportions and PNS and the posterior arc were used for the posterior proportions. The anterior vertical proportions show that 6 or 7.5% of the Howard group had equal upper and lower anterior facial heights, whereas 14 or 28% of Sassouni's group had equal anterior facial heights; larger lower anterior facial heights were found in 69 or 86.25% of the Howard group and only 18 or 36% of the Sassouni group; smaller lower anterior facial heights were found in only 5 or 6.25% of the Howard group and 18 or 36% of the Sassouni group. The very obvious observation here is that the great majority of the Howard group had larger lower anterior facial heights than upper anterior facial heights and that the Sassouni group

TABLE VI. VERTICAL FACIAL PROPORTIONS

	Howard		Sassouni		Howard		Sassouni	
	No.	%	No.	%	No.	%	No.	%
Equal	6	7.50	14	28	15	18.75	23	46
Plus	69	86.25	18	36	25	31.25	9	18
Minus	5	6.25	18	36	40	50.00	18	36

was almost equally divided as to the relative sizes of their upper and lower facial heights. The question was raised as to how much larger were the lower facial heights than the upper in the Howard group. The tracings were measured and the mean difference was found to be 9.9 millimeters with a range from -3 to 29 millimeters. The standard deviation was 5.97 millimeters.

The posterior vertical proportions show that 15 or 18.75% of the Howard group had equal upper and lower posterior facial heights, whereas 23 or 46% of the Sassouni group had equal posterior facial heights; larger lower posterior facial heights were found in 25 or 31.25% of the Howard group and only 9 or 18% of the Sassouni group; smaller lower posterior facial heights were found in 40 or 50% of the Howard group and 18 or 36% of the Sassouni group. The Howard group had fewer faces with equal posterior facial heights; in fact, when the total number of equals and the larger lower posterior facial heights were combined, they exactly totaled the number whose lower posterior facial heights were smaller. Sassouni's group showed the greater number with equal posterior facial heights, but with an almost equal number having smaller lower posterior facial heights. The mean difference in the posterior facial heights for the Howard group, was 0.44 millimeters with a range from -12 to 14 millimeters. The standard deviation was 4.73 millimeters.

The horizontal craniofacial proportions of the head and face were also studied using Sassouni's analysis. These data are presented in Table VII. The well-proportioned face, according to Sassouni, had a corpus of the mandible equal in size and position to the anterior cranial base. The corpus of the mandible, from pogonion to gonion, should fall between the anterior and posterior arcs (see Fig. 3). The Howard group had 3 or 3.75% whose mandibular corpal lengths and anterior cranial bases were equal; 73 or 91.25% whose mandibular corpal lengths were greater than their anterior cranial bases; 4 or 5% of the group had corpal lengths that were smaller. Although Sassouni mentions this proportionate relationship as a prerequisite for a well-proportioned face he does not present any data giving the numbers of his group with normal occlusion that had larger or smaller mandibular corpal lengths. He has had at least 14 or 28% of this group with all the other prerequisites so we assume that at least this number had equal cranial base and mandibular corpal lengths. The obvious factor here for the Howard group is that the corpal length of their mandibles is greater than their anterior cranial base lengths. The mean difference for this group is 7.8 millimeters with a range from -3 to 24 millimeters. The standard deviation is 4.56 millimeters.

TABLE VII. HORIZONTAL CRANIOFACIAL PROPORTIONS (Howard Group)

	No.	%
Equal	3	3.75
Plus	73	91.25
Minus	4	5.00
Total:	80	

The vertical angular proportions, or the relationships between supraorbital or cranial base angle (PSo) and the palatal mandibular base angle (PM) were studied using Sassouni's analysis. These data were presented in Table VIII. That these angles be of equal size was one of the prerequisites for a well-proportioned face. The Howard group had one or 1.25% in whom the two angles were equal; 68 or 85% of

TABLE VIII. VERTICAL ANGULAR PROPORTIONS
(Howard Group)

	No.	%
Equal	1	1.25
Plus	68	85.00
Minus	11	13.75
Total	80	

the group had larger palatomandibular angles; 11 or 13.75% had smaller palatomandibular angles. We have no data from Sassouni for comparison. The palatomandibular angles are obviously larger for the great majority of the Howard group. The mean difference between these two angles for this group is 8.2° with a range from -13° to 25°. The standard deviation is 7.58°.

Upon studying the results of the data presented using Sassouni's analysis and by personal communication with Dr. Sassouni several suggestions were developed as to where and how these proportionate relationships of the heads and faces of Negro and Caucasian children differed and further if there were possible correlations between some of these differences. These suggestions were as follows: (1) correlate the differences between the lower and upper anterior facial heights to the differences between the palatosupraorbital (anterior cranial base angle) and the palatomandibular angles; (2) correlate the differences between the positions of the palatal plane to the foramen magnum to the differences between the upper and lower anterior facial heights; (3) make composite tracings of the Howard group and superimpose and compare these tracings directly with similar tracings of Caucasian children made by Dr. Sassouni at the *Philadelphia Growth Center*.

The differences between the palatosupraorbital and palatomandibular angles were correlated with the differences between the upper and lower anterior facial heights and are presented in Figure 4. This correlation diagram shows a very positive relationship between these two factors. The means of the differences were calculated as well as the coefficient of correlation. The mean of the differences between the two angles was 8.2°, the mean of the differences between the anterior facial heights was 9.9 millimeters. The coefficient of correlation (r) was found to be 0.71.

The differences between the positions of the palatal plane to the foramen magnum are correlated with the differences between the upper and lower anterior facial heights in Figure 5. This correlation diagram shows that there is practically no correlation between these two factors. The means of the differences were calculated as well as the coefficient of correlation. The mean of the differences of the positions of the palatal plane to the foramen magnum was 6.6 millimeters, the mean

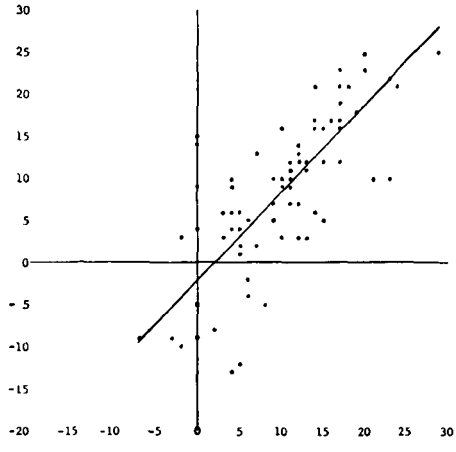


Fig. 4 Correlation diagram of the differences between the upper and lower anterior facial heights (X - axis) and the differences between the palatosupraorbital and palatomandibular angles (Y - axis) in eighty American Negro children with normal occlusion.

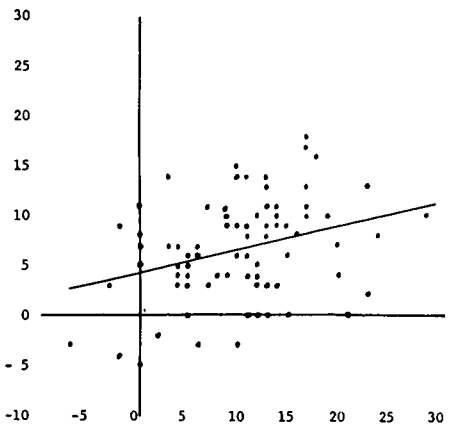


Fig. 5 Correlation diagram of the differences between the upper and lower anterior facial heights (X - axis) and the differences between the positions of the palatal plane and the foramen magnum (Y - axis) in eighty American Negro children with normal occlusion.

of the differences between the anterior facial heights was 9.9 millimeters. The coefficient of correlation (r) was found to be 0.0017.

Observation of the two correlation diagrams presented in Figures 4 and 5 shows that there is a positive correlation between the differences in the sizes of the palatosupraorbital and palatomandibular angles and the differences in the anterior facial heights, but no correlation between the differences in the distances of the palatal plane from the foramen magnum and the anterior facial heights. The palatomandibular angles have been found to be large in the Howard group as have the lower facial heights. It is felt that these factors play an important part in the particular configuration of this racial group.

The eighty cephalometric x-rays of the selected Howard group were studied again. This time they were separated into four groups as follows: 16 boys, 12 to 14 years of age; 16 girls, 12 to 14 years of age; 16 boys, 14 to 16 years of age; and 16 girls, 14 to 16 years of age. The four groups of x-rays were traced separately using the method employed by Krogman in craniometry and by Broadbent in roentgenographic cephalometry. The skeletal as well as the soft tissues were traced. This was done in the following manner: (1) We started with sixteen tracings in each age and sex group and superimposed them in pairs on the cranial base plane. (2) This gave a first average of eight tracings, which were then superimposed in pairs. (3) This gave a second average of four tracings which were again superimposed. (4) We now had a third average of two tracings which were superimposed. (5) This gave us a final average of one film which was the cumulative or composite tracing of the original sixteen. This final tracing was representative of a sex and age period and was accepted as a standard.

These standard tracings for each sex and age group were superimposed over similar standards for Caucasian children prepared by Sassouni at the *Philadelphia Growth Center* and these comparative tracings are presented in Figures 6 and 7. The cranial base plane was used as the plane of reference. The standards of the Caucasian children are represented by the broken lines, the standards of the Negro children by the solid lines. Observation of these tracings shows the over-all size of the heads and faces of the Negro children to be larger for each sex and age group; the teeth are more protrusive with larger interincisal angles; the lower facial heights are relatively larger than the upper facial heights as compared to Caucasian children; the palatal planes of boys and girls 12 to 14 years of age were inclined downward as well as that of the girls of 14 to 16 years of age; the mandibular base planes are surprisingly similar; the soft tissue profiles are similar in

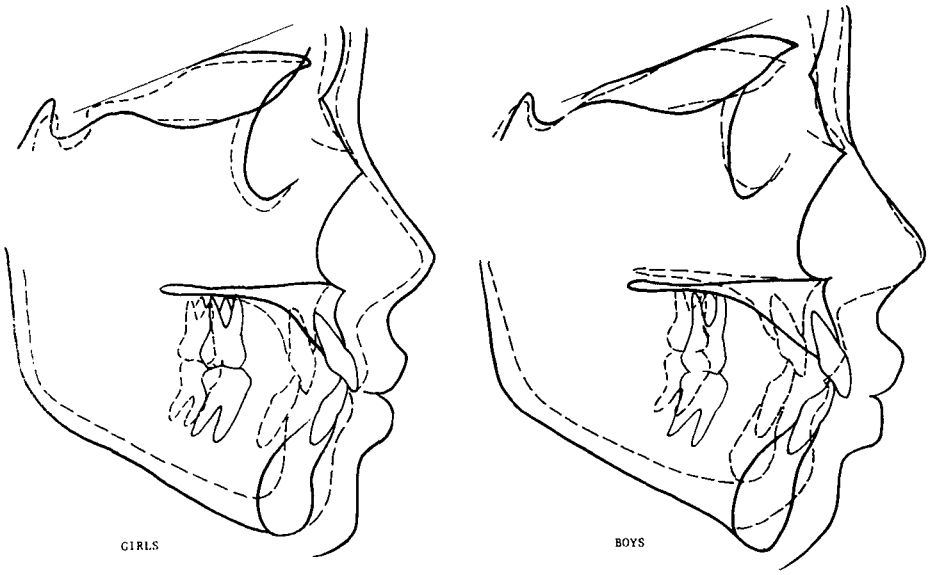


Fig. 6 Comparative standard tracing of American Negro and Caucasian children, twelve to fourteen years of age with normal occlusion. The broken lines are the Caucasian standards. The tracings are superimposed on a line tangent to the floor of the anterior cerebral fossa.

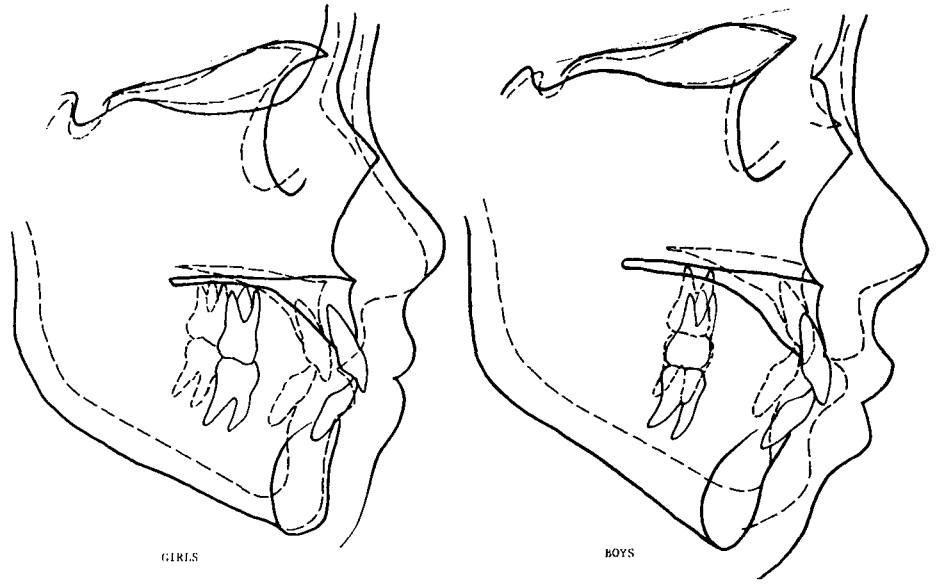


Fig. 7 Comparative standard tracings of American Negro and Caucasian children, fourteen to sixteen years of age with normal occlusion. The broken lines are the Caucasian standards. The tracings are superimposed on a line tangent to the floor of the anterior cerebral fossa.

the upper face but the areas of the lips are more protusive for the Negro children.

Summary

A sample of eighty Negro children, forty boys and forty girls, with normal dental occlusion was selected as a specific group for further study. The methods used in the study of this selected group were as follows: dental models, hand x-rays, heights and weights recorded on the Wetzel Grid, and cephalometric x-rays. The hand x-rays and Wetzel Grid were used to show that this selected group consisted of normal healthy children. The cephalometric x-rays of the selected Howard group were traced in the standard manner. The analyses of Downs and Sassouni were used. Composite tracings were also made according to the methods of Broadbent and Krogman. These composite tracings were made for the following four groups: boys, 12 to 14 years of age; girls, 12 to 14 years of age; boys, 14 to 16 years of age; and girls, 14 to 16 years of age.

Downs analysis data were compared for four North American racial groups: Caucasian, Negro, Japanese, and Chinese. The facial plane angles were similar for all groups except the Chinese whose chins were more retruded. The angles of convexity were similar for Negroes and Chinese with the Japanese approaching the straightness of the Caucasian in the maxillary part of the face. The A-B planes were similar for all the groups. The mandibular plane angles were smallest for Caucasians and Japanese with Negroes and Chinese being largest. The Y axis angles were similar for Negroes and Japanese with the largest angles being found in the Chinese group. Caucasians had the smallest Y axis angles. The skeletal patterns of these four racial groups show considerable similarity.

The dental patterns of the four racial groups were compared using a Downs analysis. The occlusal plane angles were similar for all the group except the Chinese who had larger angles, another indication of the retrusiveness of their chins. The interincisal angles were similar for Negroes and Chinese with the Japanese group being larger and the Caucasian group largest of all. The angle of the lower incisor to the occlusal plane was similar for Chinese and Japanese with Negroes having the largest angles and Caucasians the smallest. The angle of the lower incisor to the mandibular plane was similar for Negroes, Chinese and Japanese with Caucasians having smaller angles. The distance of the upper incisor in millimeters from the A-P plane was similar for Chinese and Japanese; Negroes were farthest from this plane with Caucasians being nearest.

A Sassouni analysis was done on each of the cephalometric tracings. These tracings were analysed by comparing the criteria for a well-proportioned face listed by Sassouni. The four facial planes, supraorbital, palatal, occlusal and mandibular, only met at a common point in approximately 3% of the children in the Howard group. The anterior lower facial heights were larger than the upper facial heights in approximately 86% of the Howard group. The posterior upper and lower facial heights were very variable with about as many of the lower posterior facial heights being of equal or larger size as there were that were smaller. The corpus of the mandible was larger than the anterior cranial base in approximately 92% of the Howard group. The palatomandibular angles were larger than the palatosupraorbital angles in 85% of the Howard group. The difference between the palatosupraorbital and palatomandibular

angles was found to be positively correlated with the difference between the upper and lower anterior facial heights. The difference between the position of the palatal plane to the foramen magnum and the differences between the anterior facial heights were found not to be correlated.

The composite tracings of the Howard group made according to the methods of Krogman and Broadbent were compared with similar tracings of Caucasian children, made by Sassouni at the *Philadelphia Growth Center*. The Howard group differed as follows: the heads and faces were larger for each age and sex; the teeth were more protrusive; the lower facial heights were relatively larger than the upper facial heights and the lips were more protrusive.

Conclusions:

1. There are definite and measurable differences in the configurations or facial patterns of the heads and faces of various North American racial groups, namely, Negro, Caucasian, Chinese and Japanese.

2. This study has shown that the mean over-all absolute size of the heads and faces of North American Negro children seemed to be larger than the the heads and faces of North American Caucasian children of the same age.

3. The degree and nature of the prognathism attributed to the Negro is a dental prognathism, i.e., the chin point as related to the facial plane is similar to that of the orthognathic face of the Caucasian.

4. The configuration or facial pattern of the Negro seems to be one wherein the lower facial height is larger than the upper facial height; the corpus of the mandible is larger than the anterior cranial base; the palatomandibular angle is larger than the palatosupraorbital angle and there is a positive correlation between the differences in the size of these angles and the differences between the anterior facial heights; and the teeth are anterior to the facial plane or Sassouni's anterior arc.

5. The skeletal patterns (in profile) of the Negro and Caucasian seem to be similar.

6. The differences in the craniofaciodental complex between Negroes, Caucasian and other racial groups have been pointed out and analysis of these differences seems to indicate that norms and standards of one racial group can not be used without modification for another racial group.

7. This study has emphasized the need for the presentation of new standards for Negroes, but it has also shown in measurable fashion that the range of normal variability within this group is very great, as it has been shown to be in other racial groups; because of this we wish to strongly emphasize the concept of the individual normal with modification indicated by racial attributes. The term Negro in North America is a sociological one;[10] we have been discussing anatomical and biological factors. Negro individuals will be found whose heads and faces are indistinguishable from members of other racial groups. A measure of judgment will be necessary in the utilization of the standards presented by this study.

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