ON THE ANGLE OF THE ELBOW.

BY

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WITH 1 FIGURE AND 8 TABLES.

Artists consider a woman's arm beautiful when, in its extended position it is straight, or nearly so, and sufficiently plump to give it delicate curved lines. With the elbow flexed the upper arm is considered the more beautiful the nearer its section approaches a circle. The same is claimed for the forearm near the elbow. As the section approaches the wrist the circle becomes an ellipse, and the farther it is from the elbow the more marked is its eccentricity. With the forearm flexed and semi-prone the long axis of the ellipse is directed diagonally downward and outward. It is self-evident that artists do not make either cylindrical or conical arms; they prefer as a model an arm whose section is nearly circular. The forearm is always a little flat, more so in supination than in pronation. In antique statues the upper arm is found to be more nearly circular, while in those of the renaissance a lateral flattening is shown. It appears then that the ideal arm of artists changes from time to time, possibly because the models before them changed correspondingly. At any rate the shape of the upper arm of the renaissance approaches the modern anatomical arm more than does that of antiquity.

The form of the ideal woman's arm is caused in great part by the layer of subcutaneous fat drawn over the structure below. In the ideal man's arm the structures below, especially the muscles, protrude and form marked lines indicating strength. And it is considered beautiful by many to show some of these lines in a delicate way in woman's arm. A slight outline of the deltoid, biceps and triceps does not make the arm appear masculine provided it is built upon a delicate skeleton.

The beautiful arm, then, is one that is plump, round, tapering and relatively straight. Differences are, of course, to be expected, due to race, sex and age. The amount of fat upon the arm differs much between the ages of 15, 25 and 45. The same seems to be true regarding the angle of the elbow. The arms of young girls are said to be straighter and

the motion of the elbow seems to be greater than are those of young women. At any rate, from an artistic standpoint, a slight amount of hyperextension is permitted in a child's arm, but it makes a bad impression when it is present in the arm of a muscular man. It is evident that the standard of the beautiful must change for different periods of life, and the question is whether the beautiful and anatomical normal correspond. It was mentioned above that the arms of antique statues were unlike in form those of the renaissance, the latter being more realistic.

The Greeks constructed the canon of the human body with its length eight times the length of the head, which was taken as the modulus. This gave a rather short body, too much so, for Michael Angelo found it necessary to add one-third of a modulus, making the body 8⅓ heads long. This third of a modulus was added to the legs above, which were also extended one-sixth of a modulus below. Thus Michael Angelo's canon is half a head longer than the Greek canon, all of the difference being added to the legs. This may account for the plump arms of the Greeks and the thinner arms of the renaissance. Since that time many systems of measurement have been invented, differing mostly in the modulus, and contributing little to the proportion of the body. It appears that the first scientific step was taken by Quetelet, who drew averages from the measurements of some 30 soldiers. So much variation was encountered, however, that his results proved to be of little value. Others made many measurements, as is shown by Sargent's admirable work on the average figure of American students of both sexes. The next step in advance was made by measuring from the principal joints to obtain the proportions of the trunk, and the most satisfactory system is that of Fritsch, whose modulus is the length of the spinal column. His canon, to a certain extent, outlines the human body, giving at a glance many ratios. When this is compared with numerous recent outlines it is remarkable how well they coincide. It may be added that the best recent outlines of the body were constructed by anatomists and that there is now a tendency for artists to accept a canon which is anatomically correct. Furthermore, this canon is much more like that of antiquity than like that of the renaissance, being half a head shorter than the Greek canon.

The difficulty is not to be solved by inventing a new modulus but by establishing its length. This in turn will establish the length of all other important measurements, bringing ultimately the artistic ideal and the anatomical normal together. Furthermore, measurements from the centers of the main joints are most desirable, for then exact measure-

ments can be made in a statue, since a femur or a humerus measures the same in all positions. Fritsch's canon fulfills this requirement. That the average measurement is the most beautiful is further proved by observing composite photographs of many average faces, few of which are considered beautiful, while together they are decidedly so. Nature has here been and must continue to remain our best standard.

To what extent artists may idealize variations is not for me to consider now. They must, however, remain within bounds, and when they emphasize a variation of one part their convention must make the rest of the body the anatomical normal in order to bring out well the difference. So if straight arms are the artistic ideal, the rest of the canon must correspond with the anatomical normal.

In a model an arm is not considered beautiful if it is too long, for this is said to be indicative of a lower race. Neither is hyperextension nor a lateral angle considered desirable. It is especially inartistic to have the two combined. Hyperextension of the elbow may be overlooked in children and in delicate girls, for it helps to indicate the flexibility of the body, which is a characteristic of youth.

It appears that those who write upon the angle of the elbow from the standpoint of the artist are not altogether familiar with its anatomy, for the straight arm is considered the more usual. According to Brücke, the lateral deflection of the forearm is more common in women than in men, while according to Stratz the opposite is the case.

The latter author makes the normal arm so straight that the wrist in turning rotates in a circle with the radius as its center, thus in pronation the lower end of the ulna moves lateral as much, or more, than the radius does medial (see Stratz's Fig. 67).

It has been known for a long time that the trochlea is not set at right angles to the shaft of the humerus but obliquely to it, making an acute angle directed outwards. It is this lateral angle which, according to Langer, causes the forearm to bend out when the arm is extended, and assuming that the articular surfaces of the ulna and radius are at right angles to the forearm the hand must fall upon the chest when the elbow is flexed. The amount of lateral deflection when the arm is extended equals the extent the hand moves in when the arm is flexed. The observations of Langer are accepted by Brücke, but apparently he does not consider the normal arm beautiful, and suggests various methods by which it can be corrected in a picture or a statue by always presenting the arms either partly pronated, or partly flexed, or both.

The subject was carefully reworked by Braune and Kyrklund in their study of the elbow joint, and they show that not only is the axis of

the elbow joint set obliquely to the humerus but also to that of the forearm. As a rule the angles formed by the axis with the humerus and with the forearm are nearly equal, each measuring about 83°, both acute angles pointing outward. The styloid process of the ulna which marks the long axis of the forearm in both pronation and supination, deflects fully 14 degrees from the sagittal axis of humerus when the elbow is extended, and gradually approaches it as the elbow is flexed, for the angles of the humerus and of the forearm neutralize each other in the flexed position.

This study was made to test these results, and to determine the extent of the motion of the elbow in the European and in the negro, male and female, for during a number of years past I have felt conscious that a sexual difference exists.

In order to make satisfactory measurements fixed points had to be established and after extending Braune and Kyrklund's reliable method a modified method for measurement was hit upon which when applied repeatedly to the same arm gave an error of less than one degree. Unfortunately there are more variations than I had anticipated, but I venture to give my data with the hope that they may be of more general use, and that I may be able to add to them in the course of some years. To collect and measure 100 specimens is not altogether a small task, but this kind of work must be multiplied many fold before the foundations of anatomy—descriptive, regional and artistic—become anthropological.

The arms studied were taken from the dissecting rooms and carefully cleaned, leaving all of the ligaments of the elbow intact. Then the axis of the elbow was determined by fixing the ulna and radius, and moving the humerus to and fro. By doing this it is quite easy to find a point over each epicondyle which does not move. A line extending through these two points passes through the middle of the trochlea and marks the axis of the elbow joint. Frequently there is not an immovable point over one of the epicondyles, but instead a line is determined and in most cases the middle of the line is taken as the axis. Next the humerus was fixed with this axis and a point in the middle of the upper third of the shaft in a horizontal plane 15 cm. above the plane of the table. The perpendicular plane was then passed through the middle of the upper third of the humerus and through the coronoid process, for it has been shown by Braune and Kyrklund that this process keeps within a millimeter of this plane, passing first to one side of it and then to the other. The screw motion which is said to be present by Meissner, Henke and Langer does not exist. Five centimeters from this plane a glass plate was fixed from which the measurements were taken. The horizontal

plane becomes a coronal plane when the arm hangs down along the side of the body, and therefore I still call it the coronal plane. In the same position the perpendicular plane is parallel with the sagittal plane of the body and may therefore be called the sagittal plane of the arm. The intersection of the two planes forms the axis of the humerus passing through the center of the upper third of the shaft and through the axis of the elbow below the coronoid process.

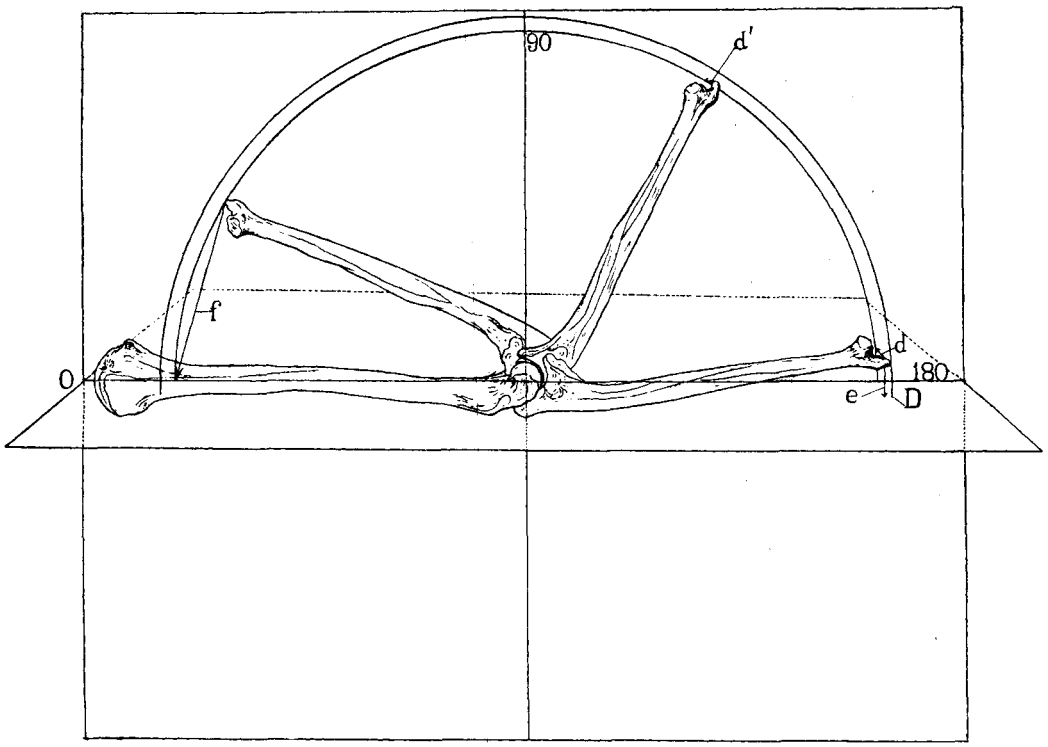

Diagram of the bones of the arm with the planes from which measurements were taken indicated. *D*, circle of maximum deflection of the ulna; *d* chord of the arc of deflection when the elbow is extended; *d'*, the same at about 110 degrees; *e*, chord of the arc of extension when reduced to degrees to be subtracted from 180 degrees; *f*, chord by which the extent of the flexion of the elbow is measured.

The angle of the axis of the joint with the long axis of the humerus was first determined by direct measurement, the right arm being clamped with the humerus to my left, and the left arm in the opposite position. In all cases the degree of flexion, extension and deflection was determined by measuring from the styloid process of the ulna. The degree

of flexion was determined by the chord of the arc which would be described by moving the styloid process from maximum flexion to the long axis of the humerus with the axis of the elbow as the center. The degree of extension was determined by the chord of the arc described by the styloid process between maximum extension and the projected axis of the humerus. Accordingly when the elbow joint did not extend to a straight line or when it hyperextended this amount was respectively subtracted from or added to 180 degrees. The amount of deflection was determined for three positions measuring from the styloid process with the elbow flexed, extended and at 90 degrees. The degree is determined by the chord of the arc described by the styloid process intersecting the sagittal plane at right angles in these three positions named above. In case the deflection is out it is marked plus and in case it is in it is marked minus.

In the appended tables the first column gives the number of the cadaver. The second column gives the length of the ulna from the styloid process to the axis of the elbow joint. Next the angles of the humerus and the ulna with the axis of the arm are given. These, together with the degree of deflection of the forearm with the elbow joint extended to its maximum, always equal 180 degrees. Then follow the columns with the degree of motion, from maximum flexion to maximum extension, 180 degrees being a straight line. The lateral angle is next given in three positions and when it is marked minus it indicates that the arm turns in. This takes place frequently when the elbow is flexed to its maximum, occasionally when at right angles, and not at all when it is extended. In other words, when the arm is extended and supinated the whole wrist including the styloid process lies to the outward of a line drawn through the middle of the upper third of the shaft of the humerus and the coronoid process of the ulna. All arms are deflected laterally.

Braune and Kyrklund have shown conclusively that the elbow joint is a pretty perfect hinge joint and that there is practically no screw motion in it. As it flexes the ulna shifts a little, first outward then inward, which motion causes the shaft of the humerus to rotate outward nearly 6 degrees in case the forearm is flexed. For all practical purposes the joint is a hinge joint, the axis being set obliquely at nearly 84 degrees to both humerus and ulna. In all cases the styloid process of the ulna deflects about 12 degrees when the arm is extended and when flexed because the angles of the humerus and ulna are about equal, the ulna lies in the sagittal plane of the humerus, *i. e.,* the ulna comes to lie directly upon the humerus and not upon the chest as is claimed by Langer. In case the angle of the axis of the ulna is less than that of

the humerus, the styloid process still deflects when the elbow is flexed and in case it is greater it is turned in. Braune and Kyrklund's few cases (nine in number) seem to bear out these statements, but they are by no means always borne out by my records. The sigmoid cavity does not hug the trochlea closely and the slight rotation of the coracoid and olecranon processes may be sufficient to account for my figures. Furthermore, the inequalities in diameter and form of the two conical surfaces of the trochlea may cause sufficient shifting to counteract a slight difference between the angles of the humerus and ulna. This is already indicated when the points below the epichondyles through which the axis passes are determined. One of them is usually extended into a line several millimeters long showing that the section of the cone of the trochlea is not circular on that side. Even my averages do not confirm Braune and Kyrklund's notion. In my 89 specimens, the average of the angle of the humerus is 82.5 degrees, and of the ulna 86.5 degrees, and yet the styloid process still deflects .5 degree when the arm is flexed to the maximum. This, of course, is when the elbow is flexed to 39 degrees, and could it be flexed to 0 the styloid process should turn in about 2 degrees. In general the irregularities of the surfaces of the elbow joint fully neutralize the fine difference between the angles of the humerus and ulna and only in a general way is the assertion of Braune and Kyrklund correct. In about three-fourths of my measurements the angle of the ulna is greater than that of the humerus, while in Braune and Kyrklund's measurements (but one-eighth as many) they were just the opposite.

The extent of motion of the elbow from flexion to extension gives some interesting results. It is well known that the extent of movement in the joint of children is much greater than that of adults, and artists often try to express this in the arms of children and young, delicate girls. I have often observed this difference in examining arms of infants in the dissecting rooms. In fact, in numerous specimens which I have examined not a single infant's arm was found in which the elbow could not be hyperextended. The measurements from the adult arm which I have made give equally interesting results, for they point towards a sexual difference. The following table gives the degree of extension of

Degrees of extension.....	155°	160°	165°	170°	175°	180°	185°	190°	195°
Number of males.....	1	6	19	14	14	6	3	1	..
Number of females.....	..	..	2	6	7	5	2	1	2
Total.....	1	6	21	20	21	11	5	2	2

89 measurements. The straight arm is 180°. It is evident that the female arm is straighter and more frequently hyperextended than the

male. The degree of flexion gives a similar table, which becomes more

Degree of flexion.....	20°	25°	30°	35°	40°	45°	50°	55°
Number of males.....	..	..	3	17	23	17	3	..
Number of females.....	1	1	6	8	6	3	..	1
Total.....	1	1	9	25	29	20	3	1

marked when it is expressed in differences, that is the degree of motion, from maximum flexion to maximum extension.

Degree of motion...	110°	115°	120°	125°	130°	135°	140°	145°	150°	155°
Number of males...	2	5	9	6	15	11	12	2	2	..
Number of females..	..	..	..	1	2	4	8	5	2	3
Total.....	2	5	9	7	17	15	20	7	4	3

The two lines now move away from each other more than before, the greatest number of cases for each sex being 10° instead of 5° apart. In constructing this table the degree given is each time the middle figure; for instance, 130° includes 128° to 132°. Furthermore, there seems to be a slight racial difference which tends to make the sexual difference rather less marked than it really is. The greatest number of European males occurred in maximum extension under 170°, in maximum flexion under 35°, and in degree of motion under 135°. In other words, the motion of the elbow of the European male is more nearly like the female than the male negro. So when the joint of the negro alone is considered the sexual difference is more pronounced than when it is considered with that of the European. The following table

Degree of motion.....		110°	115°	120°	125°	130°	135°	140°	145°	150°	155°
Negro	Number of males....	1	5	7	6	12	7	8	2	1	..
	Number of females...	..	..	..	..	1	4	8	4	1	3
Total.....		1	5	7	6	13	11	16	6	2	3

includes only the arms taken from negroes. On account of an insufficient number of records further tabulations give no results which are definite.

As far as the records go, they indicate that the elbow joint of the female is more flexible than that of the male—is more of the infantile type—and that of the European male holds an intermediate position between the negro male and negro female. Practically all of the subjects considered came from the laboring class, so a difference on account of muscular development cannot be entertained.

The amount of deflection of the forearm is shown in the data which follow. In all cases the styloid process deflects when the arm is extended

and every specimen verifies the statement of Langer and Brücke, that the whole wrist falls to the outside of the sagittal plane of the humerus when the forearm is extended and pronated. The assertion of Stratz that in this position the line falls in the middle of the wrist is absolutely incorrect. Furthermore, his diagram (Fig. 67) which is apparently based upon Merkel's normal figure, is also incorrect, for Stratz's own copies of Merkel's figures (Figs. 31 and 32), as well as the originals, coincide with Brücke's as regards this point.

With the elbow extended the average deflection of the styloid process of the ulna from the sagittal plane of the humerus is 11° from my measurements. The average length of the ulna from the axis of the elbow to the styloid process is 258 mm. With these two measurements 11° equals a chord about 5 centimeters long, so the styloid process deflects normally 5 cm. or about the width of the wrist. Therefore, with the arm extended the wrist should fall outside of the sagittal plane of the humerus in both supination and pronation. In both positions the styloid process falls about 5 cm. to the outside of the sagittal plane of the humerus and in pronation it passes through the *styloid process* of the *radius*. In the extended arm all of the wrist, or at least its greater part, falls lateral to the sagittal plane of the humerus in both pronation and supination. This marked deflection, more so in my records than is stated by any author, is no doubt due in part at least to a racial difference, for 70 of the arms are from negroes and but 19 from Europeans. A glance over the tables shows that some difference does exist, which I shall now consider. When the differences in deflection are grouped for every 5°, as was done when discussing the motion of the elbow, nothing definite is noted, and when they are grouped under single degrees the figures scatter so much that it is again difficult to see any marked result. The negro male, however, shows some 3° greater lateral deflection in the movement from flexion to extension than does the European male. The difference between the European male and female is much greater, but the number of cases are so few that this also cannot be considered. It would indeed be remarkable if more records showed that the European female had the greatest lateral deflection and that the European male the least, that of the negro lying between. If it should prove to be so, then artists have secured their ideal straight arm of females from the males and infants[1] where the lateral deflection is the least.

The racial difference becomes more marked when the total amount of

[1] Braune and Kyrklund state that the angle of the humerus in infants is much less than in adults.

deflection (that is, the difference between that at flexion and that at extension) is divided by the number of degrees of motion of the elbow. The deflection being greatest in the negro male, the result becomes still greater because the motion of his elbow is the smallest. This quotient becomes the degree of lateral deflection for one degree of elbow motion. If this in turn is multiplied by 180, the amount of deflection is obtained, in case the elbow joint could be moved from zero to 180 degrees. This quotient I shall speak of as the total deflection, it being the amount of deflection in case the elbow joint had a motion of 180 degrees. For example, in the right arm of subject No. 925 the deflection is between — 4.5 degrees and 1 degree or 5.5 degrees. This divided by the number of degrees of motion (169 — 50) 119 makes .0462 or the number of degrees of lateral deflection of the forearm for each degree of flexion or extension. In turn this multiplied by 180 gives the total deflection could the forearm move through an entire semicircle. In this case it amounts to (.0462 × 180) 8.3 degrees. Now it is found that the deflection per degree varies for different positions of the forearm, as is shown in the following table. In the first column the deflection per degree is

Race	Sex	Arm	Degree of deflection for each degree of motion from Maximum Flexion to 90°	90° to Maximum Extension	Maximum Flexion to Maximum Extension
Negro	Male	Right	.08	.10	.09
		Left	.07	.08	.075
		Both	.075	.10	.08
	Female	Right	.07	.09	.08
		Left	.075	.08	.08
		Both	.07	.085	.08
	Both		.075	.09	.085
European	Male	Right	.04	.07	.06
		Left	.025	.055	.046
		Both	.03	.06	.05
	Female	Right	.11	.10	.10
		Left	.10	.05	.07
		Both	.105	.075	.085
	Both		.05	.075	.065
Average			.07	.085	.08

given between maximum flexion and 90 degrees, in the second from 90 degrees to maximum extension, and in the third the average degree of deflection for the whole motion of the forearm. Of course to determine each figure it was necessary to start with an average. It is seen from the table that the lateral deflection per degree of motion is generally less when the elbow is flexed less than a right angle than when it is extended beyond it. The deflections seems to increase as the maximum extension is approached. This is to be accounted for in part by the irregularity of

the surface of the elbow joint. When the averages are considered it is seen that there is a marked difference between the deflection in the negro and in the European which becomes more pronounced when the males only are considered. The race of fully 70 per cent of the cadavers from which these arms were obtained can be determined by these measurements. The average deflection here is .08° and .05° for each degree of motion, and this difference is pretty constant, as can be seen from the table. The deflection between maximum flexion and maximum extension for negro males and European males is 10.5° and 6.50°, which, considering the differences in the lengths of the ulnas equals 5 cm. and 3 cm. respectively. If the total deflection is considered, that is, if the motion of the elbow were 180°, the deflection would be 14.5° and 9° for the negro and European respectively, which when the average lengths of the forearms are considered equals 6.5 and 4 centimeters. In a measure this difference is obscured for the flexed arm of the European deflects more than does that of the negro.

The conclusion of this study is that the degree of motion of the elbow is greater in the female than in the male and that the lateral deflection of the hand, from flexion of the elbow to extension is much greater in the negro than in the European. The lateral deflection of the hand in the extended arm is much greater than the artistic ideal.

Measurements.

Nearly all of the measurements are from arms taken from individuals belonging to the laboring classes. The American negro is more or less intermixed with European blood; those in Baltimore are, however, usually over three-fourths black.

NEGRO, MALE.

Right Arm.

No.	Length of Ulna.	Angle of axis of elbow joint. Humerus.	Ulna.	Degree of movement of ulna. Flexion.	Extension.	Lateral angles of ulna in different positions. Maximum Flexion.	Right Angle.	Maximum Extension.
909	255	86	83	45	162.5	4.5	5.5	11
925	270	82	97	50	169	—4.5	—1	1
956	260	85	92	47	162	—8	—5	3
1062	290	80	84	41.5	173	1.5	8	16
1072	268	67	100	33	165	—7.5	0	13
1106	290	76	90	35	176	—1	4	14
1126	270	87	88	35	175	3	3	5
1129	275	83	94	43	168	—11	—6.5	3
1136	265	75	94	43	168	—3.5	3.5	11
1142	240	84	84	48	180	—3	.5	12
1190	260	83	87	39.5	181	0	2	10
1163	260	86	80	38	162	5	7	14
1172	280	86	84	47.5	163	—1	1	10
1187	240	79	91	31	167	—2	9	10
1190	290	85	85	33	166	4	5	10
1230	245	87	81	42	161	3.5	7.5	12
1261	275	85	82.5	39	170.5	3	5	12.5
1271	270	83	85	42	168	0	4	12
1275	265	82	87	40	167	—8	—2	11
1285	275	81	94	39	162	—4	0	5
1315	270	87	81	40	163	5	6	12
——	300	84	86	40	168.5	—3	1	10
——	285	83	85	44	155	—4	2	12
Average (23)	269.5	82.5	87.5	40.5	167.5	—1.3	2.6	10

Left Arm.

925	280	83	92.5	46	192	3	6	4.5
909	255	85	86	47	164	6	6	9
956	270	82	91	44	168	—8	—3.5	7
1062	285	82	82	38	174	0	5	16
1070	266	75	94	42	179	—7	0	11
1106	290	73	89	36	173	3.5	9	18
1123	250	75	81	38.5	161.5	2.5	6	14
1125	270	84	85	43	177	5	7	11
1126	275	84	90	34.5	163	—3	1	6
1128	290	83	88	40	170.5	6	4	9
1136	265	78	91	42	172	2	4.5	11
1142	245	75	94	39	180	—3	1.5	11
1155	290	87	85	34	175	—2	—1	8
1157*	234	80	91	36.5	184.5	3	6	9
1187	240	90	82	45	158	—1.5	0	8
1190	260	85	84	46	167	1	4	11
1191	255	79	85	41	184	7.5	11.5	16
1208	230	83	81	44.5	173	5	8.5	16
1230	232	83	80	48	164	3	8.5	17
1261	278	85	80	36	164	6	8	15
1271	273	85	85	37	167	—2	3	10
1275	270	83	86	38	173	—1	5	11
1285	285	86	91	36	166	0	1	3
1315	260	88	90.5	34.5	163	3	1.5	1.5
——	295	80	84	38.5	173	0	9.5	16
——	255	80	95	39	181	—16	—7	4.5
Average (26)	265	82	87	40	172	.5	4	10.5

*Boy.

NEGRO, FEMALE.

Right Arm.

891	270	83	83	46	184	—1	5	14
1120	250	85	79	36	175.5	4.5	6.5	16
1141	265	80	87	30	171	—2	5.5	13
1176	245	85	85	32	177	2.5	2.5	10
1188	238	80	88.5	40	180	—1	3.5	11.5
1220	240	86	81	31	164	5	9	13
1221	240	83	85	38	180	4	8	12
1228	240	80	88	39	175	0	5	12
1272	240	87	76	37.5	168	7	7	17
1365	255	88	76	36.5	193	6	7.5	16
Average (10)	248	83.5	83	36.5	177	2.5	6	13.5

Left Arm.

891	260	79	90.5	43	182	—4.5	0	10.5
1120	245	83	77.5	19.5	173	7	11	19.5
1141	260	80	92	29	171	—3.5	2.5	8
1166	237	85	87	27	170.5	4	4	8
1188	235	80	92	35.5	180	—3.5	.5	8
1220	243	80	83	29	173	7	13	17
1221	240	83	86	41	174	3	6.5	11
1228	245	75	94.5	36.5	175	—4	1	10.5
1268	255	80	91	30	179	—6.5	0	9
1272	240	80	83	37	170.5	3	7	17
1365	250	80	85	37	193	8.5	11.5	15
Average (11)	246	80.5	87.4	33	176.5	1	5.2	12.1

EUROPEAN, MALE.

Right Arm.

983	240	83	88	41	172	—1.5	3	9
1123	245	83	81.5	45	165.5	6	8.5	15.5
1138	235	84	88	43.5	175	—9	—5	8
1140	270	85	81	30	169	9	10	14
1146	235	90	81	41	177	8	4	9
1258	255	85	84	35	167	4.5	4.5	11
1161	250	80	85	33	181	0	5	15
1286	250	83	87	43	163	2	5	10
1292	260	89	84	37	173.5	6	6.5	7
——	255	84	89	43	185	0	2.5	7
Average (10)	249.5	84.5	85	39	173	2.5	4.5	10.5

Left Arm.

1146	230	87	89	40.5	173	8	6.5	4
1161	255	75	87	57	166	6	9.5	18
1195	270	83	84	33	171	7	7	13
1286	253	80	93.5	35	172	—2	—1	6.5
1292	265	85	84	31.5	169	5	8	11
Average (5)	255	82	87.5	39.5	170	5	6	10.5

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Right Arm.

1131	225	77	90	37	183	—2.5	2.5	13
1225	225	82	88	44	175	—4	1	10
Average (2)	225	79.5	89	40.5	179	—3.25	1.75	11.5

Left Arm.

1131	220	82	87	40	188	3	6	11
1225	223	83	85.5	40	167	.5	7	11.5
Average (2)	221	82.5	86.5	40	177.5	1.7	6.5	11.3

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