HUMAN SKELETONS FROM GRAVE CIRCLES AT MYCENAE

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With the aid of grants from the American Philosophical Society and from the National Institutes of Health (A - 224), I spent eleven weeks in Greece during the summer of 1954 to study 192 useable skeletons, and fragments of about 250 more. The competent assistance of Mr. Anastasios Pantazopoulos and Mr. Nikos Thiraios greatly speeded repair of skeletons and recording of data. I studied 94 Mycenaeans between July 23 and August 10 through the kindness of the excavators, Dr. George E. Mylonas, Dr. John Papadimitriou, and Dr. A. J. B. Wace. Of these, 16 men, five women, and two children come from the royal graves in the circle outside the city wall excavated and studied between the end of 1951 and summer of 1954 by Professors Mylonas and Papadimitriou. These I will briefly describe in the following report arranged in order of their discovery. They are numbered, however, in the order in which we happened to remove them from their boxes for study in the Archaeological Museum in Nauplion.

Tomb A: **62 Myc.** is a broad - shouldered, strong - limbed (femur robusticity index 13.1%), and big - bodied man of medium stature. Although pubic symphysis phase III suggests an age of 23 years the thoracic vertebrae have signs of Schmorl herniations of the intervertebral disks: heavy exercise? The massive «Mixed Alpine» skull is ovoid and intermediate in form, extremely large ,with wide forehead above a very wide-cheecked heart-shaped face with deep chin and wide nose. No remains of the second person in Tomb A survive. Plates 244, 249.

Tomb A1: **69 Myc.** is a woman of about 30 (pubic symphysis phase V), of good average stature (158.8 cm), strongly built (femur robusticity 12.5), and free from arthritis. The skull is missing.

Tomb B: **52 Myc.** is a large man of about 30 (pubic symphysis phase VI, early, and vault sutures almost entirely open). Though the skeleton is too broken for detailed measurement the vertebrae and joints show no arthritis. The long and very narrow, byrsoid, Iranian-Mediterranean skull has a narrow, beaky, and toothy face with long nose and rectangular facial outline and the tilted alveolar plane and deep cerebellar fossa frequent in Iranian skulls.Plate 245.

Tomb Γ, central body: **55 Myc.** is a notably tall and strong and also unexpectedly thick-boned man (femur robusticity 13.8) buried in the position of a horseback rider. Pubic symphysis phase VI suggests an age about 33. There is no pathology. The almost rhomboid, wide, and relatively low skull

vault combines with a massive face with hexagonal outline to give an intermediate, Dinaroid, impression. The neck muscle area is strongly marked and the jaws heavy, with the usual almost perfect teeth. Plate 244.

Tomb Γ, east body: **51 Myc.** is a tall, particularly strong-boned (femur robusticity 14.0), long-bodied (lumbar centra 151 mm), and large-footed man, aged about 28 (pubic symphysis phase V). The Nordic-Iranian skull is extremely large, long, and fairly high, with full cerebellar region, strong browridges, and a big rectangular face of longish intermediate proportions. The nose is big and high, chin deep, jowls strong, and teeth perfect. The outer table of the parietals shows slight traces of healed osteoporosis. Plate 244. But the unexpected thing about **51 Myc.** is an oval hole, 27 × 30 mm, cut with clean edges and a bevel so that the greater diameters are internal. Plate 249. This is placed in the left upper part of the frontal bone, reaching within 10 mm of the coronal suture to which it is joined by a (post-mortem?) break. Two laminae from the **outer** table of the vault exactly fit each other and match this hole, but are warped or curled slightly as if they had remained attached to the scalp at the time of operation or injury. There is no sign of the inner table fragments. It is impossible to be sure if two vertical fractures extending down from this hole are post-mortem breaks or injuries which produced unconsciousness and led to surgery. Certainly the hole with its split-off cover has all the appearance of a carefully cut trephination, done with a very keen-edged chisel or perhaps gouge: there is not the splintering which a sword or axe thrust wound would show and no slash from a weapon could produce the shape of this hole, though the cracks observed are plausibly fracture lines which the trephination was designed to relieve. **33 Ler.** from a Middle Helladic grave at Lerna, excavated by Dr. John L. Caskey, is a male of Mediterranean type who shows a much more crudely cut opening, 40 × 60 mm, and bevelled the other way, but likewise with two matching covering pieces in this case including the whole thickness of the frontal bone and an adhesive soil covering perhaps replacing a layer of blood. Apparently the prince from Mycenae got better surgical technique than the contemporary commoner. **91 Ka.** a female from Early Bronze Karatas, (Angel, 1966a) shows a small round even hole. The striking thing is the lack of any exact parallels. Moodie (1923, p. 409), Breasted (1930, p. 56), and others deny any early examples of trephining in Egypt, Elliot Smith (1912) mentions only skull perforations in royal Egyptians of Old Kingdom date, and the Neolithic trephining of Western and Central Europe shows a completely different technique, using a saw or stone knife. **51 Myc.** also shows a 23 mm long shallow «wound» depression on the right frontal, further suggesting that he might have been a warrior even if the sword had not been buried with him.

Tomb Γ, south body: **58 Myc.** is a tall and strongly-built woman, probably fairly slender (clavicle 129, iliac breadth 146?), and with the fifth lumbar ver-

tebra incorporated into the sacrum. This may have predisposed to low back troubles since the lumbar vertebrae show traces of arthritis. There are also traces of arthritic change at the metacarpal bases (hands) coupled with an age of only 36 indicated by medium suture closure and pubic symphysis phase VII. The right humerus shows a healed midshaft fracture. Femur robusticity index is 12.2. The long ellipsoid skull is of full male size with a neck muscle attachment area like that of **55 Myc.** in female version. Browridges likewise agree with the markedly female true pelvis (birth canal) in showing female sex. The forehead is wide enough in combination with deep chin to give the face an elongated heart-shaped outline rather than rectangular, the nose is wide, and the mouth long and rather tilted, producing a combination varying in a lateral direction (central face) from a Nordic-Iranian norm.

Nσ bones of the fourth body in Tomb Γ, Plate 244, were available, but the published photograph (Mylonas, 1954) shows apparently that this intermediate body was a male probably comparable in size to **51 Myc.** The electrum mask from this grave, with its wide forehead, tapering face outline, and notably deep chin could fit **51 Myc.** (except for his wide jowls) if one assumes that it was done freehand and not as an actual cast.

Tomb Δ, east body: **61 Myc.** is a relatively thick-boned (femur robusticity 14.1) and short-statured man of not over 33 (pubic symphysis phase VI-) showing no excess of muscularity. Frontal region of skull, mandible, face, and other fragments show strong browridges, a big mouth region, and an impression nearer to Iranian than to Mixed Alpine. Plate 245.

Tomb Δ, west body: **60 Myc.** includes unmeasurable fragments of an adult of about 40 (sagittal suture closed internally, asterion open). Sex might be female, but is uncertain.

Tomb Π: **53 Myc.** is a man of about 33 (symphysis phase VI) and of average size and muscularity, represented by incomplete skeleton and skull. Left scapula height is 146, breadth 105, spine breadth 128, and acromion 49. As usual his skull is notably long, ovoid, with deep chin and an approximation to Nordic-Iranian rather than Mixed Alpine mode. Plate 245.

Tomb Z: **59 Myc.,** represented by a fairly complete skeleton, was in his prime perhaps the most powerful of the champions. He is very tall and broad-shouldered (clavicle 158, iliac breadth 145?), and thick-boned (femur robusticity 13.5), with large hands and feet. At the age of at least 49, probably older (pubic symphysis phase IX), he has exostoses at almost all tendon attachments, marked arthritic changes in cervical, lumbar, and lower thoracic vertebrae involving fusion of thoracic vertebrae 9 - 11 through ossification of the disk portions of the anterior longitudinal ligament, and slight arthritis of metacarpal bones. It is uncertain how far such arthritis might link with the large abscess-derived cyst at the site of the upper second molar tooth: this

has penetrated the maxillary sinus, which shows thickening of its bony walls in response to this inflammation of the mucoperiosteum. Since the left clavicle shows a pseudoarthrosis with the left coracoid process (the beak-like hook on the shoulder-blade just medial to the shoulder joint to which the clavicle is anchored by ligaments) possibly from over - use of the shoulder (supporting a heavy many-layered shield in battle?), it is possible that all the hypertrophic arthritic changes reflect simply hard usage. The strikingly large, long ovoid, and high skull, with its marked muscle attachments, almost concave sidewalls, and long rectangular horse-like face is Nordic-Iranian in the Corded Nordic sense (like skulls found with cord-marked pottery from South Russia to Scandinavia). Large mouth, deep chin, vertical face profile, and notably high and narrow nose fit this picture. Noticeable depressions in the skull vault 2 cm above the left eye and behind the left parietal boss are apparently results of heavy blows or wounds inflicted by a right-handed opponent. Plates 245, 249.

Tomb H: **54 Myc.** is a large man, tall and broad-shouldered, with the usual massive bones. He died young, not over 28 to judge by beginning closure of the sagittal suture. The long, very narrow, and pentagonoid skull vault with relatively low face is closer to the Basic White mode than any other. Plate 245.

Tomb Θ: **63 Myc.** is a curiously wide-shouldered (clavicle 154) woman of medium height (156.1 cm), with good muscularity, large feet; but humerus head (43) is in the typical female range. Left humerus length is 292, midshaft 21 × 18, acromion 46, calcaneus 80 × 43. A medium age plaque on the underside of the acromion process suggests an age of at least 35, and the lumbar vertebrae show medium arthritic lipping. No skull fragments survive.

Tomb I: **68 Myc.** is an apparently very long-bodied (lumbar centra heights 161?) man of medium stature, about 42 (symphysis phase VIII), with beginning arthritic changes of lumbar vertebral centra. The extremely large skull with extremely narrow pentagonoid shape like **54 Myc.** appears with a relatively small face to fit the linear version of Basic White mode common in Chalcolithic contexts from Anatolia and Israel to Sardinia. Plate 246.

Tomb K: **70 Myc.** is an adult of about 45 (or more) judging from closed coronal and sagittal sutures on the skull fragments, and apparently male (femur midshaft a-p and transverse 32 and 27 respectively).

Tomb Λ: **70a Myc.** consists in unrestorable fragments of a man (femur midshaft a-p and transverse 34 and 31) of good robusticity about 38 years old (symphysis phase VII).

Tomb Λ2: **133 Myc.** is a particularly short but stocky man (clavicles 148 left and 144 right, bi-iliac hip breadth 261), thick-boned (femur robusticity 13.8), muscular, with a rather sharp lumbo-sacral angle and the start of lumbar region arthritis at the age of 37 (symphysis phase VIII). Pubis is 72, ischium 87; pelvic brim a-p 97, transverse 114; pelvic outlet a-p 105, inter-

spinous breadth 73; pelvic brim slope 59°, sacral angle 39, upper sacral angle 23, lumbosacral angle 23. Sacrum is 96 high, 105 wide. Innominate height is 204. Right scapula height is 151, breadth 103?, spine breadth 137, and acromion a-p 49. The rather small, broad ovoid, and low skull vault is joined to a broad-jowled, medium-short, trapezoid face, with tilted chewing plane and peculiarly narrow nose in what forms an Eastern Alpine combination comparable to what occurs in Central Cyclades, in Cyprus and at Bronze Age Alishar and Karatas in Anatolia (also at Asine and Lerna). Plates 246, 249.

Tomb Λ2: this stocky and short-headed man shared his grave with **134 Myc.,** possibly his five year old son (left humerus length 144, midshaft 10 × 9, clavicle 75).

Tomb Λ1: **56 Myc.** is the very fragmentary skull and bones of an adult of about 25 (skull sutures open), apparently male (humerus midshaft 19 × 22, sciatic notch narrow), with no arthritis.

Tomb N: **66 Myc.** is a very tall man with the expected bone thickness (femur robusticity about 13.1), marked muscularity, and even bigger hands and feet than **59 Myc.** At age 45 (symphysis early phase IX) this man has marked arthritic changes of the vertebral column, hypertrophic exostoses on all tendon attachments, and starting ossification of rib cartilages. The high and ovoid skull vault of intermediate form and size is joined to a long hexagonal face with deep chin and narrow nose in a Dinaric-Mediterranean combination (not the short-headed typical Dinaric). Plate 246.

Tomb N, «packed» bones: **66a Myc.** is a man of about 28, probably about medium in size though no complete long bones are available for stature. The fragmentary ovoid skull vault is long, with sloping forehead and an approximation of Iranian-Mediterranean type. Plate 246.

Tomb Ξ1: **57 Myc.** is a child of about two years, with femur length of 155 mm.

Tomb Σ: **131 Myc.** is another massively built man, quite tall (femur robusticity 14.0) with slight arthritis of vertebrae but medium exostoses on shoulders and feet at age about 55. The right scapula height is 154?, breadth 111, spine breadth 138? and acromion 46. During cleaning and removal of the bones on August 7, 1954, I noticed several red-brown stones with green patches, facetted, with rounded edges, and in general a plano-convex shape. They lay between the lowest ribs and the pelvic brim on the right side, broke easily with slightly more friability than plaster, and are obviously gallstones. The pentagonoid but well-filled skull of large size and intermediate proportions has a wide enough forehead and short enough square face to fit the Mixed Alpine rather than the Basic White category. The relatively shallow but prominent mouth region contains good teeth: only three are diseased in spite of this man's age. Old age osteoporotic pitting appears around the lamda region. Plates 247, 249.

Tomb Y: **132 Myc.** is a relatively tall and apparently buxom woman

(femur robusticity 12.4, clavicle 143, bi-iliac hip breadth 270) of about 37 with roomy birth canal (true pelvis inlet 121? × 151 and outled 118? × 139, depths × breadths respectively with interspinous 123) and incipient lumbar arthritis. The pelvic brim slope is 60 degrees, sacral angle 60, upper sacrum 35. The sacral height is 110 breadth 134. Innominate height is 204; pubis 80?, ischium 79. The capacious and broad skull (cranial index 81 - 82?) has a long hexagonal face with thin nose, large mouth, and excellent teeth. This approximates a Dinaric-Mediterranean rather than Mixed Alpine norm. This skull was restored in spite of considerable warping of the vault from earth pressure; though quite complete the skeleton was rotten-woodlike in its fragility and was measurable, including the important pelvis, because of careful exposure and handling. Plates 247, 248, 249.

Six males from the 1876 excavations of Schliemann and the 1877 excavations of Stamatakis I studied in the National Museum in 1937 with the invaluable help of my wife. These L.H.I princes from the somewhat later grave Circle A immediately inside the much later city walls should be included here, leaving open the question of dynasty.

Circle A. Tomb IV: **22 Myc.** has a medium - size but rugged skull, fairly broad and sphenoid in top view, with apparently long hexagonal face, drooping orbits, and strong but not deep chin, thus approximating the Dinaric-Mediterranean tendency. Age about 35. Plate 247.

Tomb IV: **27 Myc.,** a man of about 25, has a large ovoid skull and a notably large lower jaw. There is a trace of occipital osteoporosis. Mixed Alpine. Plate 247.

Tomb V: **25 Myc.** is an extraordinarily tall and muscular man (femur robusticity 13.3) of about 39, with slight vertebral arthritis and a definite wedging of the third lumbar vertebra body anteriorly as if from a well-healed fracture early in life. The much broken skull is large and heavy, apparently byrsoid in form and long, with deep mouth region and apparently long face: plausibly Nordic-Iranian. Plate 247.

Tomb V: **26 Myc.** has a somewhat more fragmentary skull, again massive, with strong nuchal muscle area, many lambdoid Wormian bones, and a big face with very narrow and high nose above a deep mouth area and heavy jaw with flaring jowls: plausibly Dinaroid. Age about 35. Plate 247.

Tomb VI: **23 Myc.** is a man of about 45 with a notably large pentagonoid skull of intermediate proportions with a strikingly low and wide, square, almost trapezoid face. Despite some relative narrowness of forehead this fits Mixed Alpine more nearly than Basic White category. Plate 248.

Tomb VI: **24 Myc.** a man of about 27 of average stature and strength (femur robusticity 11.8), has a pentagonoid skull (cranial index 76.0) much like **23 Myc.** except for stronger neck muscle area and wider face: Basic White rather than Mixed Alpine. Plate 248.

TABLE 1

INDIVIDUAL MEASUREMENTS OF SKELETONS AND SKULLS

Skull No.	62	69	52	55	51	58	61	53	59	54	68	133	66	66a	131	132	22	27	25	26	23	24
Tomb No.	A	A1	B	Γ	Γ	Γ	Δ	II	Z	H	I	Λ 2	N	N	Σ	Y	IV	IV	V	V	VI	VI
			main	centre	south		east															
Sex, Age	M 23	F 30	M 30	M 33	M 28	F 36	M 33	M 33	M 49	M 28	M 42	M 37	M 45	M 28	M 55	F 37	M 35	M 25	M 39	M 35	M 45	M 27
Humerus :																						
Maximum length	317 R.		332 R.	342? R.	337 R.	(300) R.	308 R.		334 L.	334? L.	323? R.	290 L.	(330)		341? R.	308+			360 R.			
Midshaft maximum	25		24-	25	26	22	21	24	22+			22+	22+		23	18+			26			
Midshaft minimum	20 R.		19	20 R.	19 R.	15 R.	17 R.	19 R.	18			18–	20		20+ R.	16			20 R.			
Radius, maximum length	(245) R.	211	240 L.						248–	242 L.	237?	240+	(250) L.			208 R.			275? R.			
Ulna, maximum length	(263) R.	244–					243 R.					252–	275 L.						285? R.			
Clavicle, maximum length	158 L.					129 R.	++		158 L.	154 L.		146				143 R.			166 L.			
Femur :																						
Maximum length	437 R.	418–	(490) L.	473? L.	454–?	428 L.	415 L.		478 L.		443 R.	404–	466? L.		473 R.	424			500 L.			435 R.
Head, maximum diameter	52 R.	41	48 L.		50 L.	(40+)			51 L.			44–		45 R.		44+						44 R.
Subtrochanteric a - p	36	25		29	31	23	28–		30+		29	25			30	24–			31			25
Subtrochanteric transverse	29	32–		39 L.	40 L.	30 L.	32		37		32 R.	32+			34? R.	30–			35			30 R.
Midshaft a - p	29	27		33	30	27	30		32–	++		32+	33	29	34	26–			36			30
Midshaft transverse	27	25		32 L.	33 L.	25 L.	28–		32–			28–	30–	28 R.	32 R.	26–			30			26 R.
Tibia :																						
Maximum length	(390) R.	339	(381) L.	(390) L.	381?	345 R.		(400) L.	384		360–?	346 L.	401? L.		383+R.	350						
Nutrient foramen level a - p	39	32–				31			42			35	42–			28+			42			
Nutrient foramen level transv.	24 R.	22–				23 R.			28–			22+	26– L.			22			25 R.			
Fibula, maximum length			368 L.					356 R.			357 L.	332 R.			383 L.							
Lumbar vertebrae, anterior &	149	138	(150)	(145)	151	113(4)			(150)		161	128	(155)	(143)	(149)	134?						
posterior heights	146	131			144	107?					136	125										
Ilium, breadth	163 L.	155 R.	(++)			146			145 L.			(144)				156						
Talus, length,	60	49	55		56+	50			60–	56	55	51	64–	53	53	52			54			
height	35 L.	26+	30 R.		33	25			34	29?	32 R.	30–	36–	27 R.	29 L.	30–			30 R.			
Stature estimate	168.3	158.4	172.7	176.2	173.3	160.6	163.4	168.1	175.1	172.8	168.6	161.1	176.4	?	175.7	161.2			182.5			166.4
Type	E 2		D 4	F 3	D 1	D 1	D 4	D 1	D 2	A 3	A 1	C 5	F 2	D 3	E 1	F 2	F 1	E 2	D 1	F 2	E 1	A 5
Horizontal circumference	553		507?	537	558	525	(530)	548?	564	530?	563	508?	525?	(503)	539	524?					545	520?
Length	196		191	192	203	190	(196)	199	207	204	204?	175?	188	195?	193	179?	182?	193	(200)		195	196
Auricular height	110		105?	113	118–	115–	(120)	115?	125	123?	129	110	124?	(102)	119	120?	116?	118?	(118)		118?	118?
Basion - nasion length	—		(95)	102	123?	(107)			118			89?	(105)		(98)	(90)					98?	
Basion - prosthion length	—		—	—	118?	(100)			106			95	(102)		—	(85)					98?	
Parietal thickness	5.0		4.5	5?	6.5	4.5		5.0	6.0	4.3?	5.5	4.0	5.3	3.3	6.8						4	4.5
Breadth	149		132?	148	151	137	(145)	149?	148	138?	130	145	143?	140?	145	146?	143?	(145)	(145)		149	149
Minimum frontal breadth	108		99?	98	101	104	97	102?	98	97?	97	97?	97	(93)	104	98	97		100		91	93
Bizygomatic breadth	143?		117	140?	138	127?			130	(128)	132	122?	(137)		134?	134?			(143)		138?	145
Bigonial breadth	94		90	105	103	92?	99		95–		93?	107	(106)		(106)	96?		106			105?	
Bicondylar breadth	119?		115	(126)	118?		121		128		119	123?				129?		121			(133)	
Chin height	35		33	35	38	36	33	37?	36	30?	30?	32+	38		32	30?	30	34	High	42	29	
Face height	117		120	121?	125	117?		(123)	126	112	(116)	112?	131–?		114	115					(108)	(115)
Upper face height	64		70	72?	76	67?		72?	75	(60)	(75–)	64?	72		71–	70?				76	(65)	(72)
Nose height	47		55	(50)	56–	48?		(52)	54	(48)	(59–)	48?	52		54–	51				53?	48	
Nose breadth	28		25	(26)	27	27?			22		26?	21	23		26	20?				26?	24	
Interorbital breadth	26		23?	(24)	23?	++?			22		22?	(23)	23?		24?	20?	21	20	19?		20	17?
Upper nasalia breadth	13?		12	13	12		13?		12		13	(10)	15		17	16	11	12	11		8	12
Left orbit height	33?		35	34	37	32 R.	32		36	30 R.	(36)	29? R.	36		36 R.	35 R.	31?				(33)	35?
Left orbit breadth	43?		38	41? R.	43?	41? R.	40?		40		39–	41? R.	45?		41? R.	43 R.		39?			38	37?
External palate length	—		52?	(57)	60	50			56		53	52	60?		(53)	50?			56?	(60)	53	55?
External palate breadth	63?		66?	(65)	68	59			65		59	60?	69		(65)	66?			65?	(66)	67	69?
Minimum ramus breadth	32		32	33	36–	30	35	32	32	31	30	33+	—		34	30	31	33		33	31	
Face profile angle	80?		91?		84	92			88			79?	84?		82							
Alveolar profile angle	63?		69?		70				80				66?		60							
Alveolar plane angle	1		10?		8?	8?			8			7	0		3							
Mandibular angle	120		134	115	128	126?	125		116	133	116	127?	117		124?	127		136?	134?	117?	115?	
								74.9	71.5	67.6?	63.7?	82.9	76.1	71.8?	75.1	81.6?	78.6?	(75.1)	(72.5)		76.4	76.0
Cranial index	76.0		69.1?	77.1	74.4	72.1		66.1?	70.2	71.9?	77.2	68.8	74.7		70.4	73.6?	71.6?	(69.8)	(68.4)		68.6	68.4
Auricular height index	64.0		64.8	66.5	66.7	70.1		68.5?	66.2	70.3?	74.6	66.9	67.8		71.7	67.1?	67.8		(69.0)		61.1	62.4
Fronto - parietal index	72.5		75.0?	66.2	66.9	75.9			87.8		101.5	84.1	(95.8)		92.4?	91.8?			(98.6)		92.6?	97.3?
Cranio - facial index	66.0?		88.6?	94.6?	91.4	92.7			96.9		95.9	110.3	(109.3)		(101.9)	98.0?					115.4?	
Fronto - gonial index	87.0		90.9	107.1	102.0	88.6?	102.1		96.9	(87.5)	(87.9)	91.8?	(95.6)		85.1	85.8?					(78.3)	(80)
Facial index	81.8?		102.6	81.8?	90.6	92.1?			57.7	(46.9)	(56.8)	52.5?	(52.6)		53.0	52.2?					(47.1)	(49.6)
Upper facial index	44.8?		59.8	51.4?	55.1	52.8?			40.7		(44.1)	43.8?	44.2		48.2	39.2				41.1?	50.0	
Nasal index	59.6		45.4	(52.0)	48.2	56.2?			90.0		(92.3)	70.7?	80.0		87.8	81.4					(86.8)	94.6
Left orbital index	76.7		92.1	82.9 R.	86.1	77.1?	80.0		116.1		111.3	115.4	115.0		—	132.0			116.1	(110)	126.4	125.4?
External palatal index	—		126.9	—	113.3	118.0																

TABLE 2

Comparison of male skeletons from Royal Shaft Graves with Middle Bronze Age and Late Helladic III Greek populations and with modern United States averages.

	Shaft grave kings		Middle Bronze Age		Late Bronze Age (L.H.III)		U.S.A. Modern	
Dates	1650 – 1500		2000 – 1450		1450 – 1100 B.C			
Humerus length	*329.5r*	6	308.9	18	311.0	9	336.2	1445
Radius length	240.4	5	232.2	23	236.1	15	251.7	1364
Ulna length	263.0	2	253.2	21	252.5	14	270.4	1382
Clavicle length	154.5*	4	146.0	20	143.0	16	154.1	50
Femur length, max.	*456.1*	7	432.7	26	435.6	25	472.5	1171
Tibia length	373.4*	5	357.5	22	354.2	19	385.6	1240
Fibula length	369.3	3	348.1	9	359.0	5	383.2	1125
Stature estimate (cm)	*171.5*	14	166.3	55	166.1	49	175.1	
Lumbar heights (anterior)	*147.2*	4	133.3	19	133.2	17	143.1	39
Breadth of ilium	154.0r	2	150.1	7	149.0	11	162.4	100
Talus length	*56.6r*	9	51.7	35	53.2	17	56.9	83
Calcaneus length	*90.0r*	5	79.1	24	79.6	20	84.3	83
Metatarsal II length	*80.8r*	5	74.8	22	76.7	6	77.2	84
Metacarpal II length	*73.0r*	4	68.0	27	66.9	9	70.7	80
Indices:								
Claviculo-humeral	48.6	4	47.4	20	47.1	14	46.2	50
Brachial (radio-humeral)	*75.0*	8	77.6	26	76.6	17	73.8	182
Crural (tibio-femoral)	82.9	4	82.1	22	81.9	18	82.0	66
Robusticity of femur	13.5*	10	13.1	32	13.1	31	12.5	100
Femur pilastric (midshaft)	108.1	13	106.7	59	103.4	53	104.1	100
Femur platymeric (upper)	*83.6*	10	76.4	51	76.9	54	83.5	100
Cnemic (tibia nutr. for. lev.)	65.2	6	66.0	50	66.8	43	71.1	66
Talus, height-length	55.8*	11	58.4	41	55.7	26	58.8	83
Calcaneus, breadth-length	*51.6*	6	55.5	27	54.9	27	56.6	83
Lumbar curve (post./ant.)	96.7	2	97.2	12	96.1	14	96.2	43
Pelvic brim (depth/breadth)	85.1	1	81.6	9	77.6	9	99.2	50
Angles:								
Femur, torsion upper shaft	13.5	4	12.4	25	14.5	30	8.7	106
Femur, neck-shaft bend	129.3	3	127.7	25	128.5	33	123.2	103
Tibia, retroversion knee	9.8	6	10.5	33	12.1	27	9.3	85
Talus, diversion head	25.2*	11	28.2	43	21.8	26	24.1	83
Percentage:								
Talus, flexion facets ankle	60.0	10	71.4	42	53.9	26	39.3	84

Note: significant deviations of kings from general population (Middle Bronze Age) are italicized and possibly significant deviations ($>1 \times$ s.e.) starred, but the Shaft Grave sample is so small that all distinctions are statistically uncertain except where biologically logical (e.g. size increase). Stature estimates derive from the most recent formulae of prediction by Trotter and Gleser (1958) and sex and age estimates depend on many criteria summarised by Stewart (1954). Data for modern U.S.A. come from dissecting room samples (Angel, 1946a and bones measured in 1960 - 62 at the Jefferson Medical College), from radiographic measurements of the pelvis, and from American war dead (Trotter and Gleser, 1958). Long bone measurements are for the left side, except where indicated for the kings.

Discussion

The surprising thing about the males in this small sample of Middle Bronze Age Greek aristocracy is that in spite of their tallness their bones are not relatively slenderer than those of short and stocky peoples but are actually relatively as well as absolutely **thicker:** femoral robusticity averages 13.5 (9) in contrast to a value of about 13.0 for ancient Greek males in general and about 12.5 to 13 for Americans and other white populations. See Table 2. This massiveness and ruggedness shows up further in large hands and feet, generally pronounced markings for muscle attachments and large trunks indicated by a long lumbar segment of the vertebral column: 153.7 (3). Fourteen princes at 171.5 cm with a stature range from just over 160 to over 180 average over 5 cm taller than commoners at 166.3. It may be important that among this latter group drawn from Middle Bronze Age Attica, Asine, Argos, Lerna, and Mycenae Nordic-Iranians at 168.4 are perceptibly taller than people of pre-Greek or Early Helladic derived types (Basic White, Mediterranean, and Alpine) at 164.1 cm, with the rest intermediate. But though the princes may conceivably have less delicate Mediterranean and stocky Alpine tendencies and may conceivably carry fewer pre-Greek gene complexes than commoners (cf. Table 4) the samples are completely inadequate to substantiate this speculation which in turn is not a sufficient explanation for their excess size.

Dietary evidence at Lerna for the Middle Bronze Age includes bones of cattle (17.7%), sheep and goat (38.9%), pig (43.4%), and deer (about 7%) based on N.-G. Gejvall's counts on animal bones. Allowing for the differences in bulk of animals this means that they ate more beef than pork and more pork than mutton. M. Hopf's analyses of plant remains (1962) show barley, emmer wheat and einkorn, many varieties of fava beans, peas, olives, grapes, figs, plums and other fruit trees, and artichoke-like thistles for food. Plentiful acorns may have been for pigs primarily; but leaching will remove poisonous acid from acorns so that men can eat them. Because of their breadwheat (from the Ukraine) and eggs the Classical and Hellenistic Greeks did have a better diet than this and they are 5 cm taller than Bronze Age and Early Iron Age Greeks and have much less dental disease. I have some evidence also of a decrease in **falciparum** malaria by Classical times: porotic hyperostosis from anemia, probably thalassemia or sicklemia, decreases from an Early Neolithic high of over 60% at Nea Nikomedeia to a Classical low of 1% before the historic period increase to over 40% in Turkish times parallel to the documented increase in malaria (Angel, 1966).

I assume that the general diet at Mycenae was like that at Lerna, noting that I have picked up threshing-boat flints at Mycenae and that the tablets found by Wace (Taylour, 1964 pp. 124 - 126) mention a wide variety of plant

foods. I infer that, like the Classical Greeks, the Mycenaean aristocrats had a richer diet than the common people and that in particular they ate the amount of beef and other meat and wine described in Homer as optimal for heroes. The only evidence for this, except in their body size, are the gallstones of **131 Myc.** Malaria probably had a lower incidence at Mycenae than at Lerna or Argos, since only 8% of skulls from the royal grave circles show porotic hyperostosis and the skull wall (including marrow) is thinner. Lines of arrested growth in the enamel of teeth are common at Lerna and other Middle Bronze sites but are absent among these aristocrats. This, too, indicates childhood growth promoted by good diet and relatively free from periods of partial starvation or illness.

Extra good health appears equally striking in the teeth. The average Greek had 6.5 diseased teeth in the Middle Bronze age and 6.6 in Mycenaean times. The aristocrats have only 1.3 diseased teeth; of which .8 are carious, .5 lost, and .2 abscessed but not yet lost though usually carious. This immunity to dental disease may have a genetic component but it is more likely part of the picture of striking good health.

Also important is the factor of social selection. At this period leaders had to be capable and vital people and in most groups physically impressive people tend to be accepted as rulers or as mates for rulers already in power. This is not necessarily a matter of size, and it is noteworthy that both **61** (Δ) and **133** (Λ2) are quite short even by standards of the common people, and only **55** (Γ center), **59** (A), **66** (N), **131** (Σ), and **25** (V) are big enough to cause comment in a crowd. In any case, these Mycenaean aristocrats were not mere fattened figureheads. The wounds on the left side of the head of **51** (Γ, south) and of **59** (Z), the healed spinal column fractures of **25** (IV), probably of **59** (Z), and possibly of **62** (A), and the special left shoulder arthritis of **59** (Z) together with the signs of extra muscular strength show that these men were indeed involved in fighting and capable of being champions. The pilastric index at 109 and cnemic index of 65 show that the kings equal or surpass the posterior crest development of thigh and shin usual in palaeolithic times and continued in Greece down to Classical times presumably from extra thigh and calf muscle development in rugged terrain. The platymeric index at 84 is too high, however, like ours rather than the prehistoric ones (from 72 to 79) flattened from thigh balance stress and «economy» of bone; the kings simply show extra thickness of the upper femur from back to front as well as from side to side.

With length at 194 mm, breadth at 144, auricular height at 117 and skull circumference at 539, the skull vaults approach Upper Palaeolithic male size, indicating a brain mass unusually large for any population in a Mediterranean rather than cold climate. Such extra brain size does not necessarily mean any greater capacity for intelligence but correlates with the greater size of body

and viscera in these aristocrats. The face is less enlarged but both vault and face are longer than in commoners. This is the expected result of extra size which through normal growth balance in accord with principles of heterogony should affect linear dimensions and distal parts more than others — hence the longer vaults, longer noses, bigger and more projecting mouths, bigger hands and feet of the aristocrats. It is true that they have relatively lower heads, and relatively bigger trunks than expected from straight heterogonic enlargement. But with present samples, I cannot take the position that the aristocrats were very different from their subjects except in better growth, bigger size, and greater strength. Were they a separate group of intruders or not?

In contrast with the 3rd millennium B. C. pre-Greeks, short (162 cm), with rather small heads, just mesocrane, and fairly linear faces and noses, the Middle Bronze commoners are taller, with larger heads (longer and higher especially) and wider and shorter faces, wider noses and lower orbits. The pre-Greeks were mainly Mediterranean, Basic White and Alpine (both «Eastern» and «European» Alpine), a definite maritime shift from the taller, long-faced, wide-nosed Early Neolithic blend of Dinaric-Mediterranean with Upper Palaeolithic (Basic White plus rugged European Alpine) as listed in Table 4. The intruders during and after E.H. III seem to have been, on the one hand, Iranian plus Eastern Alpine like the Trojan plus Cappadocian plus Pamphylian areas of Anatolia (Angel, 1951), and, on the other hand, Corded Nordic plus Mixed Alpine like the westernmost steppe populations of the N.E. Balkans (Nécrasov, 1965), and somewhat like later Illyrians (Angel, 1951) as seen in Table 3. At Lerna during the Middle Bronze Age there is probable archaeological plus skeletal evidence for Minoan intruders of linear Basic White plus

TABLE 4

Percentage frequencies of morphological types in prehistoric Greece. Both sexes

Period or *group*	A Basic White	B Mediter-ranean	D Nordic-Iranian	F Dinaric-Mediter-ranean	E Mixed Alpine	C Alpine	Total N	Change from previous period
Mycenaean (L.H. III) 1,450	33.1	18.6	14.5	8.2	9.3	16.3	172	7.3
Shaft Grave royalty 1,630-1,500	14.3	0	38.1	23.8	19.0	4.8	21	to L.H. III 16.3 from M. Br. 9.6
Middle Bronze Age 2,000	20.7	9.0	28.9	10.8	12.6	18.0	111	10.4
Early Bronze Age 2,900	30.4	26.1	10.9	4.3	8.7	19.6	46	9.3
Later Neolithic 5,000	39.3	17.8	3.6	17.9	14.3	7.1	28	7.1
Early Neolithic 6,000 B.C.	35.7	14.3	7.1	35.7	0	7.2	14	

Note: types are entirely arbitrary creations from sorting of individuals. Genetically determined traits will recombine and re-form in each new generation largely at random so that types cannot express these new individualities adequately, only schematically. At best they give a preliminary overview of change.

Eastern Alpine type, for Western Balkan intruders with a Dinaroid and Mixed Alpine blend, and for south Cycladic intruders with an Iranian-Mediterranean and Eastern Alpine blend. The total result, obviously, is a fascinating and extraordinarily heterogeneous mixture, which must have been stimulating and surprising to live with, like our own mixtures in America today. More or less the same mixture, unblended, appears at Asine, Argos, and Eleusis as strikingly as at Lerna and the scattering of Middle Bronze Age and transitional period skulls (M.H. - L.H.I (-II)) from Skopelos, Eutresis, Athens, Thorikos, and Mycenae itself all fit this heterogeneity.

At Lerna the more fecund women are more linear and perhaps taller than the less fecund, and the more fertile clans (in the family grave-groups) seem to favor especially Basic White and also Eastern Alpine and Dinaric-Mediterranean tendencies; with Mediterraneans and Mixed Alpines in the least fertile clans. This does not give a precise prediction of the Basic White plus Alpine blend dominance formed in full Mycenaean times (L.H. III) as seen in Tables 2 and 3 partly because selection for tolerance for malaria (probably falciperum) had operated probably from Early Neolithic times and still continued somewhat at marshy Lerna (Angel, 1956). But this prediction from the Lerna skeletons does show how fertility differentials plus selection by disease and by social or personal preferences could develop out of the amazing Middle Bronze Age mixture almost any sort of new combination.

The aristocrats share this diversity of the general Middle Bronze population, with variability 20% above normal. But they are less Mediterranean and more intermediate Dinaroid-Mixed Alpine than the common people, with strong Nordic-Iranian influence. I cannot tell whether or not they showed the usual fertility differential, apparent at Lerna, in which about one quarter of the women produce at least half of the next generation. There are too few female skeletons to judge, although the preserved pelves of **58** and **133** (graves Γ and Y) are certainly adequate for considerable fecundity; I can't use the scarcity of child skeletons as evidence for good fertility because of the special purpose of the cemetery. In many groups the excess fertility of a few key males also tends to direct the genetic makeup of each next generation. This might apply particularly to rulers, especially if the polygyny or concubinage suggested in Homer and in later Greek mythology applied at this Middle Bronze transitional period. I suspect that it did. In any case there are enough recurrent family traits in the skeletons to suggest family lines dating back for several generations, though probably not all the way to the early intruders bringing in a proto-Hellenic language or languages between 400 and 600 years earlier. For example **58** in grave Γ could well be a close relative of her tomb-mates **51** (in vault similarities) and **55** (in heart-shaped, face), plus showing facial resemblances to **62** in grave A, **52** and **66a** and **61** resemble each other in vault form and

51 resembles **59** in profile and **55** and **66** in face detail. **131** resembles **24** a little more closely than **62. 62** closely matches **23, 53** resembles **59, 54** is similar to **68, 66** is very much like **55** and in jaw like **26** and perhaps **133,** and **132** in face is like **131** and perhaps **133. 133** is almost unique in vault form since he is smaller than **66,** otherwise vaguely similar. **22** slightly resembles both **51** and **52, 27** perhaps approaches **131**, and **25** approaches **59**. Of the earlier skeletons, therefore, **131, 23** and **24, 53** and **59,** and probably also **54** could have had key procreative and genetic importance.

E. Fischer's analysis (Karo, 1930 - 33) of the five gold masks from graves IV and V fit this evidence for family lines altogether too neatly. The heavy and concurrent brows, drooping orbits, thin beaky nose and full-lipped but narrow mouth of two masks from IV, apparently an Iranian-Mediterranean (D 3) combination, match the electrum mask from grave Γ almost exactly, except for the latter's apparently much deeper chin. This more probably shows a single artistic style for these three rather than family resemblances between **51** and **22 Myc. 27** from grave IV could perhaps have had the full forehead and face of the fat and round-faced mask with moustache (Mixed Alpine ?). Likewise the faces of **25** and **26 Myc.** from grave V (apparently Nordic and Dinaroid) may very well have fitted the rather long-faced bearded mask and the very wide-faced, strong-chinned and clean-shaven one, but are too fragmentary for the test. This comparison does not help much with the questions of origin and differentness of the rulers. Clearly it is simpler to see the origins of these ruling families in the general Middle Bronze Age population than in separate intrusions. We do not need to look to the Danube (for **51, 58**), to South Russia or eastern steppe country (for **59**), to North Iran (for **52**), to the Western Balkans (for **55, 66, 131, 27**), to Syria or Crete (for **68** and **54**), to Cyprus or Lycia (**133**), or even to Egypt (for **66a**) for mysterious foreign princes. In fact the occurrence among the aristocrats of some small men like **133, 61** and **24** plus the occurrence in the general population of tall, massive, and horse-faced individuals such as **14 As.** at Asine or **51 Ler.** at Lerna suggests that sometimes an adult ruler might be chosen directly from (and perhaps by ?) his followers even during the Shaft Grave period. I would imagine that ordinarily the rulers preferred to maintain their own family succession or to choose young children to be raised, parhaps competitively, with the special diet and stimulus and training for ruling; the data on growth and health suggest this, at least. Thus if origins of these rulers are from the general population their differentiation must be from social selection and special microevolutionary forces within partly isolated families, numerous enough to preserve for a number of generations their original heterogeneity. Very likely marriages between ruling families from Laconia, Messenia, Attica, Thessaly, and islands like Skopelos or Keos would be enough to keep these Mycenaeans heterogeneous.

There remains a further puzzle with three aspects: the reigns and political arrangements of these dynasties as connected (1) with the professional and social implications of the trephination of **51 Myc.** (2) with the unexpectedly short life span of the males, and (3) with the numbers found in the two grave circles.

The trephination seems to have had the aim of curing the concussion and probably extradural haemorrhage after a depressed skull fracture (Plate 248) made by a blow from a blunt-edged axe or club, and it shows not only incredibly good cutting tools but also much greater daring and skill than surgeons showed in the Near East. I doubt that priests did it just after death, as sometimes in Egypt, because of its coincidence with a specific spot of fracture. Thus there is a further possible interest, in the specific reason for the blow causing the fracture.

Why did these male aristocrats die at 36, the same average age as the males in the general population? The aristocrats really seem considerably healthier. They should have lived longer, perhaps up to the extra decade gained by Classical times. Were some of them too gluttonous? Can military forays or hunting accidents account for this? It seems unlikely. Is Robert Graves right in his speculation, based on interpretations of later mythology and partly on archaeological evidence of Minoan-Mycenaean religious beliefs (cf. Taylour, 1964, pp. 60-73) that in a goddess-worshipping society the pre-Hellenic kings or king-priests were killed after a limited reign and that this religious custom in some form persisted? Is it possible that after a certain cycle of years each king had to meet a ceremonial challenger in single combat, using clubs or double axes? This would explain the head wounds of **51 Myc.** and **59 Myc.,** the generally young age at death of the Shaft Grave males, and their considerable variation in age; some might overcome more challengers than others. But how did **59 Myc.** hold out so long up to his fifties with his severely arthritic and stiff back? And it can hardly apply to semi-historic long-reigning kings like Nestor, or even Atreus, Achaeans belonging to the full Mycenaean period.

I shall try to test this rather wild possibility by estimates of numbers and reigns.

Grave Circles A and B contain about 30 graves of varying size (Karo, 1927, 1930 - 33; Mylonas and Papadimitriou 1952, 1955; Mylonas, 1954: Papadimitriou, 1954). The earlier graves (Z, H, Θ, Σ, I, O, VI, II) date back well into the 17th century B.C. and the latest date close to 1500 B.C., giving a time span of 100 up to at most 150 years for the Shaft Grave dynasties at Mycenae. Grave P dates after 1460 B.C., after tholos tombs had been introduced, but it was empty and hence must be left out. Seven graves are those of women (A1, E, Θ, M, O, Y, and I in Circle A). Six are mixed family graves (Γ, Δ, Z, Λ2, III, IV) with adults of both sexes or adults (only females in III, only a male

in Λ2) plus children. One is a baby girl grave (Ξ) with three young children including the one just outside it. But most graves (13) are those of males only (A, B, Z, H, I, K, Λ, Λ1, N, Π, Σ, V, VI). Four are apparently empty because of robbers (K1, P, T, Φ). Robbers and later diggers also disturbed the contents of Λ, Θ, and perhaps others. Under these circumstances it is chancey to guess at the true number of kings who reigned. But I shall try.

I shall assume that only males ruled, as seems to have been true in full Mycenaean times according to the title wanax (or ἄναξ). There were apparently 31 male bodies in the 18 graves which included adult males (now represented by 22 skeletons or parts); graves Γ, IV, and V held 3 each, graves A, Δ, I, Λ, N, and VI held 2 males each, and B, Z, H, K, Λ1? Λ2, Σ, Π, and II each held 1 male. Out of 16 female bodies from 11 graves only 5 skeletons or parts remain; only I and III held 3 females, O and IV held 2 each, and A1, Γ, Δ, E, Θ, M, and Y each held one female. Out of 6 or 7 children from 4 graves (Λ2, Ξ, Ξ1, III) we have 2 skeletons. This makes a total of 29 skeletons for 54 people, with clearly better survival of male bones: 22 skeletons for 31 identifiable in the tomb dirt. The empty graves K1, T, and Φ (omitting huge P because of its late date) might have added up to 3 more males. So that there would be about 30 - 35 males ruling during the 120 - 140 years of M.H. III - L.H. I spanned by these two dynasties. This does indeed suggest a short average reign of 4 years, consistent with a theory of ritual replacement if not actual ceremonial killing and a young age at death.

This average reign seems impractically short. Graves Λ2, Π, and Σ were without swords or gold; perhaps **133, 131**, and an unknown were not rulers.

More important is the probability that these early Mycenaeans already used the titles of Lawagetas (Λαυαγήτας) and Basileus (Βασιλεὺς) to mean leader of the people in war and judge (?) since these titles occur in the Mycenaean palace archives of 1440 - 1200 B.C. as subsidiary to the king or priest-king, Wanax (Taylour, 1964, quoting Ventris and Chadwick, Bennett, Blegen, Wace). We must, therefore, consider not just the Wanax but also the Lawagetas and perhaps the Basileus too. The two grave circles might suggest a duality, but they are not in balance chronologically or numerically: A has 9 males and 8 females and B has 22 males and 8 females. The two circles might more logically mean some sort of alternation of dynasties, like a moiety system. In any case average reigns of either 8 or 12 years are not at all inconsistent with death at 36. A still longer reign average would result if rulers of nearby towns, such as Argos and Tiryns, were included at Mycenae. This seems to me quite unlikely in view of the «royal» shaft graves at Lerna and the family resemblances. But proof is lacking for a 2 or 4, or 8-year cycle of challenge and deposition of the Wanax and Lawagetas. Short reigns go logically with young age at death. But these plus some head wounds, one fatal apparently, are not enough evi-

TABLE 3

Average skull measurements and indices of Shaft Grave sample compared with male samples from Greece. (Angel, 1969). Northwest Balkans (Angel, 1968). Northeast Balkans (Nécrasov, 1965), and North Iran (Krogman, 1940), Minoan Crete (Duckworth, 1913, von Luschan, 1913), Amuq (Krogman, 1949), Lower Egypt (Woo, 1930), South and East Cyprus undeformed (Angel, 1971, Fürst, 1933, Hjortsjö, 1947), and Lycia (Angel, 1970).

	Shaft Grave Kings 1650 - 1500		Middle Bronze Age 2000 - 1450		Late Bronze Age (L.H.III) 1450 - 1100		Magdalenska Goca Carniola 600 - 300		Ochre graves Bessarabia 2000-1600		Hissar III North Iran 2400-1800B.C.		Palaikastro Minoan Crete 2000-1500		Chatal,Judeideh Amuq N. Syria 3500-700		Sedment Lower Egypt 2100-2000		Bamboula,Melia, Enkomi S.&E.Cyprus 1500-1150		Karatas,Lycia S.W.Anatolia 2700-2300	
Horizontal circumference	*538.2*	13	520.0	58	522.0	93	528.6	15	Large		515.2	104	515.9	21	523.8	10	511.7	40	510.2	48	512.8	44
Vault length	*194.6*	16	186.4	65	186.6	104	188.5	17	192.9	19	188.2	105	186.4	64	190.4	11	181.9	40	175.8	52	182.6	52
Auricular - vertex height	117.4	15	118.6	61	115.7	96	118.4	18	113.7	18	116.2	99	118.9	25	114.4	10	116.3	39	117.3	45	118.7	52
Base length (basion - nasion)	108.0	4	101.2	24	99.5	60	103.7	9			102.3	93	100.0	23	—		100.8	37	98.6	45	102.4	35
Parietal thickness, left	5.1	14	5.5	63	5.6	108	5.2	16					—		—		—		5.2	15	5.4	93
Vault breadth	143.9*	15	140.6	65	141.2	106	146.6	18	141.7	19	134.1	105	136.8	50	138.5	11	138.3	40	142.8	53	139.4	49
Minimum frontal breadth	98.5	16	97.4	63	96.6	96	98.5	15	101.0	19	95.5	105	95.7	10	96.0	10	92.6	40	96.8	51	96.8	61
Bizygomatic breadth (face)	133.9*	10	130.1	50	129.6	60	135.3	11	134.7	18	127.2	92	126.0	5	129.7	3	127.2	29	128.9	31	130.5	33
Bigonial breadth (jowls)	99.7	10	97.3	43	99.2	30	101.5	12	—		97.1	80	—		102.1	9	92.0	32	97.8	10	101.8	36
Bicondylar breadth jaw	120.1	7	119.9	26	122.4	22	123.2	10	—		115.6	65	—		121.1	6	114.3	26	118.4	7	121.0	23
Chin height	33.5	15	33.1	60	33.6	57	32.9	13	—		35.5	81	30	1	33.7	9	33.7	33	31.9	15	34.6	69
Upper face height	71.2*	10	68.1	49	67.8	46	71.9	11	71.4	17	69.7	103	65.0	13	65.9	5	71.5	38	67.9	39	69.4	33
Nose height	52.4*	8	49.5	51	49.1	45	53.2	11	53.1	17	50.5	102	48.9	13	51.7	3	51.4	38	50.0	41	49.8	34
Nose breadth	24.8	10	24.7	51	24.1	48	25.3	11	25.2	17	25.4	97	24.2	10	25.3	3	24.5	39	24.3	41	24.6	31
Minimum ramus breadth, jaw	32.5*	15	31.5	58	30.4	45	30.2	15	—		33.4	81	—		32.6	9	33.3	35	32.6	12	31.6	66
Face profile angle	84.0*	7	86.3	48	85.8	37	87.1	10	—		86.3	100	83.2?	11	—		84.4	37	84.7	24	86.8	30
Alveolar plane angle	5.3	7	5.5	63	7.6	40			—				—		—		—		—		7.2	23
Cranial index (br./length)	74.2	14	75.7	64	76.2	100	77.9	16	73.4	19	71.3	105	73.4	50	72.8	11	76.1	40	81.3	52	76.8	47
Auricular ht. (2xht./l.±br.)	*69.3*	14	72.5	60	70.6	96	70.7	16	68.0	18	72.1	105	73.6	*	69.6	10	72.6	*	72.6	*	73.7	47
Fronto - parietal (m.fr.b./br.)	68.4	14	69.4	62	68.1	89	66.9	14	71.7	17	71.3	104	70.0	10	69.5	10	67.0	*	67.9	49	68.9	47
Cranio - facial (biz. br./br.)	92.6	10	92.2	50	91.2	58	92.0	11	94.4	14	94.9	92	92.1	*	93.6	*	92.0	*	90.3	*	93.2	33
Fronto - gonial (bigonial/min.fr.)	100.9	10	100.3	41	103.0	23	102.9	11	—		101.6	*	—		106.3	*	99.4	*	101.0	*	106.7	27
Facial (total face ht./bz.)	90.0	7	87.9	46	89.4	23	87.9	11	—		91.0	68	(83.3)	1	92.6	2	93.7?	*	90.9	6	90.0	26
Upper facial (u. f. ht./bz. br.)	53.5	7	52.5	46	52.7	41	53.1	11	51.3	16	54.7	90	51.6	5	52.6	3	56.2	*	52.8	30	53.4	28
Nasal index (br./ht.)	46.8*	9	50.2	50	49.1	44	47.9	10	46.8	16	50.5	98	49.5	10	48.9	3	47.7	38	48.7	21	49.5	31
Left orbital (ht./breadth)	84.3*	10	81.7	54	84.9	56	86.7	6	74.8	16	80.9	104	80.2	13	80.7	4	84.1	35	82.5	43	80.9	35
External palatal (br./lg)	118.4	9	118.6	36	117.5	38	117.3	9	—		—		—		—		—		—		115.4	21
Sigma ratio: variability	120.5		128.1		101.5		High		V. high		Low		Average?		High?		Low		Highish		100.0	
Mean indicial deviations	Lase		1.8		1.3		1.7		2.0		2.5+		2.2		1.8		1.6		2.2		2.2	

Note : statistically significant deviations of kings from general Middle Bronze Age sample (which does not include kings) are italicized and possibly significant deviations starred. The orbital index for Ochre graves obviously uses breadth measured to maxillo - frontale rather than - dakryon and probably should be about 80. Starred indices * derive from mean measurements. Mean deviations from Shaft Grave sample derive from indices & face profile angle only, with fronto - gonial, facial, external palatal index and profile angle weighted at 50% of the other indices: the size factor is eliminated.

dence to prove Graves' theory of ritual killing of kings, especially if the trephination of **51 Myc.** was curative and not ceremonial. At present it seems to me more logical to argue that the kings, the Wanaktes and Lawagetes, actually had to live very much more strenuous and dangerous lives than their subjects and so died young, receiving their wounds in Mycenae's struggle to unite and rule over the Argolid and perhaps the Peloponnese. They would have faced palace plots and murder as well as war dangers. The only real proof of Graves' idea would be precise king lists for the full Myceneaan period from future finds of tablets written in Linear B Greek.

CONCLUSIONS

1. The rulers buried in the Mycenaean Shaft Graves during the time of transition from Middle Bronze Age to full «urban» Mycenaean period (about 1630 to 1500 B.C.) were 171 - 172 cm tall on the average, about 5 cm taller than their subjects and with individuals taller than 180 cm.

2. They have remarkably thick bones, and relatively and absolutely massive bodies and heads, perhaps from better diet with more protein.

3. In rarity of dental disease, lack of lines of enamel growth arrest, and rarity of porotic hyperostosis (thalassemia) in response to malaria they enjoyed better health than their subjects, despite arthritis and (in one case) gallstones.

4. Their average life span of 36 years puzzlingly is no longer than that of the general male population (possibly because of ceremonial death), more likely because of stresses of leadership in warfare, intrigue and perhaps sport, and hunting.

5. Depending on the variety of officials buried in the two grave circles — Wanax, Lawagetas, perhaps Basileus too — each one may have reigned for an average of 8 to 12 years.

6. They show the same postural and muscle adaptations to rough country as the common people do, and some special ones such as the left shoulder changes of **59 Myc.** perhaps from shield-carrying.

7. They have enough head wounds **(51, 59 Myc.)** and vertebral fractures and arthritis to show that they were active and vigorous leaders and not figure-heads.

8. The trephination of **51 Myc.** indicates considerable surgical skill and daring.

9. As well as sharing certain family trait similarities the aristocrats are as heterogeneous in head and face form and body size as is the general Middle Bronze Age Greek population, at least 20% more variable than normal.

10. Except for their greater size and muscularity they differ from their subjects only in having relatively lower heads, probably relatively longer heads, and perhaps longer noses and more projecting mouths.

11. In terms of arbitrary type tendencies they show less Mediterranean, Basic White, and Alpine («pre-Greek» trait combinations) and more Nordic-Iranian and Dinaroid-Mixed Alpine tendencies than commoners show.

12. These small trait shifts are in the direction of Iranian steppe, Anatolian and Balkan groups formed as migrant brought Indo-European speech into Anatolia, Greece, and Central Europe 600 to 400 years earlier. Possibly the aristocrats are a little more fully derived from these intruders than the commoners are, though this does not explain the rulers' body size and pre-Greek or Minoan combinations do occur among them, e.g. in **68** or **133 Myc.** It is more likely that the rulers spring directly from the extraordinarily mixed late Middle Bronze Age population which they ruled over and that their differences result from (a) better diet and training and (b) social selection for both ability and strength and subsequent microevolution.

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