The People of Herculaneum AD 79

Recent discoveries of skeletons of Herculaneum give us insights into the lives of some people contemporary with Pliny the Elder. Studies of the skeletons of people who perished in the eruption of Mt. Vesuvius in AD 79 reveal information about their health, nutrition, disease, occupations, as well as give us a glimpse of the social structure of the society. This paper will give an overview of this work: first, review new ideas about the eruption itself; second, give findings for the population as a whole; third, discuss several of the more interesting people as individuals.

The Eruption of Vesuvius AD 79

The people of Campania in AD 79 did not realize that Vesuvius was a volcano, nor did they recognize the warning signs of eruption. The first sign was a strong earthquake in AD 62 [1]. Damage was severe and not fully repaired by the time of the eruption 17 years later, as can be observed in Herculaneum today. On August 24, AD 79, intermittent earth tremors started [2]. In the early afternoon of August 24, Vesuvius erupted. Pliny the Younger described it:

> «It was not clear at that distance from which mountain the cloud was rising (it was afterwards known to be Vesuvius); its general appearance can best be expressed as being like an umbrella pine for it rose to a great height on a sort of trunk and then spread off into branches... In places it looked white, otherwise blotched and dirty according to the amount of soil and ashes it carried with it» [3].

1 Tacitus, *Annals* 15, 22-23.
2 Pliny the Younger, *Epistles*, 6, 20.
3 Pliny, *Epistles* 6, 16; Radice, 1963 for this and the following translations.

Pliny the Elder decided to sail over to investigate. His nephew reported his trip:

> «Ashes were already falling, hotter and thicker as the ships drew near, followed by bits of pumice and blackened stones... then suddenly they were in shallow water and the shore was blocked by debris by the mountains».

As Pliny could not put into shore, he went on to Stabia where there was less ash fall, and so stayed the nigth. Even at Stabia the amount of ash fall was considerable and the tremors were violent. The morning was «still in darkness, blacker and denser than any ordinary night». Meanwhile, at Misenum, Pliny the Younger observed, «a black cloud sank down to earth and covered the sea». He reported that later that day the ash cloud dispersed and pale daylight returned. The tremors continued for seven more days [4].

The eye witness report of Pliny the Younger can be amplified by studying the volcanic deposits [5]. Different sites around the volcano had different deposits and different events depending on the wind direction and the distance from the volcano. There are three kinds of deposits from this kind of eruption: air fall pumice, pyroclastic flow, and ground surge. Air fall pumice is the fallout of pumice and ash from a high eruption cloud, Pliny's umbrella pine cloud. Distribution of the ash fall depends on the direction of the wind, as well as the distance from the volcano. At Vesuvius in AD 79, this phase lasted about 18 hours, yielding a deposit of 200-280 cm. of ash fall at Pompeii and less than 20 cm. at Herculaneum.

The second type of deposit is from the pyroclastic flow: a hot avalanche of pumice, ash and gas flowing at high speed down the sides of a volcano in direction determined by the topography filling in depressions and valleys. Successive flows result in layers, making the deposits many meters thick. Distance from the volcano is a major factor in the thickness of deposit. At Herculaneum, 7 km. from

4 Pliny, *Epistles*, 6, 20.

5 Sigurdsson, H., Cashdollar, S., Sparks, S. R. J.: 'The Eruption of Vesuvius in A.D. 79: Reconstruction from Historical and Volcanological Evidence', *American Journal of Archaeology*, 86 (1982) 439-51.

Vesuvius, deposits are 20 meters thick. At Pompeii, 11 km. from Vesuvius, they are 2 meters or less. At Herculaneum, the pyroclastic flows had a temperature of up to 400°C, carbonizing parts of the skeletons. These deposits cooled and hardened to a cement-like substance.

The third type of deposit, the ground surge, is the most lethal of all and yet leaves the most inconspicuous deposit for future scientists to observe. The surge is a cloud of volcanic ash and hot gas which moves at speeds over 100 km. per hour. Ground surge is violent and explosive. It demolishes buildings, overturns boats, and kills people. There were several surges at Herculaneum and Pompeii. They were probably the «moving clouds» in Pliny's letter.

A matter of great interest is the mechanism of death of the people caught by Vesuvius. The eruption of Mt. St. Helens in 1980, a similar but smaller volcano of the U. S., caused a number of deaths. Studies of these deaths will lead us to conclusions about the deaths of the Herculaneum peoples [6]. The cloud of hot ash and gas, the surge, moving at high speed, overpowered and asphyxiated them almost inmediately. Small particles of ash inhaled, blocked the small air passages, then the pyroclastic flow came within minutes after the surge, covering the bodies causing thermal damage. Some deaths could also have occurred because of the energy from the extreme violence of the surge activity, but probably most people died from asphyxiation. The result of this eruption of Vesuvius was to preserve Herculaneum and its peoples for us to study almost 2.000 years later. Scholars had long thought that, although many people died at Pompeii, almost everybody escaped from Herculaneum. It was very much a surprise when skeletons were found on the ancient beach front in March of 1982.

Health and Nutrition of the Herculaneum Population

The population of Herculaneum is unique since contemporary Romans cremated their dead; it is, therefore,

6 Eisile, J. W., O'Halloran, R. L., Reay, O. T., Lindholm, G. R., Lewman, L. V., Brady, U. J., 'Deaths during the May 18, 1980 Eruption of Mt. St. Helens', *New England Journal of Medicine*, 305 (1981) 931-36.

invaluable to anthropologists, historians, and others interested in the Roman world. But the uniqueness creates a problem, there are no other contemporary populations from the Italic peninsula to use for comparison. We will use Hellenistic Greeks and modern Americans. At Herculaneum we have excavated, restored, and studied 139 skeletons: 51 males, 49 females, and 39 children. There are more skeletons waiting to be excavated; there are also more methods of analysis to be employed; therefore, this report is merely preliminary.

Some of the observations and measurements in particular give anthropologists insight into the health and nutrition of a population. Longevity of adults is a parameter of primary importance. But, at Herculaneum everybody died accidentally before his time, so that age at death statistics are meaningless. Stature is also a very important indicator of general health and nutrition. Of course, heredity dictates the maximum stature possible for each individual, but poor nutrition or disease can interfere with a persons' achieving this potential. Therefore, mean stature statistics, particularly in comparison with other populations, can be useful. Stature at Herculaneum is comparable to Hellenistic Greeks, but shorter than modern Americans. With this parameter, we also have modern Neopolitan statistics to consider. The male mean stature is 164.0 cm. and the female is 152.6 cm., both considerably shorter than the Roman period people [7]. See Table 1 for this and the following discussion.

Other important indicators of health and nutrition are the relative flattening of long bones and the pelvis. With much heavy exercise, muscles get larger, but with poor nutrition, long bones are slender and small. They must flatten to accomodate increased muscle mass. Thus, flat long bones suggest heavy exercise in the presence of poor nutrition. Comparison of upper femoral flattening (platymeric index) indicates the Herculaneans and the Hellenistic Greeks to be roughly equivalent, but both to

7 D'Amore, C., Carfagni, M., Matarese, G., 'Definizione Antropologica della Popolazione Adulta di un Comune della Provincia di Napoli', *Rend. dell'Academia di Scienze Fisiche e Matematiche della Società Nazionale di Scienze, Lettere ed Arti in Napoli*, Serie 4, vol. XXXI (1964).

be somewhat flatter than those of the modern U. S. people. The pelvis is located in the body at an angle of 60° to the horizontal. So if there is, because of poor nutrition, any softening of the bone, the weight of the upper body pressing down will cause it to flatten somewhat. The mean pelvic brim index of both the Herculaneans and the Hellenistic Greeks is flatter than modern Americans. Differences between the sexes in respect to pelvic brim index in both populations are probably due to sampling errors and are likely not significant. The mean pelvic brim index of male and female together for Herculaneum is 83.9, N=78, and for Hellenistic Greeks is 85.8, N=7. Perhaps this is a more valid way to look at this statistic.

Dental health is also revealing. Its study shows another aspect of differences between an ancient and a modern population. The ancient Mediterranean peoples that have been studied by the autor all have, in general, much better teeth than modern Western peoples. Most of the Herculaneans have perfect edge-bite occlusion and few lesions, defined in this paper as the total of antemortem loss, caries, and abscesses per mouth. In Table 1, note that the Herculaneans have slightly better teeth than the Hellenistic Greeks and much better teeth than modern Americans.

There are other observations we can make from bone that tell us about the people, but there are many things we do not know from skeletal remains. Most disease is of the soft tissue; a few long-standing conditions leave traces in the bone. The author did not see much pathology, but it is usually not possible to do so. Slight to moderate arthritis is observable and fairly common in ancient and modern populations. The higher levels reported in the U. S. modern population (63.8 mean of both sexes N=135 to 42.3% mean at Herculaneum, N=97) is an artefact of a somewhat older population. Trauma, healed fractures and dislocations can readily be assessed in skeletons of Herculaneum. Almost three times as many males suffered some accident as did females. The population average of 22.7% is close to the U. S. modern of both sex means of 17.7%. Healed anemia is detectable in skeletons

as porotic hyperostosis, a swelling of the inner table of the parietal bones of the skull. Both ancient populations have levels of healed anemia far higher than the modern U. S. This may reflect nutritional problems, but it is more likely to be a result of heterozygotic thalassemia [8].

In addition to observations and measurements of bone, chemical analysis of bone mineral is being used to study the population. Bone mineral can give us insight into nutrition and social factors of a population. Atomic absorption spectroscopy was used to determine calcium, phosphorus, strontium, zinc, and magnesium. Animal bone and soil were also analyzed as controls [9]. With Herculaneum a study of lead in bones was begun.

For the study of nutrition, the most interesting mineral is strontium. Strontium is present in bone only in trace amounts where it substitutes for calcium in the apitite structure. The strontium/calcium ratio in bone can be used to demonstrate relative amounts of animal —versus vegetable— source protein in the diet of a particular population [10]. Calcium and strontium are present in vegetables in about the same proportion as in the soil. Herbivores, feeding on the plants incorporate a small amount of strontium in their bones, but none into their soft tissue. Carnivores, eating flesh, have much less strontium in their bones. Omnivores fall between. Animal bones of known species can be used for comparison with human bones to give relative amounts of animal —or vegetable— source protein nutrition. Since strontium in bone is so dependent on the quantity of strontium in the soil of a specific site, a site-specific sheep/goat bone is used to make rations with human bones for comparison of one population with another.

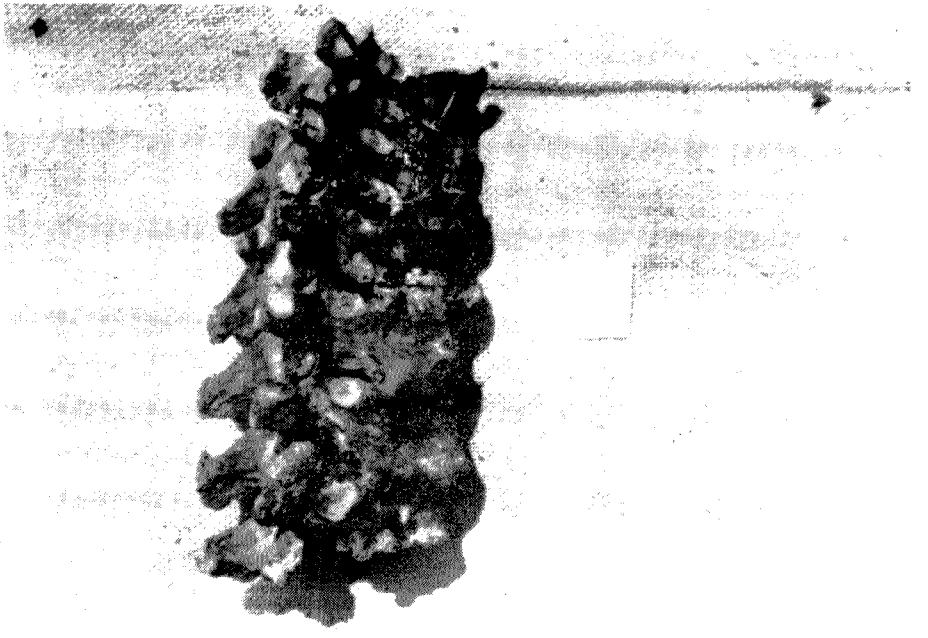
One problem with the interpretation of soil, plant, and animal system described above is that it does not take

8 Angel, J. L., 'Pyrotic Hyperostosis, Anemias, Malarias and Marshes in the Prehistoric Eastern Mediterranean', *Science*, 153 (1966) 160-63.

9 Bisel, S. C., A Pilot Study in Aspects of Human Nutrition in the Ancient Eastern Mediterranean, with Particular Attention to Trace Minerals in Several Populations from Different Time Periods, University Microfilms, 1980.

10 Brown, A. B., 'Bone Strontium as a Dietary Indicator in Human Skeletal Populations', *Ann Arbor* (1973).

Photography 1



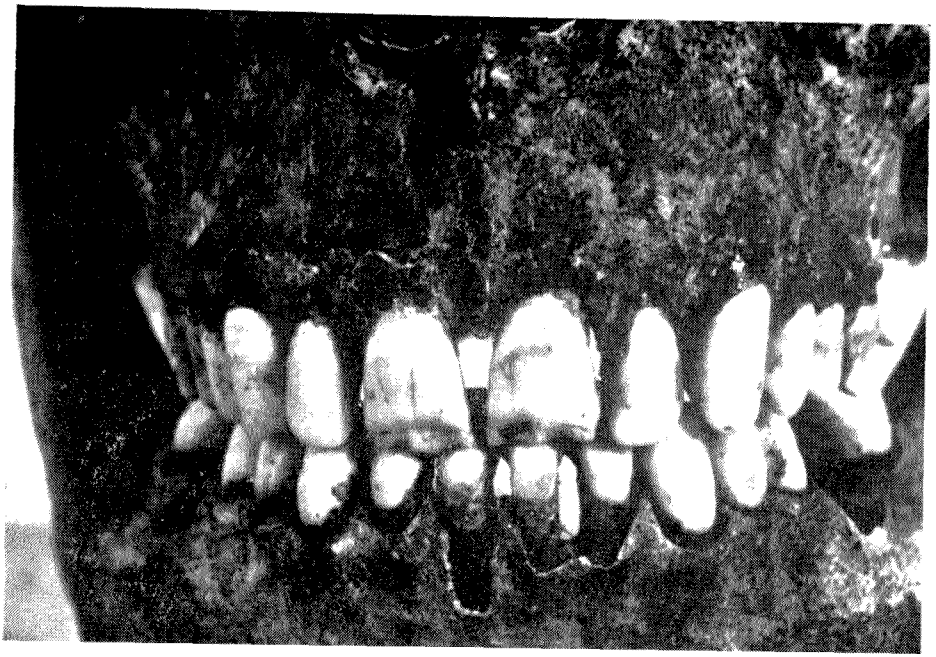
Photography 2

Photography 4

Photography 3

Photography 5

Photography 6



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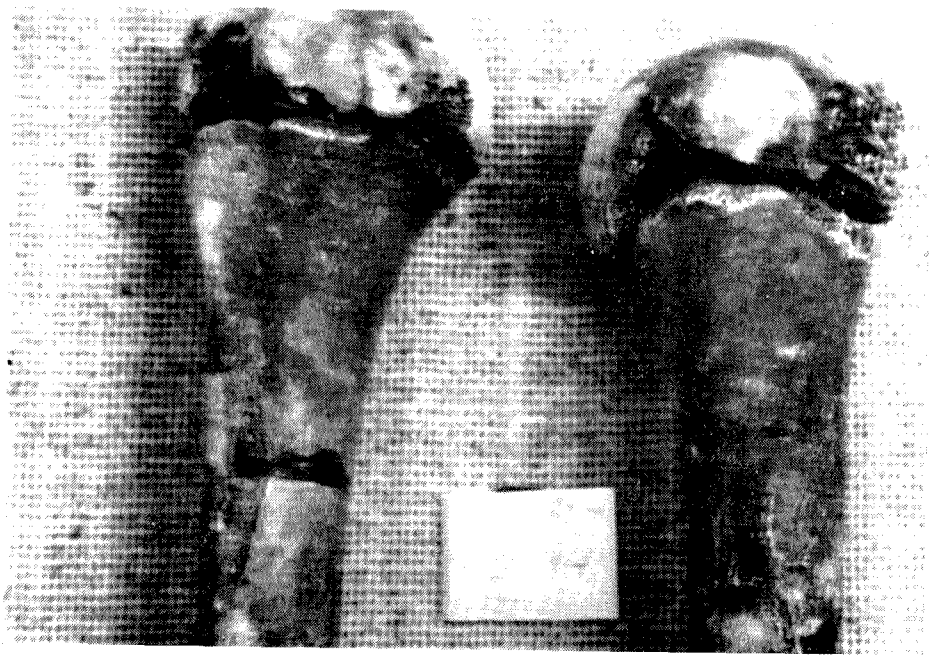

Photography 8

into account seafood sources of protein. This high quality animal protein also has high strontium values. Sea water is very rich in minerals. Animals living in this environment absorb high quantities of minerals, including strontium into their flesh. This fact can make reconstruction of human diet more complicated. A laboratory procedure which addresses this problem is the assessment of the relative amounts of carbon 12 and carbon 13 isotopes in the bone by means of mass spectroscopy [11]. The author has not yet performed this analysis; therefore, data and conclusions about protein are preliminary both by their number and methodology. The author analyzed samples from 44 skeletons from Herculaneum: 27 males and 17 females. There was no real sex related difference in any mineral. The mean site corrected strontium/calcium ratio at Herculaneum is .760, at Athens it is .466 (N=17). The higher level at Herculaneum could reflect a higher vegetable protein diet, or a higher seafood diet, or a combination, as opposed to the reliance on terrestrial animal sources. As both ancient groups are rather equally healthy, it seems reasonable that both consumed rather equal amounts of complete animal source protein. It would appear that the Herculaneans relied on seafood protein, and the Athenians on terrestrial animal sources. However, nothing definite can be said until the carbon 12, carbon 13 ratios are studied. Lead studies began with the Herculanean population. Methodology employed sample preparation in a controlled environment, dessication in an oven, digestion in concentrated nitric acid, and analysis with flameless atomic absorption [12].

Results are preliminary and difficult to interpret. Of the 43 sampled at Herculaneum, there were 17 females and 26 males. Determinations were done on the outermost layer of bone cortex, the «periosteal» layer, as well as on

11 Schoenninger, M. J., De Niro, M. J., Tauber, H.: 'Stable Nitrogen Isotope Rations of Bone Collagen Reflected Marine and Terrestrial Components of Prehistoric Human Diet', *Science*, 220 (1983) 1281-83.

12 J. McCall, Mayo Clinc, personal communication. Bisel, S. C., Angel, J. L., 'Health and Nutrition in Mycenacian Greece. A Study in Humain Skeletal Remains', in *Contributions to Aegean Archaeology: Studies in Honor of William A. McDonald*, Wilkie N. C. and Coulson, W. D. C., eds. (1985) 197-210.

samples on mixed layer cortex. In almost all instances, the periosteal layer lead levels were higher and, in some instances, much higher. Also, comparison samples from Hellenistic Athens on 5 males and 6 females were run. Again, the periosteal layer lead was higher than the mixed layer lead. In addition, all Athenian means were higher than the Herculanean ones. But, number of samples is so small that differences are probably not significant. Also, comparison of 5 samples from neolithic Franchthi Cave in Greece were analysed. These people who never used lead had only a trace amount in their bones. A closer look at the lead levels of the Herculaneans shows a few who deviate widely from the mean. There are two people with very high lead in mixed layers as well as in the periosteal layer. One at 2,790 ppm, and one at 6,350 ppm, which figures have remained constant upon repeated rechecking. These two people have been excluded from the reported statistical mean of mixed layer levels. There are also six other people with levels of 1,000-2,000 ppm in the periosteal layer, but with more usual levels of 25-150 ppm in mixed layers. Although the metabolism of lead into bone is not completely understood, it stands to reason that these eight people must have had, at least in some time in their lives, some problems from high lead in their systems. Of the Athenians, there are two of the eleven with periosteal lead levels of 1,100 and 1,280 ppm and mixed layer lead levels of 280 and 440 ppm. These Athenians may also have had problems. The lead study is still preliminary; more samples need to be analyzed and checked. However, it does seem likely that plumbism existed in this culture.

Five Herculaneans

We have examined some of the important parameters of health and nutrition of the population as a whole. Every skeleton has an interesting story to tell, but we have chosen five individuals to study more closely from a sociological viewpoint: Methodology of aging, sexing, etc. [13].

13 Cf. Angel, J. L., Bisel, S. C., 'Health and Stress in an Early Bronze Age Population', in *Ancient Anatolia*, Riggeway, B., Steck, T., eds., (1986) 12-30.

The «Ring Lady», although wealthy and privileged, led an active life. We know she was wealthy from the beautiful jewelry found with her [14]. The enlarged deltoid crest on her humerii, as well as other muscle attachments, attest to the enlargement of her muscles. Her exercise would have been from sports or the like rather than from labor. She was slightly taller than the average at 157.2 cm. with relatively round femora (PMI=89.4). Her pelvic brim was extra round (PBI=103.2). All of these data point to above average nutrition. She produced about 2-3 births as shown by the scars on her pubic symphysis. Giving birth would have been easy with a deep pelvis. The prominence of her prognathous jaws and teeth meant that she did not have an attractive face. However, we must remember that, even though she was about 46 years old, she still had all of her teeth, minus the two lower third molars congenitally, without caries or abscesses. She did have one major problem which would have become worse if she had lived longer: advanced periodontal disease (see plate 1). There is much bone loss around the alveolae and increased vascularity as shown by the tiny holes. This bone loss would have provided access to infection and contributed to abscess formation. This condition would have caused tooth loss within a few years had she been alive. Another problem she had is shown by the tibia shafts. There is a moderate striation of the anterior shafts. As blood circulation is more sluggish in the lower legs, this condition may have been caused by the pooling of blood carrying a chronic low grade bacterial infection. Despite these two relatively minor health problems, she was a strong-boned (robusticity index equals 13.2), well-exercised woman.

A second Herculanean is in direct contrast to the «Ring Lady». About the same age, this man was from the lowest socio-economic bracket. He was short, 163.5 cm., with spindly and flattened bones (PMI=78.3), and rather flattened pelvis (PBI=82.6). He has large deltoid crests with some pulling at the muscle attachments showing a life of hard labor. All of these data point to poor nutrition and,

14 Gore, R., Massatenta, O. L.: 'The Dead Do Tell Tales', *National Geographic Magazine*, 265 (1984) 557.

by extension, to a life of poverty and hard labor. His most painful health problem was his teeth. He had lost seven before death and had four caries and four abscesses. One of these abscesses was so advanced that it drained into the maxillary sinus. This side of his mouth caused him so much discomfort that he chewed on the other side, even though it had no teeth. Evidence for this conclusion is from the excessive calculus formation on the molars of the unused side of his mouth. His most interesting problem is the fusion of the spines of six thoracic vertebrate (see plate 2). This condition would likely not have been painful, but it would have decreased mobility and caused a slight scoliosis to the right. It would have been impossible for him to expand his chest fully upon heavy breathing with exertion. There is minimal arthiritis in the rest of the spine and not much elsewhere in his skeleton. This condition may be ankylosing hyperostosis (Forestier's disease) [15].

A third interesting Herculanean is the Soldier. Found on the beach front with his bronze military belts and his long sword, he is assuredly a soldier. We know from his bones that he was a big, tough, well-exercised, heavy-boned man of about 37 years. He was about 174.5 cm. tall, well above average for this population. His long bones are above average in roundness (PMI=86.7), as is the pelvis (PBI= 88.2). The deltoid crest, as well as other muscle markings, are all well developed showing a life of active labor. His hand bones show that the muscles here were also well developed; his work required heavy use of his hands. The artifacts found with him also bear this out. On his back was a pack containing a hammer-adze combination, two chisels, and a hook for holding tree branches; he was a carpenter as well as a soldier. His face was rugged and masculine (plate 3). He was missing three molars antemortem, and also missing three incisors antemortem. These latter probably were lost through violence. Another sign of violence can be seen in the anterior shaft of the left femur (plate 4). An exostosis of 78 mm. × 18 mm. running

15 Forestier, J., Jacqueline, F., Rotes-Quersol, J., *Ankylosing Spondylitis* (Springfield, 1956) 340.

longitudinally to the shaft is a remainder of a stab wound to a muscle. Bleeding occurred, followed by ossification of the clot. As the stab was parallel to the rectus femoris muscle fibers, good healing occurred, allowing continued full function of the leg.

A fourth Herculanean is also a man who had experienced some violence, although we do not know his profession. About 51 years old, he had earlier in life sustained a fracture of the right forearm, both radius and ulna which subsequently healed (plate 5). The configuration of these fractures suggests that they occurred in the parrying of a heavy blow. The broken fragments of shaft overrode slightly, shortening the bones by about 9-10 mm. Some impairment of motion seems likely, particularly in the rotation of the forearm. A worse problem in functioning for this man existed in the severe arthritis of his knees (plate 6). The anterior of the condyles condials of the femora and also the articulating surfaces of the patellae were worn smooth and eburnated from friction, the wearing of bone on bone. The friction had even progressed to the point of there being cysts on the condyles behind each patella. It is certain that he must have had very painful knees, interfering with many activities. He was, at about 51 years, among the older segment of the society, slightly shorter than the mean at 167.2 cm. stature, and with average flatness of long bones (PMI=81.1), with average roundness of the pelvis (PVI=87.0) and with only two teeth lost antemortem, he was, therefore, not of either extreme of economic class. He did work hard resulting in extreme hypertrophy of deltoid crests and other muscle markings, but we do not know at what occupation he achieved this muscularity.

The fifth Herculanean to be discussed is yet different: a young girl. She was discovered in one of the chambers holding a baby of 11 months. This baby was wearing several pieces of bronze jewelry, probably meaning the child was of the upper-middle class or better. It is likely that the girl was not, however, of this class. About 14 years old, she was still prepubital as shown by the unfused state of her pubis, ischium, and ilium. A glance at her teeth

shows that she had had serious problems when she was aged 10-12 months. At that time, she was either extremely ill or starved. We know this because there are deep grooves of the incisors (plate 7) and of the first molars. There was little calcium in her system to form the enamel in the crown area of those teeth then forming. The grooves in the molars were so deep that the lower molars became grossly carious and then abscessed; the teeth were extracted shortly before she died. There is a little new bone formation in the empty alveolae by way of healing. Perhaps her teeth and the story of starvation during her early childhood that they tell are not sufficient to make the case for her being of lowest socio-economic bracket, but the humerii are (plate 8). The insertions for the pectoralis major muscles on the shafts of the humerii show deep grooves from the pulling of the tendon attachments. This condition would likely have resulted from exertion: heavy lifting. It is not likely that a daughter of a upper class family would be so overworked. Therefore, it seems more probable that she was a slave.

Here we have looked at several individuals from the time of Pliny. Each person has an interesting story to tell. It is instructive to view the population as a whole to understand the sociology of the historical period. This paper has tried to give an overview of a study still in progress.

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Table 1 Selected Statistical Indicators of Health and Nutrition

	HERCULANEUM				HELLENISTIC GREECE[1]				U. S. MODERN WHITE[2]			
	♀		♂		♀		♂		♀		♂	
	x̄	N	x̄	N	x̄	N	x̄	N	x̄	N	x̄	N
Stature - Cm	155.2	43	169.1	51	155.5	13	171.1	7	162.4	70	175.0	88
Platymeric Index	83.1	43	81.9	48	78.8	14	83.5	6	86.3	72	88.2	87
Pelvic Brim Index	89.5	35	82.9	43	82.7	4	90.0	3	93.5	55	93.1	58
Total Number Dental Lesions	3.9	35	3.6	44	5.2	114[3]			15.7	170[3]		
Slight to Severe Arthritis %	36.4	44	47.5	53	66.7	6	42.1	14	55.1	60	69.8	75
Trauma %	11.4	44	32.1	53	50.0	6	35.7	11	16.9	106	18.4	125
Healed Anemia %	40.9	45	28.3	53	66.7	6	46.2	13	9.0	205[3]		

Table 2: Bone Mineral: Strontium and Lead

	HERCULANEUM						HELLENISTIC GREECE[1]						Neolit. Franch. cav[e]		
	♀			♂			♀			♂			♀, ♂		
	x	s.d.	N	x	s.d.	N	x	s.d.	N	x̄	s.d.	N	x̄	s.d.	N
Sr/Ca Site Corrected	.788	.098	17	.736	.104	27	.369	.069	12	.520	.310	5			
ppm Periosteal layer Pb	249	157	16	380	453	25	.435	449	6	496	530	5			
ppm mixed layers Pb	63	43	17	100	56	26	204	107	6	124	177	5	3.3	1.1	5

1 Cf. note 9.
2 Cf. note 13.
3 Male and female reforted together, cf. note 12.