DENTAL ANTHROPOLOGY OF THE NILE VALLEY

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Introduction
In his 1972 article titled 'Dental Anthropology of Early Egypt and Nubia', David Greene states that 'the study of Egyptian and Nubian dental anthropology is at present based upon a few published reports ...' (p 315). He lists nineteen references concerned with Egyptian and Nubian teeth and skeletal remains in the bibliography. His stated goal is 'to review this meagre data and present a synthesis of present knowledge' (Greene 1972, 315). Our goals for this paper are to present a synthesis of Nile Valley dental anthropology and to assess the changes which have taken place during the intervening eighteen years.

The historical literature review is organised into three interpretative themes: 1) dental disease, disease process, and dietary reconstruction; 2) childhood stress; and 3) genetics, dental morphology, metrics, and adaptation. The literature synthesis indicates several areas for methodological improvement and these suggestions are organised into the section titled methodological critique. In the conclusion the present state of Nile Valley dental anthropology is compared to the state of affairs in 1972.

Dental Disease, Disease Process, and Dietary Reconstruction

Dental Caries
Since Mummery, in his classic work of 1870, established the relationship between dental caries and diet, numerous researchers have argued about temporal trends in Egyptian and Nubian caries frequencies. Ruffer (1920; 1921) states that the caries rates remained relatively stable from predynastic to Christian times before rising suddenly during the Ptolemaic period. Other more recent investigators provide data demonstrating an increase from predynastic to dynastic periods (Derry 1933; Hillson 1978; 1979; Leek 1986). In contrast, Grillette (1964; 1973; 1977; Grillette and Davide 1967), employing the Marro collection at Turin demonstrates a decline in caries from 33% to 28% affected individuals between the predynastic and dynastic Egyptian samples. Egyptian caries rates reach their highest levels from Roman times onward (David 1985; Gaballah et al. 1980; Strouhal 1984).

In Nubia caries are infrequent during the Mesolithic at 1% (Green 1972; Greene et al. 1967), increase slightly but remain low during predynastic times (Smith and Jones 1910), and reach a high of 18 to 23% during the Christian occupation (Beck 1988; Beck and Greene 1989; Martin et al. 1984). As the frequency of caries is related to the physical consistency and composition of the diet, these trends have implications for the reconstruction of Egyptian and Nubian diets.

Our review of the literature clearly demonstrates that any trend established for the long time spans of the Nile archaeological sequences is dependent upon the samples being used. For example, dynamic caries rates per individual range from a low of 10% affected individuals reported by Hillson (1979) to a high of 42% reported by Mummery (1870), while rates by tooth range from a low of 0.4% (Leek 1966) to highs of 2.3% (Brothwell 1963) and 4.65% (Grillette 1977) affected teeth.

Hillson (1979) establishes the importance of this variation within time periods when he points out that the increase he found between the predynastic and Middle Kingdom samples is overshadowed by the much greater differences between contemporaneous individual cemeteries. Grillette (1977) demonstrates differences associated with settlement and presumably social class by reporting a per-tooth caries rate of 4.03% from a village settlement and a higher rate of 5.42% from the urban centre at Assiut.
Similarly in Nubia, increases over time and variation between contemporary populations are attributed to changing socio-economic factors which affect the diet (Armelagos 1968; Beck and Greene 1989). For example Beck (1988) demonstrates that caries increase over time among the Medieval Christians of Kulubnarti as increasing village autonomy provides greater local access to resources and improved health. Strouhal (1984, 164) articulates the importance of this variation by suggesting that 'it seems necessary to continue the research by studying clear-cut samples from single localities and well-defined periods, taking into account their socio-economic level.'

Dental Attrition
Ruffer (1921) notes the extreme dental attrition found during all periods in Egypt from the predynastic to the Coptic. Leek (1967; 1972) attributes the extensive wear found throughout the Nile Valley to the abundant sand in the environment, use of stone grinding utensils and the presence of whole grains of seed in the bread. Ruffer (1921) observed a temporal trend of wear decreasing with time and a geographic variation with wear greatest in Upper Egypt. Grillotto's (1977) study of dental attrition also demonstrates a decrease in dental wear between his predynastic and dynastic samples. He attributes this decline to development of more elaborate food preparation techniques. Ibrahim (1987) shows a decline in attrition over time and attributes variation in degree and pattern of wear to dietary differences between cultures, localities and socio-economic levels. These studies establish that anlaysis of dental attrition can provide insight into both dietary and socio-economic change.

Dental Microwear
Puech et al. (1983) employ nitrocellular impressions and a light microscope at 100 magnifications and, more recently, a scanning electron microscope (Puech and Leek 1986) to examine the microwear of predynastic and dynastic tooth surfaces. They describe the 'blunt' character of the few striations visible and note the virtual absence of large striations. Puech and co-workers (1983; 1986) attribute the blunt striations to the rarity of large abrasive particles and the presence of particles too small to leave striations. They suggest that the polishing observed on the tooth surfaces is associated with the frequent chewing of papyrus masticatories (wads of papyrus fibre chewed to stimulate saliva flow) as suggested by Dixon (1972). Dixon (1972) notes the similarities of mastication and expectoration between Egyptian papyrus chewing and the chewing of fibrous desert plants in prehistoric southwest Texas, USA. The high dietary fibre content of these prehistoric Texans has been established by coprolite analysis and the presence of fibre quids in the dry caves, while scanning electron microscopy of the molars has demonstrated polished tooth surfaces similar to those reported for Egypt (Marks et al. 1988).

Dental Abscess and Tooth Loss
Ruffer (1921) is one of many to note that dental abscessing can be found in every skeletal collection from Egypt and Nubia. One of the consequences of abscessing is antemortem tooth loss which has increased over time in both Nubia and Egypt (Ibrahim 1987). Both caries and extensive dental attrition have been identified by Satinoff (1972) as the major causes of abscessing among Nile Valley peoples at various times and locations. The extensive attrition of Mesolithic teeth from Sudanese Nubia is clearly identified as the cause of the 28% affected individual abscess rate (Greene et al. 1967). If attrition declines with time and abscesses increase, then caries must have played an increasingly important role in antemortem tooth loss (Ibrahim 1987).
Burns (1979; 1982) shows that the interrelationship between caries and attrition is a complex one with various degrees of attrition being associated with both increased and decreased caries frequencies. Brothwell (1963) establishes a direct relationship between severe dental attrition and abscessing from the predynastic period to the Thirteenth Dynasty, but an inverse relationship in the Twenty-Sixth through Thirtieth Dynasty. Presumably this increase in abscessing in the face of decreased attrition can be attributed to an increase in dental caries.

Elemental and Microscopic Analysis
Elemental or isotopic analyses have to date not been employed in dietary reconstruction in Egypt. Grandjean et al. (1979) and Nielson et al. (1986) use teeth to show that Nubian lead levels are thirty times less than those in modern Denmark, but small increases in Nubian lead levels appear to be associated with increased use of lead. Stack (1986) employed atomic absorption spectrometry of root tips to compare amounts of cadmium, copper, iron, lead, strontium, zinc and magnesium from the Bristol mummy with four Egyptian and four Nubian mummies.

One interesting discovery by Bassett et al. (1980; see also Armelagos and Mills in this volume) is tetracycline staining in Nubian bone. The ingestion of this broad spectrum antibiotic in the food provides an explanation for the low skeletal infection rates found in some groups (Martin et al. 1984; Armelagos et al. 1981). Recently two of three teeth from the late Roman occupation of the Dakhleh Oasis showed tetracycline labelling of the enamel matrix (Cook et al. 1989). These discoveries not only explain the low observed skeletal infection rates, but also have implications for variation in dental caries rates. The presence of tetracycline in the food could have had a cariostatic effect and may explain some of the anomalously low caries rates. Comparison of caries rates between groups with and without tetracycline consumption should prove of interest.

Tooth Loss in Sudanese Nubia
A detailed examination of dental caries, attrition, tooth loss and cultural variation in Sudanese Nubia will illustrate the intricate interrelationship of the disease processes involved in antemortem tooth loss. The data derived from five cemeteries in the Wadi Halfa area (see Adams 1977; Armelagos 1968; Martin et al. 1984). Cemetery 6B16 is Meroitic, NAX and 2413 are X-Group, and 6B13 and 6G8 are Christian. In Fig. 1 the percentages of teeth with caries and resorbed sockets in the mandible and maxilla for the combined samples are plotted by tooth type. The decreasing rates of caries from the molars to the incisors are a normal agricultural pattern. The concordance of the caries and resorbed socket rates indicates that caries played a significant role in antemortem tooth loss. High correlation coefficients indicate a close relationship between caries and antemortem tooth loss in the Meroitic (6B16 = 0.86) and X-Group (NAX = 0.86, 2413 = 0.85) samples. Much lower correlation coefficients for the two Christian cemeteries (6B13 = 0.59, 6G8 = 0.40) suggest that other factors are involved in tooth loss during this later period.

Fig. 2 shows little relationship between the rates of high attrition scores and resorbed sockets indicating that wear is not the prime causal agent for tooth loss. In other words, extreme wear which exposes the pulp chamber to infection and subsequent abscessing is not the cause of high antemortem tooth loss. Fig. 3 displays a direct relationship between extreme attrition and caries rates at all but the Christian site of 6G8. The data suggest that items in the diet which resulted in more frequent high wear scores also contributed to higher caries rates. At 6G8 the physical consistency of the diet remains the same as at 6B13, but its cariogenicity increases.
Fig. 1. Percentages of teeth with caries and resorbed sockets by tooth type with maxillary and mandibular teeth combined for all samples.

Fig. 2. Percentages of extreme wear and resorbed sockets by cemetery sites.

Fig. 3. Percentages of extreme wear and caries by cemetery sites.
This study illustrates the importance of analysing variation between skeletal samples belonging to a single culture. Both the caries and attrition rates are different between the two X-Group sites of NAX and 2413. In fact the diet of NAX appears more similar to the Meroitic site of 6B16. Of special note is the fact that the Christian occupants of 6G8 show the only reversal of wear and caries rates, which suggests that this is the first major dietary change in this sequence of sites. Palaeodemographic analysis by Armelagos et al. (1981) shows that the Christian occupations experienced the first major improvement in life expectancy, and dietary changes intimated by these dental data may have been responsible. Socio-economic stratification, demonstrated by Green et al. (1974) for the site of Meinarti, suggests that the dietary difference between the two Christian sites of 6B13 and 6G8 may be due to social stratification and increased access to more or different cariogenic foods. A similar change in dental pathology over time has been demonstrated for the Christian population of Kulubnarti and has been attributed to increased local autonomy and economic development (Beck 1988; Beck and Greene 1989).

This brief examination of Nubian dental data illustrates the necessity of comparing homogeneous samples and testing for socio-economic differences before samples are combined for further rate comparisons of caries, antemortem tooth loss, abscessing, and dental attrition.

Childhood Stress
Enamel Hypoplasia
Enamel hypoplasias, linear depressions in the enamel surface, are frequently employed in the reconstruction of childhood stress. Increased hypoplasia frequencies are associated with increased childhood mortality and morbidity, and the age distribution of the defects is used to define the chronological pattern of childhood stress.

Hillson (1978; 1979) found fairly constant 40% hypoplasia rates in skeletal samples from predynastic and dynastic Egypt and Nubia. Three Egyptian samples from Badari, Sedment and Hawara have higher rates. Hillson (1979) concludes that childhood stress was higher for these populations. Variations in the peak frequencies are attributed to variation in the ages of weaning between temporal and social groups (Hillson 1979). In contrast Ibrahim (1987) notes an increase in hypoplasias over time in his Egyptian samples with the implication that childhood stress also increased over time.

Blakey et al. (1989) find no difference in the frequency of hypoplasias and hypocalcifications in incisors and canines between the Meroitic and Christian samples from El Gelli located along the Middle Nile. However, when only canines are tabulated, enamel defects increase over time (Blakey et al. 1989). These results imply that stress increased only in the later ages of the individuals, when the canines were still forming and the incisor crowns were complete.

Although trends in hypoplasia frequencies over long spans of time and between wide spread locations may be informative, it is changes or lack of change within short time spans and restricted geographic regions which are most informative. For example Karhu (1990) reports that hypoplasias are ubiquitous among the Medieval Christian Nubians from Kulubnarti with some indication of increased stress over time. Van Gerven et al. (1990) report a 4.2 mean hypoplasia rate for the early Kulubnarti Christian sample and 3.7 mean rate for the later sample. The earlier sample shows a prolonged period of hypoplastic occurrences indicating a longer period of childhood stress associated with shorter time spans between hypoplastic episodes. Taken as a whole, these data demonstrate that childhood stress declined over time. This decline in childhood stress is connected, as previously mentioned, with decreased morbidity and mortality associated with increased local autonomy (Van Gerven et al. 1990).
Microdefects of Enamel
In 1956 Sognnaes sectioned four teeth from a predynastic skeletal sample from Kench in Upper Egypt. Microscopic examination showed that two of the teeth had pronounced incremental lines in the enamel and three of the teeth exhibited interglobular dentine (a defect of calcification). This was the first histological study of ancient Egyptian teeth. Accentuated striae of Retzius, now termed Wilson bands, extend from the enamel surface to the enamel adjacent to the dentine and are the result of physiological disturbance of the ameloblasts or enamel forming cells. This physiological response to stress leaves a permanent record in the enamel. Because these microdefects record milder stress episodes than hypoplasias, they are more frequent and provide a more sensitive measure of childhood stress.

Rudney (1981; 1983a; 1983b; Rudney and Greene 1982) examined the frequency of Wilson bands in first molars from two Nubian samples to determine the relative differences in childhood stress. He demonstrates that, contrary to expectation, there was a decline in Wilson band frequency between the Meroitic and X-Group samples. This decline in stress is attributed to the development of local autonomy, adaptation to helminthic disease and differential ingestion of tetracycline contaminated foods (Rudney 1983b). The age peaks in the defect frequencies between fourteen and seventeen months are attributed to weaning (Rudney 1983a).

Genetics, Dental Morphology, Metrics and Adaptation
Craniomorphologic changes over time and variation between contemporaneous skeletal samples in both Egypt and Nubia are frequently explained by various combinations of population migration, replacement and admixture (see Greene 1981; Van Gerven et al. 1979 for discussions). Dental measurements, anomalies and morphology have also been used to argue for the presence or absence of migration and admixture. The use of dental data to establish genetic stability over time has made it possible to explain cranial variation in terms of in-situ evolutionary change and adaptation.

Dental Anomalies
Ruffer (1921) was one of the first to use dental data to imply genetic differences between Nubians and Lower Egyptians, when he reported that reduced tooth number was rare in Nubia, while agenesis of the central mandibular incisor was more common in Upper Egypt. Despite Ruffer's early reference to dental anomalies, others, such as Leek (1972) and Smith (1986), have reported the presence of traits such as supernumerary teeth and agenesis (i.e., failure of teeth to form), but none has used them in populational studies. These rapidly scored traits are highly heritable and could be profitably employed to establish populational differences and similarities.

Dental Morphology
Dental morphology has been extensively used to establish genetic stability in the Wadi Halfa region of Sudanese Nubia. Greene (1967a; 1967b; 1972; 1973) employs sixteen morphological traits to establish genetic continuity between the Meroitic, X-Group and Christian occupants of Wadi Halfa. This conclusion contrasts with those drawn by others from cranial analyses. His 1982 work not only establishes the validity of this conclusion using multivariate statistics, but extends the genetic continuity to the more recently excavated Christian cemeteries from Kulubnarti. Establishing populational continuity has made it possible to attribute changes in health and mortality to changes in socio-economic conditions rather than population migration and/or replacement.
Dental Metrics

These dental morphological similarities have been strengthened by metrical studies using bucco-lingual and mesio-distal tooth diameters. Calcagno (1986a) demonstrates close relationships between the earlier Nubian A-Group, C-Group and Pharaonic samples and the later Meroitic, X-Group, and Christian occupants of the Wadi Halfa region.


Nubian Cranio-dental Change

Having established genetic continuity in Sudanese Nubia using dental morphology and metrics, the observed craniometric variation begged an evolutionary explanation. Three hypotheses have been proposed to account for morphological changes. The 'masticatory function hypothesis' (Carlson 1976; Carlson and Van Gerven 1977), the 'caries-resistance-dental reduction hypothesis' (Armelagos 1968; Calcagno 1984; Greene 1970; 1972; Goodman et al. 1986; Van Gerven et al. 1977) and the 'increasing population density hypothesis' (Macchiarelli and Bondioli 1984; 1986). The masticatory function hypothesis suggests that the chewing complex of the face will reduce and there will be associated cranial remodelling with changes in subsistence patterns. Consumption of processed foods will lead to an alteration in the growth of the chewing complex. In response to this reduction there is a secondary reorientation of the face and vault. While this hypothesis does not exclude the possibility of genetic changes in facial reduction, it does not consider genetic evolution to be the major source of change.

The dental reduction hypothesis places greater emphasis on the genetic evolution of tooth size. The dietary change from highly abrasive foods shifted the selective advantage from large morphologically complex teeth. The large, complex teeth are capable of resisting wear, while smaller, simpler teeth are more resistant to dental caries. The selection for smaller, less complex teeth occurred within the overall masticatory apparatus and cranial remodelling.

Macchiarelli and Bondioli (1984; 1986) have argued against a need to consider selective factors in understanding the reduction in tooth size or differential reduction in the craniofacial complex. They interpret the decrease in dental and facial size observed in post-Pleistocene populations as a result of an overall decrease in body size related to stresses associated with increased population density. They argue that there is no evidence for selection favouring either smaller teeth or alterations in craniofacial architecture. Specifically, they do not believe that a shift in diet could have caused the rapid facial reduction and the 15% reduction in occlusal surface area (from 2319 to 1971 square millimetres) reported by Frayer (1978). The magnitude of this change in the shift from the upper Paleolithic to Mesolithic periods cannot be due to a 'completely different survival capacity' over the last ten thousand years. According to Macchiarelli and Bondioli, the reliance on a selectionist interpretation is due to sampling error. We have an abundance of dental remains (that do show size reduction) but lack the postcranial material necessary to interpret systematic changes.

Armelagos and co-workers (1984) have countered the position of Macchiarelli and Bondioli. They note that over the last eleven thousand years Sudanese Nubian populations underwent precisely the transition from a low density dispersed pattern to a higher density central place pattern suggested by Macchiarelli and Bondioli in their hypothesis, but experienced a more rapid change in the craniofacial complex than in the postcranial skeleton. The Nubian series is especially appropriate for an assessment of the body size
hypothesis, since there is evidence for biological continuity over this time period and there are postcranial skeletal remains.

The analysis of changes in femur length shows that there is a four percent decrease in stature from the Mesolithic through Christian periods (Armelagos et al. 1989). Changes in cranio-facial morphology of these same populations would have been far more profound and far more complex, if they were just a reflection of the reduction in body size. Examination of percent changes in craniofacial measurements from Mesolithic through Christian times reveals three clusters of change. Facial height, cranial height, parietal chord and frontal chord (complex one) show an increase in size. Facial length, cranial length, symphyseal height and mandibular ramus height (complex two) demonstrate a slight decrease of from 0.8% to 4.8%. In cluster three (length of masseter origin, length of mandibular corpus and symphyseal thickness) there is reduction of from 13% to 26% between Mesolithic and Christian times (Carlson and Van Gerven 1977; Armelagos et al. 1989).

In this transformation of the Nubian skull there is a reduction in the attachment of masticatory muscles suggesting a reduction in their size. The slight increase in cranial height and a decrease in cranial length are secondary responses to facial reduction. These changes in the chewing musculature and bony attachments resulted in a smaller face that is more inferior and posterior in position. The cranium is transformed into a higher and more spheroid form. This pattern of transformation, while not explicable in terms of simple body size reduction, can be understood in terms of alternative hypotheses (masticatory function hypothesis and caries resistance-dental reduction hypothesis).

Calcagno (1984) presents dental data from ancient Nubia that make it possible to evaluate the relative roles of facial reduction and dental reduction from Mesolithic through Christian times. By analysing the diachronic order of facial reduction and dental reduction, it is possible to understand their respective roles in cranio-facial remodelling.

Tooth breadth, which is a reliable indicator of crown size, decreases at the rate of one percent per thousand years between Mesolithic and A-Group-C-Group (early agriculturalist) periods. This rate of dental reduction would suggest a strong selective pressure favouring smaller teeth (Calcagno 1984). The reduction is seen in anterior and posterior, mandibular and maxillary teeth in males and females.

There is a deceleration in the rate of reduction between early agriculturalists (A-Group-C-Group) and later intensive agriculturalists (Meroitic, X-Group and Christian periods). During this time, anterior tooth size approaches stability, while posterior teeth continue to reduce, but at a slower rate.

This pattern of dental reduction closely follows the pattern of masticatory reduction reflected in the third cluster of cranio-facial measurements. As previously discussed, these dimensions show an initial rapid reduction between Mesolithic and early agricultural periods of 12.5% to 21.6%. This, however, is followed by a slower reduction of 6% from early to later agricultural periods.

The correspondence between the rate and timing of dental and masticatory features makes it difficult to accept either of the selectionist hypotheses as the primary factor in explaining the change. The fact that there is a continuing reduction of the posterior dentition suggests that there may be a continuing advantage of smaller caries-resistant teeth.

Our inability to separate changes in the dental system from the masticatory features of the skull may just be a function of biological reality. The dentition, the bony system that supports the teeth, the musculature that moves the jaws are all a single functional complex that has evolved through time in response to dietary changes. More highly processed cariogenic foods
of the Neolithic may have simultaneously shifted the selective advantage in favour of smaller teeth, while at the same time contributing to a new nutritional environment in which reduced neuromuscular stimulation results in changed patterns of bone deposition and craniofacial growth.

Methodological Critique
The literature review provided above makes it obvious that dental caries are the most consistently reported and most comparable of the dental data sets. The use of caries for documenting dietary changes could be enhanced by employing a tooth surface recording system such as the one used by Moore and Corbett (1971). Comparisons between studies would be enhanced if the reported caries data also included the numbers of teeth examined and the age structure of the samples. At present few data sets from the literature can be aggregated for analysis, because the basic sample size data are lacking.

In contrast, the large number of dental attrition schemes makes it virtually impossible to compare data between studies. We recommend the adoption of a single scoring system by all researchers. One, developed by Scott (1979), is already used by some Egyptologists and discriminates best between samples when tooth wear is slight to moderate. Another, proposed by Smith (1983; 1984), has the advantage of scoring both anterior and posterior teeth and discriminates well, when attrition is moderate to extreme.

The study of dental microwear patterns has proven useful in many parts of the world for identifying dietary differences and changes in food preparation technology (see Teaford 1988 for a review). The application of this technique to Nile Valley dental samples should be expanded and the actual teeth or high quality replicas should be examined with a scanning electron microscope. Alternatively, if scanning microscopy is too costly, teeth can be directly observed with a Nomarski reflected light differential interference microscope, if the teeth are coated with an opaque material such as gold.

Enamel hypoplasias are frequently used in palaeopathological studies, but systems for scoring and determining the age of formation have not been standardised. Comparability between analyses requires that the same teeth be recorded because the different tooth classes (e.g., incisors, canines) have variable susceptibilities to the stressors causing hypoplasias. The recommended method is to record hypoplasias on the maxillary central incisors and mandibular canines. It has been suggested that magnitude of the stress can be estimated from the width and/or depth measurements of hypoplasias. Hillson and Jones (1989) offer a technique for obtaining these measurements.

The analysis of enamel microdefects can add significantly to the study of childhood stress. Because Wilson bands represent less severe episodes of stress, hypoplasia and microdefect frequencies interpreted together provide a more detailed picture of the chronology and magnitude of childhood health than does either defect alone. Preliminary research by the senior author suggests that diseases with cyclical episodes, such as malaria, can be identified with these data. However, Wilson band analysis suffers from the same problems as hypoplasias. Defect definitions and the tooth types chosen for analysis must be standardised. Although Rudney (1981) used first molars, the recommended teeth are the same as for hypoplasia analysis, maxillary central incisors and mandibular canines.

Despite the significant contributions which dental morphology analysis has made to the study of Nile skeletal samples, comparability of data between studies is virtually impossible. This is due to lack of standardisation, which is attributed to failing to publish detailed morphological descriptions and photographs of the traits being scored or to publishing in relatively obscure and hard to get vehicles. This situation could be alleviated by adopting a standardised widely available system. Our experience recommends the thirty-
nine trait dental morphology system established by Christy Turner at Arizona State University, USA. The advantage of this system is that plaster models and descriptions of the morphological variants are available.

In summary, the synthesis of Nile Valley dental anthropology recommends two changes in the overall research strategy. First, there must be standardisation of data collection procedures, which would provide comparability of data between studies. Preparing this review has made it evident to us that anyone desiring to synthesise the data will be compelled to re-collect data from already studied collections. Second, many of the problem domains chosen for study are too broad in both time and socio-economic stratification. Meaningful interpretations require focusing on narrower time frames and teasing out the rank and occupational differences which may exist (see Saffirio 1972). Some of the most recent studies have done this to the great benefit of understanding the ancient populations and cultures of the Nile Valley.

Conclusions
Greene's 1972 paper cites only nineteen skeletal or dental publications, while we have been able to include seventy-three contributions to Egyptian and Nubian dental anthropology. This represents a significant increase in our knowledge during the intervening eighteen years. It also clearly indicates an increased interest in dental anthropology. The identification of seven completed dissertations and one thesis concerning dental anthropology since 1972 documents an increase in the number of new researchers entering the field, while many of the pre-1972 people are still active.

Greene (1972) concentrates his discussion on three topics: 1) using dental morphology to establish population stability; 2) a general discussion of caries and dental attrition; and 3) a consideration of the dental reduction hypothesis. The present synthesis also considers these same topics, but differs in introducing new methodologies, new research domains and bringing the previous areas to new levels of understanding. New methodologies include microwear, hypoplasia, Wilson band and elemental analyses. New research domains include a focus upon variation within limited temporal and geographic areas. Differences in caries, dental attrition, and dental defects are demonstrating the complexity of Egyptian socio-economic organisation and adaptation to local conditions. This goes significantly beyond documenting differences between the predynastic and dynastic periods. Where Greene discussed genetic stability and dental reduction, these two concepts have been united into complex models of evolutionary change and adaptation.

In summary, the future of Nile Valley dental anthropology looks bright with new researchers, new methodologies and the introduction of a comprehensive bio-cultural research paradigm.

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