Meetings

Death and Disease in Ancient Egypt

Today, mankind is afflicted with many forms of disease. To cope with these conditions, whether metabolic, infectious, or parasitic, it is sometimes necessary to know how they evolved in the first place. However, so few facts are known from the past that it is difficult to erect acceptable theories to explain their evolution. It is essential, therefore, that relicts of ancient times be examined to see what conditions were then prevailing.

A seminar was held in Detroit, Michigan, on 1 and 2 February 1973, to exchange ideas on the greatest source of material available at present, which is the vast collection of mummies in ancient Egypt. The seminar was sponsored by the Department of Physiology, Wayne State University School of Medicine; the Division of Physical Anthropology, Smithsonian Institution; and the Department of Ancient Art, Detroit Institute of Arts.

Many mummies have been autopsied in the past, but the methods used seemed unlikely to produce new types of data. This seminar emphasized the applications of the latest forms of technology, as well as a multidisciplinary approach, which included physical anthropology, Egyptology, medicine, pathology, microbiology, parasitology, physiology, radiology, electron microscopy, and dentistry.

The symposium began with an 8-hour unwrapping and autopsy of an Egyptian mummy loaned by the University Museum, University of Pennsylvania. The anthropologists and Egyptologists of the group dated it tentatively as from 700 B.C.

The body was covered with about 12 layers of wrappings that had been partially soaked in resin, and parts of these had to be removed with hammer and chisel. The body, that of a male approximately 35 years of age, was in excellent condition, even some eyelashes still remaining. Five packages of organs were removed from the abdomen and thorax. In addition, the heart with an attached segment of trachea was found in situ along with approximately 25 centimeters of aorta and portions of the diaphragm. An intact eyeball was also removed for further examination.

The right foot appeared to be deformed. X-ray examination suggested osteomyelitis of the right fibula and degenerative changes in the lumbosacral spine. Further studies will be made on these conditions.

One package of organs was covered with insect pupae, which were shown by electron microscopy to be those of a fly; studies are already in progress to determine the species. Specimens were taken for a wide range of histologic studies, as well as for resin analyses and searches for trichinellosis, intestinal parasites, and proteins. Bacteriological examination showed that the abdominal cavity was sterile.

Aidan Cockburn (Smithsonian Institution) opened the seminar with a discussion on infectious diseases in antiquity. He stated that infectious diseases in ancient times can be identified in various ways—through writings, paintings, sculptures, clay pots, preserved bodies, and desiccated feces. Most infections of man are derived from those of an ancestor common to all primates millions of years ago. Apes and monkeys have many infections similar to those of man because they are descended from this same ancestor, but after the Ice Age, agricultural developments changed the pattern for humans. In Egypt, for example, some practices (notably irrigation) led to the prevalence of the fluke parasite *Schistosoma*, which is the curse of that country today.

William H. Peck (Detroit Institute of Arts) reviewed the subject of mummification in ancient Egypt. The well-preserved specimens are found only in the perennially dry areas of the country. In prehistoric times, the practice of burial in the dry desert sand naturally preserved the body; it was only with the progress of Egyptian civilization and the development of funerary practices that a complex technique of embalming became necessary. As the tomb structure became elaborate, the body was no longer protected and kept dry by the warmth of the desert sun, so steps had to be taken to render the corpse less likely to decay. The practices of artificial drying, wrapping, evisceration, and housing in containers were all invented to replace the simple process which had occurred naturally. The funerary arts of ancient Egypt developed at the same time as burial rituals and funerary beliefs became more complicated.

Prehistoric malaria in the Near East was the subject of a paper by J. Lawrence Angel (Smithsonian Institution). *Plasmodium falciparum* is connected with the condition of sicklemia and anemia, which register in bone as enlarged marrow space or porotic hyperostosis, shown most clearly in the skull.

Porotic hyperostosis occurs in more than one-third of 169 adult samples from the prehistoric Eastern Mediterranean, and more severely in a few children who were perhaps homozygous for abnormal hemoglobin. Other possible causes of porotic hyperostosis may have included hookworm and amebiasis. These examples were taken from sites dating from Mesolithic through Neolithic times, and especially from sites close to marshes. From 4000 to 3000 B.C. (the subboreal climatic phase), lowering of the sea level and improved farming and swamp drainage caused the incidence of porotic hyperostosis to drop to 1 percent. Later it again reached its former level with an increase in malaria. Similarly, the incidence of porotic hyperostosis in predynastic Egypt was followed by a reduction in ancient times.

The histology of mummy tissues was described by Theodore A. Reyman (Mt. Carmel Hospital, Detroit). Small amounts of protein were detected chemically and electrophoretically. Metabolic products, such as uric acid, urea, and bilirubin, were found.

Skeletal muscle was readily identified, the staining reaction depending on the state of preservation. In some cases, cross-striations were found. Connective tissue components appeared to be well preserved. Bone and cartilage showed the greatest degree of preservation, occasionally containing intact nuclei. The connective tissue and some adnexal structures of skin could be identified. A lipochrome-like pigment was noted in degenerated neurons in the brain. Metabolically inactive tissues, such as bone, cartilage, and connective tissue,

were the best preserved. As a general rule, muscle and epithelial tissue were the least well preserved.

From Czechoslovakia came a paper by Eugen Strouhal and Luboš Vyhnánek (Náprstek Museum and Charles University, Prague, Czechoslovakia). Their indirect methods for dating ancient Egyptian mummies are based on dating coffins by shape, decoration, paleography, and evaluation of the name of the deceased person. There are many examples, however, in which the results are not consistent because the mummy could have been displaced after the removal of the coffin from the tomb.

Only direct methods can yield better results. The most widely used one consists in dating according to the changes in mummification techniques.

More accurate modern dating methods are based on the carbon-14 treatment, in which either the fleshy remains or bone collagen is used. The former procedure, however, does not yield good results because of impurities from mummification stuffs which are not easily removable, and the latter requires sacrificing a larger part of skeleton; this today, from the museological point of view, does not seem to be justified.

Robin A. Barraco (Wayne State University School of Medicine) discussed the results of his search for intact protein in mummy tissue. Desiccated tissue samples were taken from two Egyptian mummies. The samples consisted of heart tissue, a strip of of abdominus rectus, and a section of neck tissue. The presence of proteinogenous material in the extracted samples was indicated by the use of the Folin-Lowry method, scanning spectrophotometric analysis, amino acid analysis, and polyacrylamide gel electrophoresis. Qualitative analysis of the proteinogenous material was difficult as a result of the high salt content of the product, which is probably due to the alkalis used by the ancient Egyptians in the mummification process.

James E. Harris (University of Michigan School of Dentistry) reported on the radiographic survey of the mummies of the New Kingdom Pharaohs in the Cairo Museum. The objective of the last expedition to the Cairo Museum (in January 1972) was to expand, through radiographic examination of the Royal Mummies, the knowledge of anthropometric variation, growth and development, disease, traumatic injuries, and the art of mummification. The mummies of the New Kingdom Pharaohs provide a biological collection which is unique because of the availability of extensive historical documentation.

The ultrastructure of mummified cells was discussed by Peter K. Lewin (University of Toronto). As part of a generalized study of the histology of mummified tissues, skin, muscles, tendons, and bones from an Egyptian mummified hand dating from about 400 B.C. were examined by electron microscopy to determine their state of preservation at the ultrastructural level. The electron photomicrographs are the first ever recorded from an Egyptian mummy, and although greatly shrunk, they show good preservation. Intact cells with cellular and nuclear membranes were demonstrated, as were some cellular cytoplasmic components of skin such as granules, mitochrondria, and tonofilaments. Red cells were also recognizable in the specimens.

The seminar closed with a general agreement that a Society of Paleopathology with its own journal was needed to provide coordination of effort among scientists in many different disciplines. As an interim measure, it was decided to provide a newsletter for communication among those active in the field until a journal can be established. The full mummy autopsy was recorded on color videotape. An edited 1-hour version of this tape will be made available to universities for teaching purposes.

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Bacterial Plasmids

The important biological role and widespread distribution of bacterial plasmids have become increasingly apparent. These extrachromosomal genetic elements have been identified in a wide variety of bacterial genera and species, and, despite their nonessentiality for the viability of their host organism, plasmids determine bacterial traits that are often crucial to the organism for adaptation to its environment.

Twenty scientists from the United States and nine scientists from Japan met for a 3-day conference on bacterial plasmids at the East-West Center in Honolulu, Hawaii, on 13 to 15 November 1972. The conference was sponsored by the U.S.–Japan Cooperative Science Program of the National Science Foundation and the Japan Society for the Promotion of Science. One of the pioneers and a guiding figure in the development of the field of plasmids, Professor Tsutomu Watanabe, died on 4 November 1972. In recognition of the fundamental contributions of Professor Watanabe, and as an indication of the esteem and respect with which he was held by the scientific community, the participants of this meeting dedicated the conference to his memory.

Particular emphasis at the conference was placed on the sex factor (F) of *Escherichia coli*, on colicinogenic (*Col*) factors, known to determine the production of antibiotically active proteins designated colicins, and on R factors, plasmid elements that closely resemble sex factors and carry genetic determinants for resistance to commonly employed antibiotics.

The fact that plasmid elements have been identified as covalently closed, circular duplex DNA molecules has permitted the application of density gradient centrifugation in the presence of dye for the isolation of these molecules from bacterial cells. Isolation of very large plasmid elements was considered by D. Freifelder (Brandeis University). Considerable attention was paid to the buoyant density and size of the various plasmid elements isolated by these techniques. There was agreement that *Col* factors and R factors with sex factor activity generally are found as molecules of relatively high molecular weight and are present to the extent of a limited number of copies per cell. Those plasmid elements lacking sex factor activity usually have a relatively low molecular weight and are present as multiple copies in the cell, although exceptions have been observed. The phenomenon of R plasmid dissociation into two circular DNA components, a self-transmissible circular transfer unit (RTF) component and a smaller circular (r) component carrying the antibiotic-resistant genes, has been described in *Proteus mirabilis*. Aspects of the dissociability of R factors into the RTF and r components and the preferential replication of the r component under conditions of growth of the bacterium in the presence of one of the antibiotics were discussed by R. Rownd (University of Wisconsin), H. Hashimoto and S. Mitsuhashi (Gunma University), and J. Punch (Medical College of Virginia).

The use of heteroduplexing techniques for the analysis of structural relationships of certain identifiable genetic regions in sex factors that have incorporated segments of the bacterial