Application of the Flotation Technique in Arid Areas

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The 1970 excavations at Tell el-Hesi, Israel, provided an opportunity (necessity) to adapt the flotation process to an arid area. While it is too early to present the findings of the research, a discussion of the process seems pertinent and, hopefully, will encourage more widespread use of the technique. Tell el-Hesi is located midway between Askelon and Beer Sheva in the northern portion of the Negev desert. Although there remains some discussion about its ancient name, the site is presumed to have been in the border area of ancient Philistia and Israel on a major trade route. Previous excavations of the site were by Sir Flinders Petrie (1) and Frederick J. Bliss (2) in the 1890's.

The flotation technique used was that of Dr. Stuart Streuver (3). Basically, Streuver's method simply employs relative specific gravity to separate organic material from soil, stones, etc. It has two primary advantages. First, it allows for the recovery of very small seeds, etc., that would be missed by even the most careful examination of dry soil as it is removed from the site and, secondly, it permits examination of relatively large quantities of soil. This allows for the recovery of information heretofore thrown away with the spoil. The process requires relatively simple equipment that may be manufactured by local craftsmen at nominal cost and, ideally, a source of running water. Sources of running water have been rivers, streams, irrigation works, etc. To a very limited extent tap water has been used to process small samples. The location of Tell el-Hesi precluded access to a traditional type of water supply. Also, because of vehicular logistics of the expedition, it was not feasible to transport the samples to a source of running water. Therefore, it was decided to attempt the construction of a flotation facility dependent on a once-daily supply of hauled water.

Basic necessary equipment included buckets with mesh bottoms. The buckets were fashioned from heavy galvanized metal, cylindrical, and approximately sixty centimeters in diameter and depth. Steel strap handles were affixed to one end and the other was covered with heavy-duty $\frac{1}{16}$-inch mesh screening reinforced by steel cross straps. Scoops were approximately ten centimeters square and four centimeters deep; they consisted of brass wire frames covered with brass carburetor screen. The exact dimensions of the buckets and scoops are not considered critical but approximate the optimum size for ease in handling. The $\frac{1}{16}$-inch mesh screen of the bucket was adequate to retain almost all of the heavier-than-water artifacts while allowing the sand and silt of the fill to wash through without undue clogging. The carburetor screen scoop proved a bit too fine for the soil characteristics of the Tell and could have been slightly coarser to prevent clogging. No serious inconvenience was experienced in this regard, however.

The water was supplied by a small trailer-mounted tank pulled by a Land Rover. Water was obtained from the irrigation works of a nearby citrus grove, located approximately ½ mile away and reached by a dirt road traversing various wadies and fields.

The flotation tank was constructed of veneer-covered pressed board 1 inch thick lined with light-weight galvanized metal. The basic dimensions of the tank were 1 meter high, 1 meter wide, and 2 meters long. A baffle of light-weight galvanized metal with two one-inch-diameter holes at mid depth was placed across the tank 1 meter from each end. Prior to filling with water the tank was reinforced on three sides by piling loose stone against it up to the top edge. The remaining long side, or

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working face, was reinforced using wooden braces providing two working areas slightly less than 1 meter square. The tank was set on the edge of a wadi located downhill from the excavation fields.

Processing of a typical sample began with removal from its context at the excavation. Samples were placed in a labeled goofas (a container fashioned from used automobile tires and holding an amount of fill that can be conveniently handled by one person) and carried to the flotation site. A whole or part goofa of fill, depending upon the consistency and condition of the fill, was placed in the bucket. The flotation process itself was carried out by submerging the buckets $\frac{3}{4}$ of their depth into the water and swirling the water within them by rapid back-and-forth movement of the handles. It was important to avoid any up-and-down motion of the bucket as this could cause small seeds to be carried out the bottom and lost. Agitation of the sample continued until the plant material was separated from the fill and washed essentially clean by the swirling action of the water within the bucket. Where running water is available this point is recognized by the clearing of the water inside the bucket. With this scheme the signal of completion was weight and the rattling of small stones. Then, the swirling was stopped and the floating and suspended materials were scooped out. The swirling and scooping were repeated for each sample until all floating and suspended materials were removed. As long as there was no splashing and the rim of the bucket remained above the water surface, a given sample within the bucket remained free from contamination from other samples.

The light or scoop fraction was placed on newspaper, covered by a sheet of damp newspaper to prevent too rapid drying, and allowed to dry in the sun. (Streuver's method provides for further treatment of this fraction to separate bone and plant by floating in $ZnCl_2$. We found this unnecessary as very few small light bones were encountered.) The heavy fraction that remained on the screen in the bucket was placed on a plastic sheet and dried in the sun. The heavy fraction was then examined for possible artifacts or bone fragments and to be sure that all carbonized material had been removed. The unwanted portion was then discarded. The light fraction was inspected and packed in paper toweling and placed in boxes for shipment to the laboratory for examination and analysis. Any absorbent, protective material could have been used in drying the light fraction; newspaper was used because it was readily available and inexpensive. The heavy fraction could also have been dried on any convenient material that was durable enough. The plastic sheeting, like the newspaper, was readily available and inexpensive. The tank proved adequate for processing reasonable amounts of fill, and its capacity was not exceeded during the 1970 excavations at Tell el-Hesi. Periodic pauses in operation were necessitated by excess foaming in the tank and to allow the accumulated silt in the bottom of the tank to be shoveled out. The foaming was somewhat alleviated by the addition of kerosene as a surfactant. Removal of settled silt from the bottom of the tank was dependent on the amount of fill processed. The baffle in the tank made the operation much easier as it reduced turbulence, and thus foaming, and allowed silt removal from one section while the other was in use.

The actual operation of this system suggested two modest improvements: For easier removal of the silt a "thief" (bottom constructed with about $\frac{1}{3}$ pitch leading to centered outlet) should be incorporated, and to conserve water coupled with a settling tank constructed by digging an appropriately sized hole and lining it with sheet plastic. The water may be returned from the settling tank to the flotation tank by a semirotary hand pump.

In summary, the flotation process is adaptable to almost any excavation site, even arid desert areas, with inexpensive locally obtainable equipment. The author's experiences involved applications of the technique in Israel, Turkey, and the U.S.A. in a variety of climatic areas during various seasons. In every case slight common-sense modification of Dr. Streuver's technique has provided excellent results. In view of this it is felt that the minimal

cost is not significant when viewed in perspective to the added invaluable dimension of botanical and ethnic evidence that almost certainly is missed unless the flotation process is employed at an excavation.

Literature Cited

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