Comments on Maltese 'cart tracks' ('cart ruts')

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The following comments have been inspired by a personal inspection of 'cart tracks' south-east of Dingli in September 1999, a summary of related investigations (Evans, 1971) kindly provided by the Curator of the Archeological Museum in Valletta, Mr. Reuben Grima, and a handout obtained on location from Mr. N. J. Bonello, containing his notes on Dingli and its surroundings (Bonello, 1999). The latter source will be dealt with first since, being the latest, should reflect the current thinking about the tracks.

Bonello (1999) notes.

We read in this document that "Historians believe that they date since the Bronze Age which means over four thousand years ago. The most probable theory is that they were formed by sledges to which two hard-rock runners were tied. These sledges were drawn by strong animals, such as oxen, as a kind of transport." The handout includes a sketch of the supposed 'stone runner' which has been approximately reproduced here in Fig.1.

I am not qualified to comment on the supposed age of the tracks and would just note that Evans (1971) cites four different opinions: (1) Zammit, who believed them to date from the Neolith, (2) Fenton, governed by the idea that they were made by large wheels, dates them to about 700 A.D., (3) Boule suggested the early Iron Age (early part of the first millennium B.C.), and (4) Gracie who generally agrees with Boule. Evans himself suggests that some aspects of Gracie's research point to the date around 1400 B.C. Since Fenton's date is tied to the idea that the tracks were made by wheels (which is extremely unlikely - see later) his date can be disregarded, so that the age between Evans' 3400 to "over four thousand years" appears to be the prevailing opinion. The only comment I would make is that even a significantly earlier origin of the tracks would be consistent with my suggestion of their 'construction' to be discussed later.

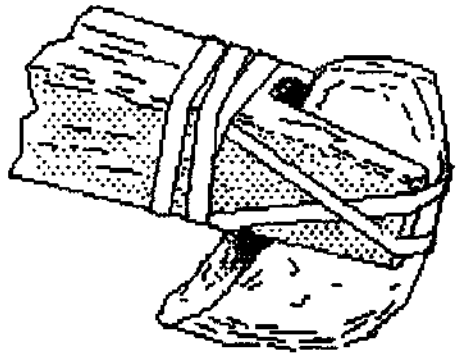


Fig.1. *"Stone-runner" pictured in Bonello (1999).*

Given the plausible assumption shared by most authors that the tracks were made by some vehicles used for transport, and bearing in mind that workers engaged in this transport, rather than devising ways how to make their job more difficult than necessary, most likely tried to make it as easy as possible, I am utterly sceptical regarding the "most probable theory" about the nature of these vehicles as cited by Mr. Bonello. The reasons for my scepticism are as follows:

1) The virgin terrain was (and still is) formed by limestone with an extremely rough and jagged surface. **Initially, before any tracks existed**, the vehicle, whatever it was, would have to be pulled across this terrain. Stone-runners such as shown in Fig.1 would have been the most ingenious hindrance in making a sledge move across such terrain. The runners would get repeatedly stuck, one or the other end of the sledge would have to be frequently lifted to get it moving, which, given its presumably heavy load - say, 100 to 200 kg (lighter loads would be more easily carried by people, either solo in baskets or bundles on their backs or heads, or in pairs using stretchers) - would be quite a hard and frustrating work. Moreover, under the jerky movement (which would be extremely hard on the draught animal), the ties of the runners would tend to get loose, or break, and the runners would fall off. The only circumstance under which I can imagine the 'stone-runners' to be employed at the initial stage would be if the purpose of the sledge, rather than transport, was the carving of the tracks. However, even this job would be more easily done without a sledge, just with a hammer and chisel.

2) The 'stone-runners' would be equally impractical in the **final stage** when the tracks are fully formed and relatively deep - say 25 cm or deeper. In this case the major hindrance would probably be the rubbing of the heels against the side walls, which would cause the runner ties (presumably made of leather straps or similar) to disintegrate in no time, notwithstanding the fact that, given its maximum thickness of about 10 cm (Gracie gives typical width of the rut as "about 2½ in at 1 in above the lowest point" - see Evans, p.202), the heel would not be strong enough to support a runner in a groove as shown.

3) The stone-runners would function relatively 'best' in well-formed, straight, and relatively shallow tracks, i.e. in an **intermediate stage**. But it is here where their unreasonableness would be most readily exposed. The point is that, out of the materials available for the runner to the stone-age, or even bronze-age, man' - stone, wood, or metal - the **friction between the runner and the stone surface of the track would be highest for a stone-runner**, followed by a metal one, and **lowest for a wooden one**. For comparison, typical friction coefficients are as follows (Van Nostrand's Sci. Encyclopedia, 1968, p. 730):

stone on stone..... 0.65
iron on stone 0.50
wood on stone ..... 0.40.

This may not be known to some modern 'theorists', but it surely was clear to stone-age labourers, as it is to anybody who has ever tried to drag a heavy stone over a stone, concrete, brick, or dry-asphalt pavement: the easiest way to do it is to put wooden planks under the stone and drag either the stone or the planks. For a real-life example, see Fig. 2 showing the author while building stone terraces in his garden in the early 1990s.

To summarize, the 'theory' that the tracks were formed by sledges equipped with 'stone-runners' can be safely discarded.

Evans (1971) survey.

I agree with Evans (p.203) that "Gracie's solution [that the tracks were made by **slide cars**] is probably the right one". As a background for my reasons for favouring the slide car, it is instructive to summarize the arguments against wheeled carts, some (but not all) of which are stated in Evans' review:

Fig.2. *The author moving a heavy stone over an 'uneven concrete terrain'.*

(a) Wheeled carts could not reasonably be used to start the tracks on the virgin terrain, given its extremely rough and jagged surface - the cart would break down in no time and, even if it did not, it could hardly follow exactly the same (and relatively straight) course to start a track.

(b) The changing width of the tracks (up to about 15 cm) would require at least one of the two wheels on the same axel to be able to slide along it. That means a construction deliberately designed with a changing track-with in mind. Such a complication would hardly have been contemplated when the cars were first built and when no tracks yet existed.

(c) As Zammit assumed (p.202), the use of wheels would have required first to start the tracks deliberately "by notching the rock so as to give a guide to the route to be followed". Given the laboriousness of such undertaking, and considering the difficulty of constructing - in the stone (or early bronze) age - such a relatively sophisticated structure as a wheeled cart itself, the incentive would have been to develop (and maintain) a rather permanent and coordinated network of tracks, rather than make them in a haphazard manner and in the profusion in which they are found.

The last argument can be used as a convenient starting point for the support of the slide-car proposition. Given the profusion and haphazard locations of the tracks, **it must have been easy to start them**, it must have been easier to start a new route than to use an old and well-worn one if the latter was either longer, or if it required some elaborate modification of the cart (e.g., due to a large depth of the old track - see later), or if it were inconveniently distant from the location of the material that had to be loaded and transported.

In my opinion, this condition would best be satisfied if the 'cart' consisted of a platform supported by two more-or-less straight sections of tree trunks (or bigger branches) stripped from the bark and, perhaps, with stumps of the side-branches left at the ends as an aid for supporting a platform and for attaching a rope or shafts for pulling the cart. An example of such an arrangement is sketched in Fig.3a.

Such a cart, **initially functioning like a sledge,** (i) would easily bridge cracks and bumps on the terrain (Fig.3a); (*ii*) the pulling action would tend to lift its front end thus making it relatively easy to surmount obstacles; (iii) the lifting of the front would shift the weight of the load towards the rear end, so that the ends of the shafts would start tracing tracks in the ground as shown in Fig.3b; (iv) with the track depth reaching and exceeding the thickness of the runners, the front end of the cart would have to be lifted progressively more, so as to keep the bottom of the platform above the terrain - at that stage it would become advantageous to keep the front end raised permanently, which would be done most simply by using longer poles with longr heels for the platform support and attaching their front ends directly to the harness of the draught animal thus making the **transition to a proper 'slide car'** as shown in Fig.3c (the inclined platform may then have required some adjustment at the rear end to prevent the load from falling off); (v) this arrangement would accelerate the deepening of the tracks in two ways: firstly, by concentrating the whole load-weight in one point (as compared to the 'sledge' stage where it is distributed over several points of contact) the friction would be increased, and, secondly, the grinding action would be intensified owing to the fact that stone debris, sand, soil, etc., inevitably littering the ruts, would be pressed against their bottom by the trailing ends of the poles thus spontaneously simulating the common practice whereby diamond, corundum, or other hard-rock sand is used to increase the abrasive efficiency of polishing, carving and drilling tools when working with hard materials.

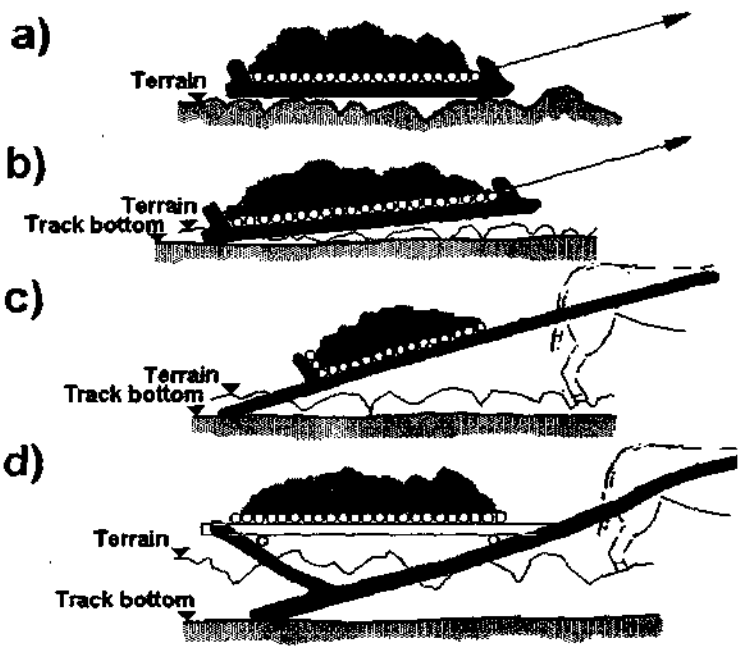


Fig. 3. *Suggested evolution of 'transport vehicle' and of the formation of cart tracks by its use.*

It is easy to see that such vehicles would be easy to construct since the platform - made of smaller branches - would also function as cross-struts, while the structure - being tied together with ropes or leather straps - would be flexible enough to adjust to some variation of the track width. Such vehicles would also be easy to repair by simply replacing a broken shaft or, if only

the heel were worn out, tying a few-feet long pole (perhaps of harder wood) to the old one. This ease of repair (or strengthening) of the heel would also dispense with a need to "shoe" it as suggested by Evans (this would not be a simple task anyway, given the primitive tools of the stone age).

The growing depth of the tracks would require to raise the cart platform to progressively higher positions, which would call for a strengthening of the construction, perhaps by adding cross-struts or making other more demanding adjustments (Fig.3d). Eventually, a point would be reached where starting a new route on virgin terrain as described above would be easier than constructing more elaborate carts needed for the old deep tracks.

Two additional points come to mind:

1) Zammit is cited as advancing a suggestion that the tracks "run predominantly from the valleys up to the heights..[and were used for] the carting of soil up from the valleys to make fields on the heights...". This led him to a logical assumption that the "bifurcations [were] deliberately made shunts" (p.202). The more likely interpretation is that the tracks run predominantly ***from the heights down to the valleys***, i. e. that they were used for downhill transport of materials. In such a case, the 'shunts', rather than artificially constructed to facilitate track *divergence*, would form naturally by several tracks *converging* into one (as can be seen, say, on the west side of the Dingli site) that led to a place where the materials were needed. Such could be the case if, for instance, stone for the building of dwellings in a settlement were transported from different quarries on the heights. Moreover, such convergence would create no problem even if the use of individual quarries were separated by long periods of time and new shallow tracks merged with old deep ones - this would hardly be feasible in case of divergence, especially in an up-hill direction.

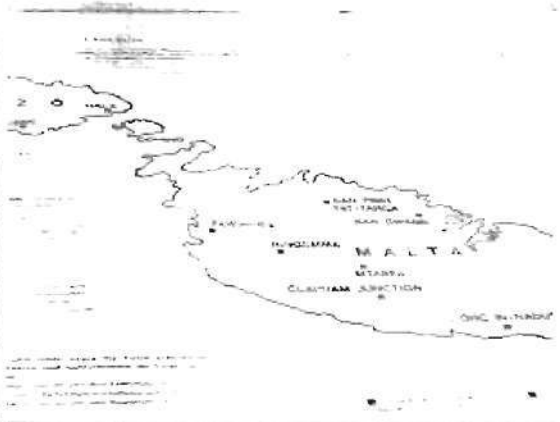
2) It seems to have been taken for granted that the carts were always driven by 'strong animals'. However, there is nothing to exclude the possibility that they were driven by people. Three to five adults could easily handle a load of, say, 150-200 kg, so that the carting could well have been a 'family enterprise'. If this possibility is allowed, the 'carting business' could have been much more widely practiced than would be the case if it were restricted only to those who owned draught animals. This would help explain the profusion of the tracks.

While all this is just speculation, I think the described evolution accounts rather well for all the observed facts, from the abundance of the tracks to their mergers, varying width and depth, and the haphazard cris-crossings of their routes.

References

Bonello, N. J. (1999). *Dingli and its rurroundings*. Notes compiled by N.J. Bonello, "Fatima", Busket Road, Dingli, Malta (unpublished).

Evans, J. D. (1971). *The prehistoric antiquities of the Maltese islands*. Chapter on "The Cart Tracks" (pp. 202-204), University of London, London.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