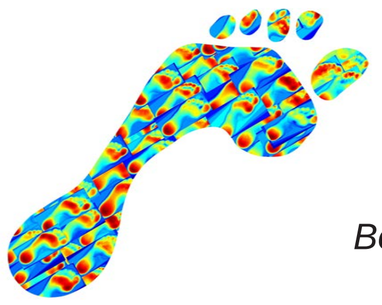
Human Tracks: What Can They Tell Us?



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ABSTRACT

This poster provides a general introduction to the study of human tracks and gives you a flavour for some of the things that tracks can proivide information about, as well as outlining some of the research that Professor Bennett and his colleagues have been undertaking over the last three years. The work was funded by a grant from the Natural Environment Research Council (NERC) which finished in September 2013. During this time the team have published over a dozen research articles on human tracks and developed new tools and methodologies. Much of this work is summarised in Professor Bennett's forthcoming book on human tracks.

Bennett MR and Morse SA (2014). *Fossilised Locomotion: What can footprints tell us?* Springer.

What can tracks tell us?

Both ancient and modern human tracks contain lots of information, they can tell us about: (1) human presence in the past, what people were doing and where they were going; (2) they can tell us about the body proportions of ancient track-makers; (3) we can use a series of tracks to work out how fast someone was walking and also the biomechanics of that locomotion; and (3) at modern crime scenes human tracks may help reconstruct the sequence of events and in some cases link a suspect to a crime.

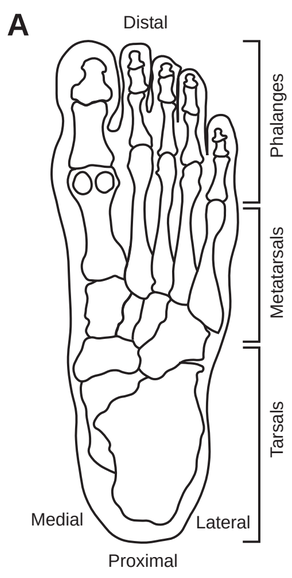
The pattern of human gait follows a stereotypical pattern. First the heel hits the ground (heel-strike), leaving a rounded impression. As the centre of mass shifts forward the subject's weight moves forward along the lateral or outside edge of the foot. In the latter stages of stance weight shifts towards the medial side of the foot moving across the ball and the subject toes-off using the first two toes as flucrum. But did our ancestors walk in the same way? Some researchers think they did while others think that they walked as we do today. This is just one of the questions that Professor Bennett has explored over the last few years.

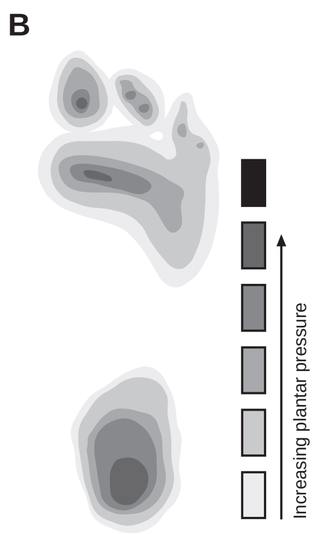
To understand the record of 'fossilised locomotion' contained within a series of tracks one must understand how the substrate over which the track-maker walked may have influenced both their gait - think of how you walk differently on an icy or muddy surface compared to a solid one - and the morphology (topology) of the track itself. Ancient fossil footprints occur in lots of different geological environments and are preserved in river muds, on the shores of lakes, in coastal lagoons, in deserts and in volcanic ash. All of these environments are different and if we are to compare them then we need to understand how substrate may control track topology. This is also one of the questions that Professor Bennett has been studying over the last few years.

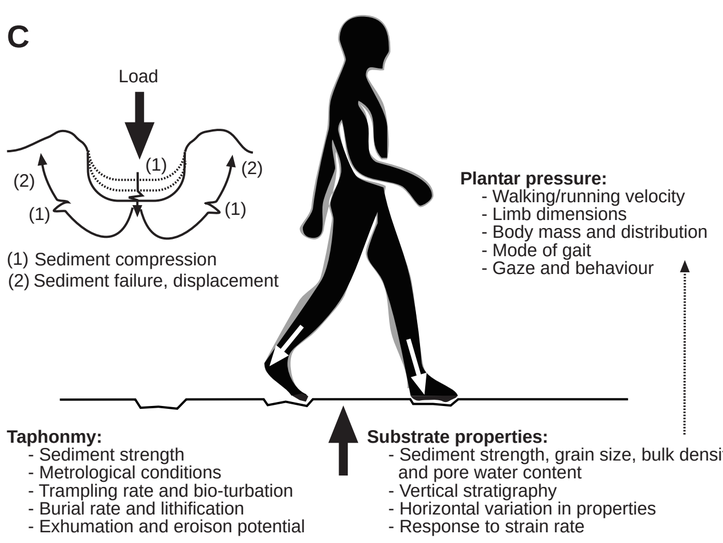
The relationship between the pressure we apply through our feet (plantar pressure) and the depth of a track is central to this work but is not a simple one. Professor Bennett and his colleagues have conducted lots of experiments at the beach and using pressure senstive treadmils to understand these relationships. In fact the relationship is very sensitive to track depth and the best tracks for recording biomechanical information are shallow ones left in firms substrates.

The size of your feet changes as you grow older and in proportion to your overall body size, in particular your height. It is possible to develop emperical (statistical) models that allow one to predict the stature of a track-maker from the size of their tracks, this can help archaeologists to say something about the population who made the tracks but also in some cases to identify which parts of a community did certain tasks. For example, most human tracks associated with herds of livestock tend to be those of children, young adults and women. Human tracks may also allow one to say something about body mass and understanding how the topology of a track changes with body mass is important and also has implications for the study of obesity in modern humans.

The study of human tracks is an example of geoarchaeology, the coming together of the geological and archaeological sciences. Geoarchaeological principles can be used at modern crime scenes and much of this work has relevance to forensic science both in the UK and overseas. While most people are habitually shod in developed countries, many people still go unshod in large parts of the World either for climatic or socio-economic reasons. Barefoot impressions are a common feature of crimes scenes in other countries.



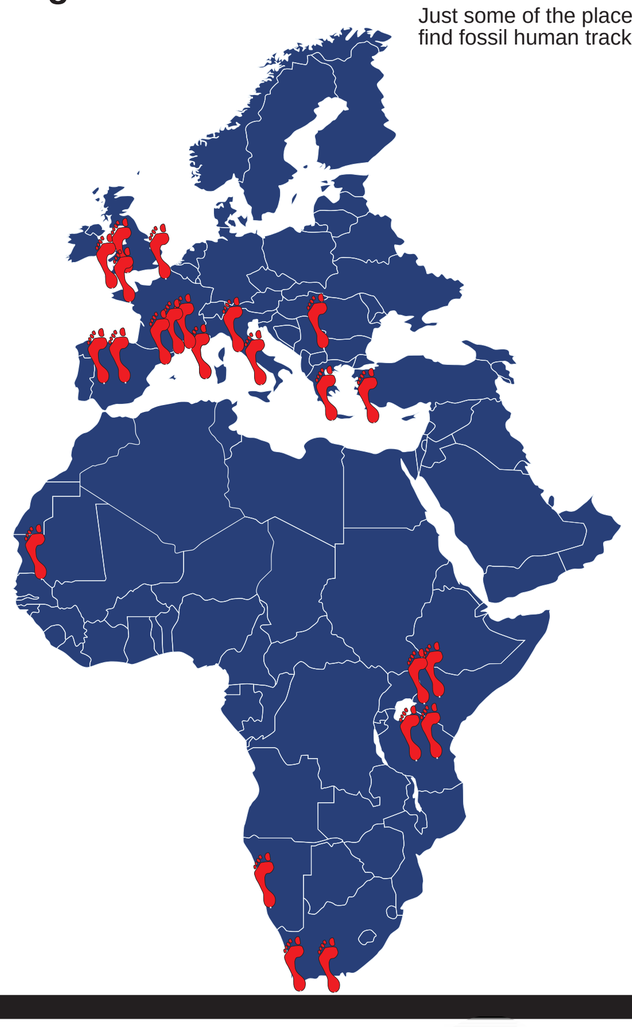




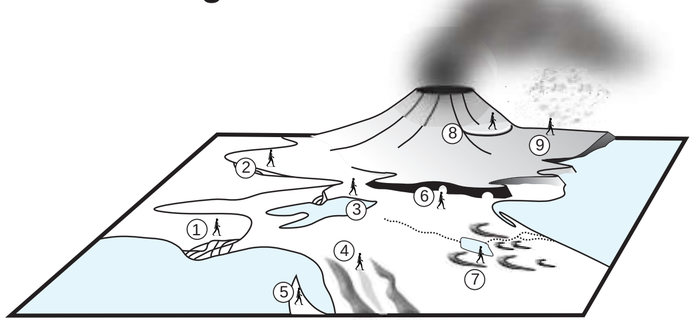
The top left diagram shows the main bones of the foot; top right shows a typical pattern of plantar pressure applied during normal walking. The bottom diagram lists some of the variables at play in the formation and preservation of a human track. Taphonmy is the study of fossilisation; in this case the fossilisation of a human track.

Finding Tracks

Just some of the place you can find fossil human tracks

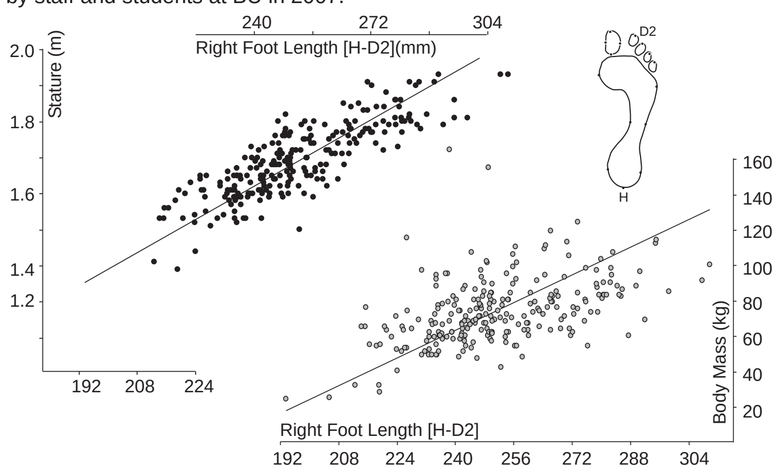


Track Forming Environments



Characterising the Track-maker

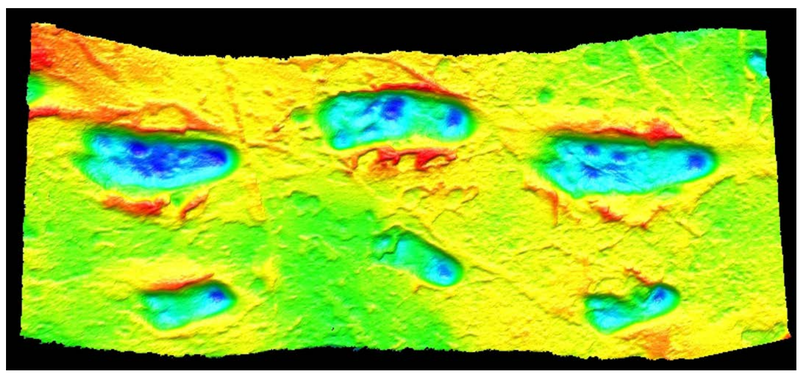
A number of emperical relationships have been found that link foot dimensions to those of the body. These vary and are dependent on the population on which they are based; i.e. they are population specific. This is can be challenging for the geoarchaeologist who examines the 'unknown' track; which is the correct empirical model to chose? How representative is it of the track-maker? Notwithstanding these issues inferences on stature are frequently made. The relationship shown below is based on an emperical model developed on the basis of data provided by staff and students at BU in 2007.



The tracks below are based on means for each weight catergory and show how track topology varies with weight. Further work is needed to develop this type of inference but variations clearly do exist as one would expect.

Oldest Tracks

The oldest hominin tracks in the World are dated to 3.66 Ma and are found at a place called Laetoli in Northern Tanzania. The tracks were deposited in volcanic ash. There are two parallel trackways at Laetoli made by three individuals, one of which walked in the footsteps of a previous track-maker. The tracks were first discovered in 1978/79 and have caused lots of scientific controversy since. They were probably made by *Australopithicus aferensis* (Lucy) and some believe that this ancestor walked in a different way to us, with bent knees and bent hips. Others believed that the tracks were made by someone walking upright like we do today. Below an optical laser scan of part of the trackway is shown. The site is now buried in order to conserve it.



In 2009 Professor Bennett and colleagues published the discovery of a new hominin footprint site close to the village of Ileret in Northern Kenya. This site has been dated to 1.5 Ma and the tracks are believed to have been made by Homo erectus, the first hominin to migrate out of Africa. The tracks are preserved in silts and fine sands deposited by flood waters and have been excavated out of an eroding bluff as shown below.

Substrate and Track Topology

Substrate has a major influence on track topology and has to be factored into any intepretation of a track. The trackway shown below illustrates how topology varies with increasing water content of the sediment. As illustrated by the pictures below sediment properties - grain size, moisture content and bulk density - all have a role to play in determining the topology of an individual track.

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