outwards[12]. But these models seem to have difficulty in explaining the observed levels of transport[13]. Vinković[5] proposes a transport model based on the non-radial component of the radiation-pressure force. He shows that the radiation pressure from the star, combined with that from the disk's near-IR light, could push grains outwards along the disk's surface irrespective of its curvature.

But Vinković's theory is valid for micrometre-sized dust grains, and crystalline-silicate grains that big cannot emit much light at their characteristic mid-IR wavelengths. If only micrometre-sized silicate crystals were transported to the outer disk regions, neither protoplanetary disks nor comets would exhibit the observed sharp emission features of crystalline silicates. It would be interesting to see whether other mechanisms such as turbulent mixing and the 'X-wind' model would effectively carry submicrometre grains, which are efficient mid-IR emitters, outwards and incorporate them into comets. It is also possible that some — but not all — crystalline silicates are made *in situ* in cometary comae[14]. ■

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ARCHAEOLOGY

Origins of the female image

Paul Mellars

Discovery of the sexually explicit figurine of a woman, dating to 35,000 years ago, provides striking evidence of the 'symbolic explosion' that occurred in the earliest populations of *Homo sapiens* in Europe.

On page 248 of this issue[1], Nicholas Conard describes an archaeological discovery of considerable significance — arguably the world's oldest depiction of a human figure, carved in impressive detail from a solid piece of mammoth ivory, and only 60 millimetres long. The find (Fig. 1) is remarkable for several reasons.

Fragments of the figure were excavated from archaeological deposits in the Hohle Fels cave in south Germany, dated by a range of more than 30 radiocarbon measurements to at least 35,000 years in age (in terms of the newly 'calibrated' radiocarbon timescale). They were recovered in association with characteristic stone, bone and ivory tools belonging to a period, the Aurignacian, that represents the earliest settlement of Europe by fully anatomically and genetically modern human populations, and which saw the simultaneous demise of the preceding Neanderthals[2,3]. And the figure is explicitly — and blatantly — that of a woman, with an exaggeration of sexual characteristics (large, projecting breasts, a greatly enlarged and explicit vulva, and bloated belly and thighs) that by twenty-first-century standards could be seen as bordering on the pornographic. As if to emphasize the sexual characteristics, the figure's arms and legs are severely reduced in size, and the 'head' has been reduced to the form of a carefully carved ring, evidently to allow the figure to be suspended from a string or thong.

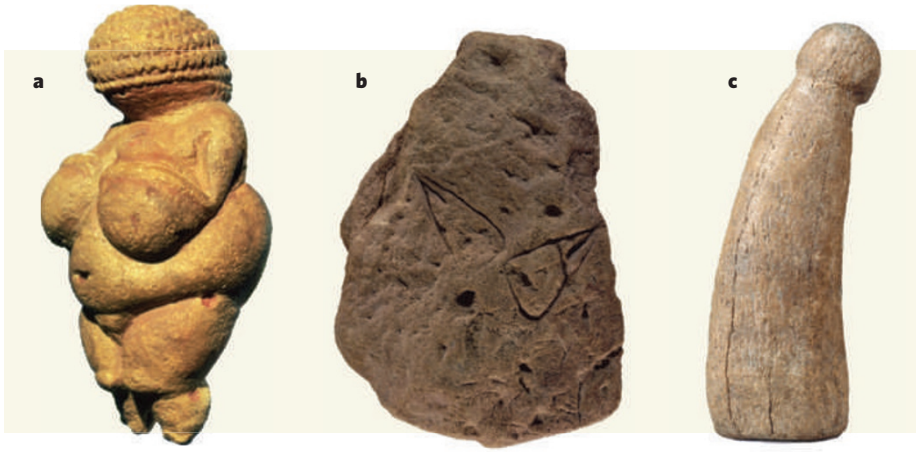
H. JENSEN/UNIV. TÜBINGEN

Figure 1 | A 35,000-year-old sex object. The newly described[1] Aurignacian figurine, 60 millimetres in height, viewed from different angles.

This find is the latest discovery in a veritable art gallery of early 'modern' human art recovered over the past 70 years from a series of cave sites located in the Schwabian region of southern Germany, only a short distance north of the Danube valley[2,4] — the route by which the earliest populations of *Homo sapiens* probably penetrated central and western Europe[3]. Four sites in this region have now produced a total of 25 small carvings, all made from mammoth ivory and depicting various forms ranging from superbly sculpted mammoths and horses, through bison and cave lions, to elegant bird-like forms, and two curious half-animal, half-human ('therioanthropic') figures[2]. The same sites have also yielded numerous small, carved ivory beads or pendants and the world's oldest unmistakable musical instruments: these take the form of perforated flutes manufactured from segments of bird wing bone and meticulously conjoined segments of mammoth ivory[4]. As a reflection of the artistic creativity of the earliest *H. sapiens* populations in Europe, this collection of south German material is currently unique.

What makes the German finds especially remarkable is their emphasis on fully in-the-round sculptures (figurines), frequently embellished with enigmatic, evidently symbolic, markings. Such markings take the form of criss-cross designs or (in the case of the newly discovered figure) repeatedly incised lines that might conceivably represent schematic depictions of skin clothing[2]. Other kinds of art forms have been known for some time from broadly contemporaneous sites in western and southern France, including — most spectacularly — the highly sophisticated drawings of horses, bison, deer, rhinos, cave lions and other animals in the Chauvet cave in southeastern France. The drawings were discovered in 1994, and dated by radiocarbon-accelerator measurements of the charcoal actually used to make the drawings to approximately 36,000–37,000 (calibrated) years ago[5]. Possibly slightly earlier in date are several paintings executed in red iron oxide on limestone slabs from the Fumane cave in northeastern Italy — including one figure that has been interpreted as an apparently quasi-human figure with animal-like horns[6]. But the cornucopia of small, carved ivory statuettes from the south German sites must be seen as the birthplace of true sculpture in the European — maybe global — artistic tradition.

The feature of the newly discovered figure that will undoubtedly command most attention is its explicitly, almost aggressively, sexual nature, focused on the sexual characteristics of the female form. As Conard[1] points out, this figure is strongly reminiscent of the later,



A. BRIDGEMAN ART LIBRARY; B. P. JUGIE/MNP, LES EYZIES, DISTR. RMN; C. RMN

Figure 2 | Sexual images in early *Homo sapiens* European art. a, A 'Venus' figurine from Willendorf, Austria, 105 millimetres in height and dated to about 28,000 years ago. Note the similarities to the older figurine from Hohle Fels, described by Conard[1] and shown in Figure 1. **b**, Female 'vulvar' symbols carved on a limestone block from the La Ferrassie rock shelter, southwest France, dating to about 35,000 years ago. **c**, A phallus, carved from the horn core of a bison, from the Blanchard rock shelter, southwest France; the carving is about 36,000 years old and is 250 millimetres long.

well-known 'Venus' figurines recovered from a range of sites stretching from the Pyrenees into southern Russia, and associated with the subsequent Gravettian toolmaking cultures. These figurines are dated to between about 29,000 and 25,000 years ago, and most of them show a similar exaggeration of the sexual characteristics and a curious downplaying of the arms, legs and heads[2,7] (Fig. 2a). The extension of this obsession with female characteristics back to at least 35,000 years ago should perhaps not come as any surprise, because explicit representations of female 'vulvar' symbols had already been recorded from a number of early Aurignacian sites in western France, all incised on blocks of limestone, and again dated back to at least 35,000–36,000 years ago[2] (Fig. 2b). Interestingly, this sexual-symbolism aspect of the art is effectively symmetrical, as the same sites have yielded equally explicit phallic representations, carved out of bone, ivory or (in one case) the horn core of a bison (Fig. 2c). The possibility that these could represent 'girls' toys' (as one first-year student once hesitantly expressed it) should perhaps not be dismissed.

Whichever way one views these representations, it is clear that the sexually symbolic dimension in European (and indeed worldwide) art has a long ancestry in the evolution of our species. To some, this has often been taken as a possible reflection of fertility beliefs, designed to ensure the continuity of life in both the human and animal realms[8]. The archaeologist and ethnographer André Leroi-Gourhan interpreted the whole of European cave art during the Upper Palaeolithic, roughly 40,000 to 15,000 years ago, in terms of a dualistic, 'structuralist' reflection of the opposition of the sexes[8]. Other workers, such as David Lewis-Williams, have seen the same symbols as possible elements in shamanistic rituals and beliefs[9].

From an evolutionary perspective, of course, the most striking feature is the sudden eruption of all these forms of artistic or other explicitly symbolic creations with the arrival of the earliest *H. sapiens* populations in Europe, and the shortly ensuing demise of the pre-existing Neanderthal populations of the continent[3]. We know that these modern populations came into Europe from Africa, where they had originated much earlier and where early forms of symbolic expression have been found as abstract, geometrical designs engraved on pieces of red iron oxide extending back to at least 75,000, and possibly 95,000, years ago[10]. But the advent of fully representational, 'figurative' art seems at present to be a European phenomenon, without any documented parallels in Africa or elsewhere earlier than about 30,000 years ago[11]. How far this 'symbolic explosion' associated with the origins and dispersal of our species reflects a major, mutation-driven reorganization in the cognitive capacities of the human brain — perhaps associated with a similar leap forward in the complexity of language — remains a fascinating and contentious issue[12,13]. ■

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NATURE

50 YEARS AGO

A recent issue of the *Australian Museum Magazine* is devoted almost entirely to New Guinea ... The physical geography is described by D. F. McMichael and the geology by G. A. U. Stanley. J. S. Womersley discusses the vegetation of the island, while other contributors provide details about the mammals, birds, fishes and insects. Until the early 1930's it was thought that the central region of New Guinea was uninhabited and uninhabitable. Since that time it has become known that about 600,000 people live in the Australian territories alone ... This issue is also of interest for its reference to the discovery of a rare animal in Australia, the potoroo (*Potorous tridactylus*). This animal, which is related to the rat-kangaroos, is now rare in New South Wales, not having been recorded in the State since 1913. It is still common in Tasmania. The specimen obtained by the Museum was killed by a dog near Gosford, New South Wales.
From *Nature* 16 May 1959.

100 YEARS AGO

In the April number of *Das Blaubuch* Dr. T. Zell discusses the question whether animals take advantage of experience and become cleverer than their parents, the question being answered in the affirmative. Among numerous other instances mentioned by the author, reference may be made to the following. From early times it has been noticed that vultures have learnt to accompany armies in the field, for the sake of the prospective feast after a battle. Killer-whales accompany whaling-vessels, and gulls do the same ... Birds and quadrupeds have learnt to take no notice of railway trains, as have horses of motors, and nowadays many fewer birds immolate themselves by flying against telegraph-wires than was formerly the case ... Sheep-dogs, again, know by experience that it is only the members of their masters' flocks that it is their business to collect.
From *Nature* 13 May 1909.

50 & 100 YEARS AGO