but assumes a central role in scene 3 (not discussed here for reasons of brevity).

Lastly, *another peripheral association*: At the time of the dream, my second son had a long-standing and worrying problem with his hearing. As a result, he found noisy surroundings intolerable. In scene 2, the house is under construction. (Actually, in the U.S. holiday, it was the bridge, not the house, that was under construction.) The new bridge was being constructed from concrete. Sand is a component of concrete. When I stood below the new bridge, I experienced the irrational fear that I described earlier. From the perspective of my second son, the U.K./U.S. house would be a bad buy because construction work would render it too noisy. As with the sand theme, this "damaged hearing/ear" theme continues into scene 3 as the baby/child lands on his/her ear before disappearing into the sand.

From the perspective of waking consciousness, these four memories are dissociated. A stop to photograph bridges during a holiday, a phone call from my eldest son about a possible house purchase, quicksand, and my second son's hearing problem seem to have little in common. But associations can be identified. The first is place – the first two memories feature a house positioned "on the edge of town." The second is an emotion – fear. During the stop to photograph bridges, under the new bridge I experienced a fear that I told myself was irrational. Similarly, on hearing about the house in which someone had died, I felt a fear that I tried to dismiss as illogical. My childish fear of quicksand was confused; it focused on the "wrong" type of sand. My son's hearing problem was worrying, but, at the time of the dream, the cause was unknown despite rational investigation. So these four fears shared a common feature – they defied logical analysis. Fear seems to drive the dream plot so that in scene 2 the feared object is the house/bridge under construction. Someone had died in the house – this association engenders the cloth–shroud association. The construction association seems to elicit both "sand" and "noisy," which then associate to quicksand (which I feared as a child) and my second son's hearing problem, about which, at the time of the dream, I was fearful. Thus, scene 2 creates a nexus of associations initiated by place/fear.

Open Peer Commentary

The analogy between dreams and the ancient art of memory is tempting but superficial

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Abstract: Although the analogy between dreams and ancient mnemotechniques is tempting because they share several phenomenological characteristics, this analogy is superficial at a closer look. Unlike mneomotechnically encoded material, rapid eye movement (REM) dreams are inherently difficult to remember, do not usually allow conscious subsequent retrieval of all interconnected elements, and have been found to support subsequent episodic memory in only rare cases.

First, we would like to emphasize that we do agree with the author on several points of her theory: During dreams, fragments of both recent and remote experiences reappear, in particular emotionally relevant ones; the seemingly bizarre links between these dream elements may actually be explained by idiosyncratic semantic networks (which can be revealed, for example, through psychoanalysis or other techniques); and there is good evidence that rapid eye movement (REM) sleep supports subsequent memory retrieval of emotional events (e.g., Nishida et al. 2009). Furthermore, on a phenomenological level, dreams do share several characteristics with ancient art of memory (AAOM) mnemotechniques: Both are hyperassociative – that is, they connect individual contents through rich networks of links (which for mnemotechniques increases the number of cues which make these contents accessible) – and these associations may appear random and bizarre on the first sight but actually serve a hidden logic.

Despite this apparent similarity between dreams and mnemotechniques, we argue that dreams are unlikely to function as effective mnemotechniques. The ultimate goal of mnemotechniques is to improve memory, but dream memory is deficient compared with memory for waking experiences (Hobson et al. 2000). Not only are dreams remembered rarely, but dream memories also typically contain much less detail than does memory for experiences acquired during waking state. This may be due to various psychological factors, including the apparent strangeness of dreaming experience (which impedes subsequent recall; see Bartlett 1932), as well as due to physiological factors such as the low level of functional EEG connectivity in brain regions that are crucial for declarative memory (Fell et al. 2003). A mnemotechnique that sets individual memory contents into a framework that is inherently difficult to remember is paradoxical. (Imagine a device for motor control that renders your movements random and uncontrollable.)

It could be argued that while dreams themselves are difficult to remember, they support the consolidation of their constituents; in principle, an efficient mnemotechnique does not require that the entire connection of various items be remembered, but at least that the individual items within this connection can be easily accessed and therefore better remembered. Indeed, this seems to be what the author has in mind when she hypothesizes that "[i]f hyperassociative dream scenes do encode episodic memories and these scenes are retained as hippocampal indices, these are non-conscious phenomena used, in normal wake, to 'search' for memories in cortical networks" (sect. 5.1, para. 1). Thus, the idea is that dreams trigger subsequent retrieval of parts of the episodes that are retained in them through nonconscious processes. Even if this is the case, the parallel to mnemotechniques is at best remote – mnemotechniques are used to support conscious recall of entire fictitious or real memory episodes, not to trigger memory unconsciously for individual constituents of these episodes.

But leaving this aside for now, what is the empirical evidence for a role of dreams in episodic memory consolidation? It is well established that non-REM (NREM) sleep (Plihal & Born 1997) and NREM mentations (Wamsley & Stickgold 2010) support later retrieval of declarative memories. REM sleep appears to play a more prominent role for subsequent memory of emotional memories (Wagner et al. 2001) and procedural memories (Plihal & Born 1997), although evidence is mixed in this respect because a recent study suggests that pharmacological reductions of REM sleep facilitate the consolidation of motor sequences (Rasch et al. 2009). Evidence for a role of REM dreams in the support of later retrieval of episodic memories is extremely scarce (Cipolli et al. 2005; Fiss et al. 1977).

Finally, the physiological order of REM sleep and NREM sleep is inconsistent with the proposed model. The author suggests that "elaborative encoding of episodic memories during REM dreaming may be followed by the instantiation of episodic junctions during NREM" (sect. 8, para. 1). However, REM sleep usually follows NREM sleep – the first REM episode usually occurs at the end of the first sleep cycle, and generally there is more REM sleep in the second half of night and more NREM sleep

in the first half of night. Thus, the physiological order of REM sleep and NREM sleep would rather suggest another sequence of processes: Consolidation and integration of episodic memories via the formation of semantic network connections probably already occurs during NREM sleep, and these connections may later be activated (and, possibly, more thoroughly integrated) during REM sleep (Diekelmann & Born 2010).

To summarize, the analogy between REM dreams and AAOM mnemotechniques is convincing at only a superficial phenomenological level but is odd, at a closer look, for several reasons: Unlike mneomotechnically encoded material, REM dreams (1) are inherently difficult to remember, (2) do usually not allow conscious subsequent retrieval of all interconnected elements, and (3) have been found to support subsequent episodic memory in only rare cases. Furthermore, the physiological order of REM sleep and NREM sleep suggests that REM sleep supports, if anything, a secondary consolidation or integration step.

Some Renaissance, Baroque, and contemporary cultural elaborations of the art of memory

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Abstract: The target article addresses historical and present-day mnemotechnics as a practice. It also deserves scrutiny as culture writ small. For would-be Hermetic adepts of the Renaissance and Baroque, the ancient art of memory (AAOM) provided both an iconography and a projective-test vision of possibilities. In contemporary fiction, Memory Palaces become a metaphor for the workings of mind, of culture, and of information technology.

> To dream is to coordinate the objects we viewed while awake and to weave a story, or a series of stories, out of them. We see the image of a sphinx and the image of a drugstore, and then we invent a drugstore that is changed into a sphinx.
> —Jorge Luis Borges, *Other inquisitions 1937–1952* (1964b, p. 21)

A king's mouth gapes monstrously wide as he prepares to bite off another man's head, despite remonstrations from a scholarly winged onlooker. In an otherwise-deserted courtyard, beside a blazing hearth, a Roman legionary raises his sword against a giant egg. Another scholar points over-sized compasses towards a geometrical figure inscribed on an external wall where the plaster is crumbling from the brickwork. Despite the grotesquerie, these images are neither dreams nor Surrealist collages, coming instead from the Baroque alchemy tradition (Klossowski de Rola 1997). No resource of engraving has been spared to lend each scene an illusory realism and bolster it with circumstantial detail of stage set and costume. Schematic outlines would convey the same concepts but would not imprint the reader's psyche.

Alchemy illustrations were not mnemonic per se but represented an elaboration or repurposing of the ancient art of memory (AAOM). They exemplify a proto-scientific conviction that the hidden rules governing the operations of the universe are knowable, and to understand and internalise these rules is to control them. To Hermetic/Cabalistic thinkers such as Bruno and Camillo, the AAOM provided precisely the tools they sought for internalising the principles they had discerned (Yates 1966). Thus the techniques for translating information into memorable imagery flourished through the 1600s.

One manifestation of this conviction was the humanist enthusiasm for Egyptian hieroglyphs (Iverson 1993). We meet them, for instance, filtered through the AAOM, in the dream-narrative *Hypnerotomachia Poliphilia* (Colonna 1499/2005). The *Hieroglyphics* of Horapollo acquired oneiric illustrations in which disembodied eyeballs and hands drift like hot-air balloons above Northern Renaissance landscapes (Anon. 1543/1551/1993). Unconstrained by mundane translations, scholars could regard hieroglyphs as a cosmic source code, with esoteric symbols that mirror the key constructs of reality.

Alchemical diagrams were part of a broader "emblemata" tradition of imprinting the mind with moral precepts allegorised into memorable pictorial terms. The results have been compared to "flashcards for the insane." The intention, broadly didactic, became explicitly mnemonic in the *Ars Memoranda* and *Rationarium Evangelistarum* (Anon. ca. 1470/2002). Here the Evangelistic gospels were compressed into 15 images with details designed to evoke episodes from the narrative. A flying lion, an awl piercing its leg, might juggle hieroglyphs and brandish a small donkey while a goat bursts, *Alien*-style, from its chest.

The classical AAOM emphasises the structuring of knowledge into manageable bundles. Each "bundle" is encoded as a striking tableau in which memorable characters engage in activities or display attributes that simultaneously store the information and enhance the heraldic vividness of the scene. Llewellyn proposes that the parallels with the imagery encountered in dream are the product of convergent evolution rather than coincidence. In dream, to ensure wide linkage and avoid new memories from merging with older ones, the hyper-associative "indexing" process avoids the most obvious associations while it weaves links between recent experience and earlier memories. In the AAOM, incongruities and *bizarrerie* are a strategy for memorability. The difference is that dream incongruities are seldom apparent at the time. The juxtapositions and indeterminacy may be not just impossible but *unrepresentable* – purely verbal combinations that cannot translate into visual terms – yet we blithely accept them. House and bridge co-exist as in quantum mechanics. Bats eat cats as easily as the converse; ants conjoin with elephants (Colonna 1499/2005). Dreams may bring the conviction that we are experiencing visual percepts, but instead they seem to be a spread of activation across neural networks through which abstract, ungrounded symbols interact.

A second key element of the AAOM is the Method of Loci. Each tableau is associated with one specific location along a familiar route – one niche within a cathedral, perhaps, internalised by repeated visits – both distinguishing the tableaux and enumerating them so that bundles can be recalled without omissions. Retrieval becomes a kinaesthetic metaphor of mentally retracing the route through embodied experience. This mental/architectural filing system has parallels with the collective external memory of information technology, instantiated as the cyberspace of science fiction. It is not surprising, then, that contemporary literary uses of the AAOM focus on the Method of Loci. In Watson (1990), the titular aliens are mnemonic adepts whose abilities reshape reality: one by one, as they commit the details of Earth's architectural highlights to memory, buildings disappear.

To provide a framework or armature for organising later material, loci must be rote-learned. Fiction often abandons this necessity as a tribute to the power of creative imagination. The Memory Palace employed by Hannibal Lecter to organise his lifetime of learning has no counterpart in the tangible world (in which "it would rival the Topkapi Palace in Istanbul for size and complexity"; Harris 1999). The Bureaucrat's palace (Stanwick 1991) is mobile, fractal, telescopic: Stanwick is using the tropes of the AAOM to describe a virtual-reality software interface and see it anew in the reflection of antiquity. One might invoke Borges (1964a). What are the Garden of Forking Paths, the labyrinth of Ibn Hakkan al-Bokhari, and the Library of Babel, if not Memory Palaces? The House of Asterion has 14 pools, 14 mangers, 14 courtyard loci.

Conversely, the role of the grotesque tableau has dwindled. It may be that drama, absurdity, emotional arousal, and the extremes