[PART 2:]

Restoration of limbs
Illustrations of phantom limbs are intriguing as they depict an invisible perception. But such illustrations are also important: they provide a form of objectivity to phenomena, which particularly in the past, have often stretched credulity. Acknowledging the paradox of using images to reveal an absent though sensate body part, depictions of phantom limbs are discussed from a neurological perspective, starting with medieval pictures that showed the miraculous restoration of limbs, and which possibly represented pictorial metaphors for a phantom limb centuries later. Phantom limbs—whether resulting from amputation or deafferentation—became illustrated, and some reasons for their illustration are considered. Although often depicted by others, the most precise and perhaps revealing illustrations of these phantom phenomena have been those made when patients guide the artist, or draw the phantom themselves. In the case of phantom pains, the painful component too is sometimes illustrated, again, as with the miraculous, in metaphorical terms. More recently, depictions of phantoms have also been revealing in studies of some underlying mechanisms of phantom phenomena, notably in demonstrating novel patterns of referring sensations after amputation and attributable to cortical plasticity. Mention is made of photographs of phantom hands visualized using a—mirror—ed box, such visualization recalling the miraculous restoration of limbs pictured in the past.

The nature of the outline of the phantom is included in a discussion of demarcation of an already invisible body part, before concluding that images of phantom limbs, provide an invaluable background to understanding and studying these remarkable sensory phenomena.
Images of phantom limbs are enigmatic and intriguing, for they only depict missing body parts whose existence is subserved by their illusory sensory perceptions for which objective evidence is unnecessary yet unobtainable. Yet these images are invaluable, because they enable the amputatedee to reveal to another what they experience, and, by making real, clarify the curious features of the phantom, such as the abnormal posture of limbs or parts of limbs, telescoping of distal structures proximally, and no longer gaps in the phantom limb. The present paper aims to discuss how images contribute to understanding the phenomenology and some underlying mechanisms of phantom limbs.

How can something be illustrated for which there is no proof of existence? Viewed in this way, images of phantom limbs recall images of any number of other phenomena for which evidence is absent, with religious images, providing perhaps the most compelling examples: no one has seen any of the scenes thought to be described in the Bible, or miracles recounted, yet only count less out of any one image created. That illustrations of phantom limbs and of a kind of religious image, unexpectedly share features is exemplified by those images that illustrate religious legends in which amputations are followed by restoration of limbs. Such images date at least 600 years, an example being the 15th century Spanish painting illustrating the miracle performed by Saints Cosmas and Damian. In this miracle, the diseased legs of a devout man is amputated and that of a deceased Ethiopian is transplanted, yet still in its place, some depictions showing the new legs in the process of being attached to the stump of the amputee's other legs. (Fig. 1), whereas others show the...
Such miracles form part of the iconography of hand dating from medieval times, and are included in the medical, folkloric and historical accounts ranging from the 14th to the 17th century. These early depictions indeed illustrate the limb phenomena is strongly supported by some of their accompanying commentaries that parallel reports of the sensations sometimes described by real or imagined amputees—for example, "... during the three days that followed the restoration of the leg, the toes and the foot were not yet mobile nor extended but grown together into a new first finger without heat nor color..." (Price and Twombly, 1978). Thus, developing the suggestion that loss and miraculous restoration of body parts constitute a metaphorical or symbolic presentation of a restored limb—of its place—in its place of an amputated one—a metaphor for a phantom limb. That a metaphor was employed was hardly surprising, a phantom limb surely being inexplicable and too strange for an image's amputees to no longer report, at least until Ambroise Pare's brief reference to the phenomenon.
Recognization usually is as being the first to describe the phantom limb (Pare´, 1551), but he did not illustrate the phenomenon, and Hansen.

Limbs were subsequently described by numerous authors, including René Descartes, Aaron Lemos, Charles Bell and Silas Weir Mitchell (for historical review, see Finger and Hustwit, 2003). Weir Mitchell contributed greatly to the description of the clinical features, and is also noted as having first used the term 'Phantom Limbs', the title of his article that appeared in 1871 in Lippincott's Magazine (Mitchell, 1871). He had previously described the phenomenon in a frictional account for a lay audience, which appeared in The Atlantic Monthly in 1866. In this story, which Weir Mitchell published anonymously, a quadriamputate in the presence of other ed presence limbs invisible to even themselves.

All the features describe 'unseen [ ]host[s] of lost part[s]'. Appearance[s] that imagine that imagine 'restore [ ] limbs always emerging only past[ ] [G]ive it] centuries]

[Hand[s] remain ignorant despite their occurrence throughout time immemorial.
the prevalent common sense assumption of phantom experience as path-finding is wrongheaded and largely based on a long-standing and pernicious folk assumption that the physical body is necessary for experience of a body (Halligan, 2002). I suggest that illustration is a powerful tool in correcting this wrongheaded assumption, because illustration serves to validate what are otherwise solely patients' anecdotal accounts, whether verbal or written. Providing a permanent record, the picture, itself, bestows validity and objectivity to phenomena—at least in the past—stretched credulity. Even a few decades ago sufferers often distrusted the reality of their sensations, and disbelief in what was experienced and fear of insanity were not uncommon (Riddoch, 1941). Even in the particularly devastating instances of severephantom pain, 'many amputees are afraid to discuss their phantom pain with their doctors for fear of losing their credibility . . .' (Sherman, 1997). But an illustration, however rough, and whether created by the sufferer or someone else on their behalf, reveals and documents the phenomenon convincingly and for all to ‘see’. Furthermore, illustration provides an invaluable aid when considering possible mechanisms subserving phantom phenomena. Some of these aspects are already considered in the observations, that allow.

Although numerous different phantom body parts have been described, including for instance the breast, bladder and rectum (Melzack, 1990), it is mainly phantom limbs that have been illustrated. Thus there are countless pictures of phantom limbs, which are commonly and conventionally shown as dotted outlines, that provide a simple, usually stereotyped diagrammatic representation; doubling and even tripling, e phantoms—such as those reportedly induced by hypnosis in a patient who had
amputations—have been depicted using such dotted outlines (Fig. 2) (Cedercreutz, 1961). Such diagrams can be striking and revealing just as in the similarly stylized representation of the phantom and of an amputee who subsequently underwent the Krukenberg operation; in this procedure the forearm stump of charcoal is split to allow further movements of the stump to be achieved. How eloquent is the diagrammatic demonstration that, remarkably, the hand—too—has become split (Fig. 3)—revealing another, already othered ‘for the first time’ (Kallio, 1950).

Typically such explanatory diagrams have been made by others rather than the patients themselves. However, drawing precisely what the amputee actually as it and, more importantly, because it fails to perceive (as Derrida sees, as one “seen”) two approaches as feasible (as one “seen”)

An impression, albeit stylized, of the complex phantom phenomena actually experienced by these amputees. A recent and particularly powerful form of visual representation, again involving the patient himself, is the digitally-manipulated and 3D realization of the phantom, an example being the amputee’s phantom by and for the hand, perhaps somewhat telescoped but always isolated and remote from the stump. The artist, Alexa Wright, aimed to accurately model the missing site so as to better show what the patient perceived.
In respect of their hands, and was guided by the patient himself. The second approach to depicting phantom hands, comprised as illustrations created by patients, are less common. However, sometimes patients have been encouraged to draw what their own feel like. For instance, Haber (1956) interviewed 24 unilateral above-elbow amputees, and at the end of a ‘each subject made a pencil drawing of his phantom limb; examples are shown in Fig. 6. These amputees’ drawings illustrate very simply but effectively various phantom phenomena, including phantom limbs that appear telescoped into the hand, drawn up into the stump, while others extend with or without gaps. [L]imbs appear telescoped into the hand, drawn up into the stump, [while] others extend with or without gaps. [F]orms of picturing are compelling because, although crude and unembellished, they are personal testaments to what the patients experience, and confirm graphically the repertoire and consistency of the phantom phenomena, unfolding.

Rarely phantom hands that result from deafferentation, rather than loss, have also been illustrated by patients themselves, as in the pictures drawn by a professional sculptor who sustained a spinal cord transection with complete loss of sensation below D8 (Avenarius and Gerstenbrand, 1967). His drawings convincingly reveal the phantom position of his legs (Fig. 7). Another example demonstrating the value of even the very simplest of pictures, as if being
Balla diagrams. [A] ‘third arm’

insist[s] of [a] torso.[·] [·][·][H]an[d]ling,[·] a term drew on [and over] a body [only ever] drawn[ing.]

[A] limb, experiencing various forms of [g]ain,

drawing [on the][ ][han]d’s[·] memory of the previously intact[·].

[S]ensations never experienced — [only ever] [·][your] own?

[G]ain cannot [““]be[““][ ][·]. [J]ust a
description[·]. analogy and metaphor

[in]form[ing][·] [g]ain,

[forming more] limbs

Pictures serving [as]

[han]d[s][·].

[L]imbs are sensory [con]ceptions[·]
Phantom, and reference of sensation following amputation has received particular attention over the past two decades. For example, sensory stimuli applied to the cheek are sometimes felt in the "phantom hand" [dle", and the precise point-to-point topography of these sensations has been very usefully illustrated by means of diagrams. These valuable diagrams illustrate an underlying shift in cortical representation of body parts, i.e., the functional remapping attributable to cortical plasticity, which follows a loss of a body part, instead being musselled with limbs.

The face referred to now as a ceaseless piling of individual fingers [leading to no] hand[.], fingers [migrate down] [other] arm[.]

Rel[ation] observed by plasticity, mirror[ring] the missing body, intact[ing] limb [over limb]—an exploited to restore the sens[e] of mobility and to [induce] [gain in[to] the [hand][.]

if . . . we substitute[—]for the
lost limb an artificial member . . . the sense of sight will soon refer, in our consciousness, the hand or foot to its old position. Thus, restoration to awareness of an absent limb can occur both by means of a mirror and by a prosthesis, and these 'restorations' to recall all the miraculous restorations illustrated in the past.

Also notable here is that the photographic image showing the 'restored' phantom limb in the mirror in Fig. 11 recalls the picture of the similarly 'restored' prosthetic limb painted 600 years ago and shown in Fig. 1.

Another, related way in which illustration contributes to understanding phantom limb phenomena are the diagrams that show the topography of referred sensations in the phantom limb elicited by vibrotactile stimuli applied to the pectoral region (Kew et al., 1997). The diagrams in this PET study, however, do not illustrate phantom limbs; rather, the diagrams depict the cutaneous sites on the intact body from which sensations referred to the phantom were produced. In other studies too, diagrams have been used to demonstrate similar phantom phenomena—for example, the phantom sensations induced following tactile stimulation of distant points in lower limb and breast amputees, and the topographic changes over time of the areas that elicited phantom sensations in a patient covered with an amputated left index finger (Berlucchi and Aglioti, 1997). Yet another use of diagrams in studies of phantom limb phenomena are the schematic representations of the position of the phantom arm in patients who underwent local...
The "real" hands and no number of arms were held still and outstretched, and the body, except for the arm's movements, was kept still. Each position was appended on the diagrams. Here again the diagrams were made by the experimenters and not the patients, but the diagrams added some objectivity to the patients' accounts, and enabled the experimenters to conclude that 'our perceived limbs are, at least in part, images based on central neural activities and are not solely the result of feedback from our reality.'

Demarcating the phantom limbs presents a further paradox, because not only are they depicting body parts that are missing, but what is being depicted is not the actual body part but a sensation. It is thus the sensation of a limb that is shown by means of a diagram or a picture, even if not a photograph, which usually consists of an outline, or contour, demarcating the extent of that phantom sensation. Despite its representation, however, we are not aware of such demarcation—an aspect that touches on some concepts concerning the body-image (Schilder, 1935; Critchley, 1950; Tessari et al., 2010). "Thus, when closing our eyes with our arms held still and outstretched in front of us, we cannot feel the extent of our limbs and where our fingers end. There is a tendency towards the dissolution of the body-image. When we close our eyes and remain as motionless as possible, the body image tends towards dissolution" (Schilder, 1935), yet phantom limbs are nevertheless pictured, not as vague shapes but as clear cut outlines.
The same empirical consideration applies to Penfield and Boldrey’s homunculi, which too were necessarily drawn with outlines demarcating the extent of the body parts mapped over the cerebral cortex (Schott, 1993). Thus, from the graphic perspective, depictions of both phantom limbs and homunculi similarly incorporate outlines of the extent of imaginary structures. Such considerations touch on the dichotomy between ‘how we perceive our body to be, and how we remember or believe that it is’ (Longo et al., 2010), and illustrations enable us more readily to imagine, though never experience, what a phantom limb feel like to the amputee[s they are].

Illustrating phantom limbs and other body parts is an intriguing endeavour: it enables the phantom body part resulting from loss or deafferentation to achieve corporeality and objectivity, albeit not reality. Such illustrations arguably date back several centuries to the miraculous ‘restorations’ of amputated limbs, and in the past century have ranged from simple drawings to recent computer-generated images of phantom limbs. But if illustrating a phantom limb is at the same time paradoxical by virtue of displaying something not only absent but solely sensory, the mechanisms subserving phantom phenomena are becoming less enigmatic. It is increasingly recognized that the amputee’s experience of these sensory phenomena, often realized through illustration, can contribute to understanding the nature of the body schema and the widespread network of neuron—the neuromatrix (Melzack, 1990)—postulated as being the substrate for ‘the body in mind’ underpinning the phantom (Halligan, 2002). Many images of phantom limbs have thus not only been poignant and of significance to those who have lost in the limb[s], but have also provided much of importance for those studying these remarkable sensory phenomena.