

Restoring Phineas Gage: A 150th Retrospective*

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ABSTRACT

September 13 1998 marked the 150th anniversary of the accident to Phineas Gage, one of the most famous cases of survival after massive injury to the brain, and certainly the most famous case of personality change after brain damage. For this article a sample of the current literature about Gage was examined. It was found that although his case is mentioned in about 60% of introductory textbooks in psychology, there is a good deal of inaccuracy in what has been written about him. Similar inaccuracy was found in a smaller sampling of the psychiatric, medical, physiological, linguistic, and general neuroscientific literature. The main basis of the inaccuracies is an ignorance or disregard of what is contained in the primary sources about Gage, coupled with a tendency to attribute to him characteristics that belong to other cases of frontal damage. The errors and their bases are discussed in an endeavour to restore the picture of Gage to its original state. The paper includes an Appendix of verbatim quotations from the primary sources that can be compared with the later, inaccurate renditions.

Keywords: brain injury, personality change

A moral man, Phineas Gage,
Tamping powder down holes for his wage,
Blew the last of his probes
Through his two frontal lobes;
Now he drinks, swears, and flies in a rage.
Author unknown

Phineas Gage is probably the most famous case of survival after massive injury to the brain, and certainly the most famous case of personality change after brain damage. Although much written about, a good deal of what has been written is strikingly at variance with what little is known about him; in fact it is about as accurate as the

summation in the above limerick. On this 150th anniversary of the accident, it is my intention to restore our picture of Phineas Gage to its original state.

My title is based on the analogy of restoring an old painting that has become so changed by centuries of grime and amateurish attempts at restoration that it is sometimes impossible to discern the underlying original. I do not have that disadvantage. The primary documents, mainly the reports of John Martyn Harlow the physician who treated Gage and followed up his case, show us what we have to take as the original portrait. Of course, we do not know how ac-

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curate Harlow's rendering is, but that is irrelevant to my point. It the only picture of Gage that we have.

THE ORIGINAL PICTURE

Phineas Gage suffered his accident at 4.30 p.m. on Wednesday 13th September, 1848, just outside Cavendish, Vermont. Employed by the contractors who were preparing the bed for the Rutland and Burlington Railroad, he and the men of the gang of which he was foreman were putting a cutting through a large rocky outcrop about three quarters of a mile south east of the town. It was his job to place the explosive powder and fuse into the holes drilled in the rock, pack it or 'tamp' it down, and then tamp sand or some other inert material on top of the charge. For this purpose he used a specially made tamping iron, a small crowbar-like tool weighing thirteen and a quarter pounds and three feet seven inches long. At its wider end, the tamping iron was one and a quarter inches in diameter but, over about a foot, it tapered to a diameter of one quarter of an inch at the other. As the consequence of an accidental explosion, the tamping iron was blown completely through Gage's head. It entered pointed end first, under the left zygomatic arch, came out the top of his head mainly left of the midline at about the junction of the coronal and saggital sutures, and landed some 25 to 30 yards behind him.

Gage, who may not have lost consciousness, was then helped by his men to an oxcart, in which he rode unsupported to the inn or tavern in Cavendish, where he resided. There he sat on the steps until medical help was obtained, mainly from John Martyn Harlow, the Cavendish physician. Following a stormy recovery, Gage was well enough to return to the family farm in Lebanon, New Hampshire, on 25th November, just under three months after the accident. Harlow reported the immediate effects of the accident in the December (Harlow, 1848), which Henry Jacob Bigelow, the then professor of Surgery at Harvard University's medical school, reprinted in 1850 in his further account (Bigelow, 1850a, 1850b).

Phineas recovered physically, surviving for eleven and a half years, but was so changed psychologically that he never worked at the level of a foreman again. When he died of epilepsy in San Francisco on 21st May, 1860, there was no autopsy. His body was exhumed in the presence of Dr. J. D. B. Stillman, Dr. Henri Perrin Coon, the Mayor of San Francisco, and David Dustin Shattuck, Gage's brother in law. Although there are no records of the exhumation, my research suggests that it took place in late November or early December, 1867 (Macmillan, 2000, in press). The skull was removed, taken to Harlow, and the rest of his body reinterred. In 1868 Harlow gave an outline of Gage's subsequent history, described the damage revealed by his study of the skull, and deposited it and the tamping iron in the Warren Anatomical Museum of Harvard University (Harlow, 1868, 1869).

SIGNIFICANT ERROR

In the course of estimating the significance given the Gage case, I found that although he appears in nearly 60% of the introductory textbooks of psychology published in the 15 years before 1998, much of what is contained in those texts is strikingly at variance with Harlow's picture. To arrive at this estimate, and the conclusion based on it, I examined the most recent editions of some 60 introductory texts published since 1983 that happened to be on the shelves of three Melbourne university libraries and catalogued in the numerical range 130 to 150 of the Dewey system. The sample has no pretence to be random or complete, and the prevalence estimate it yields is certainly not accurate. First, in the Dewey system, the cataloguing and therefore the shelving of books is subject to the vagaries of the word order in the title. Thus a work titled *Introduction to Abnormal Psychology* tends to be somewhere within the 130–150 range, but *Abnormal Psychology: An Introduction* may be there or at various places among the medical or psychiatric text books, and the catalogue numbers given titles like *Cases in Abnormal Psychology* seem to be assigned at random. Second, Gage appears reasonably frequently without

benefit of a name or subject index entry for himself, or for 'Harlow, 'Bigelow,' 'brain,' 'brain damage,' or 'frontal lobes,' and without Harlow's or Bigelow's papers being listed in the references. Short of a detailed reading of each work, one cannot be sure if Gage were mentioned or not.

When we analyse what is actually said about Gage, we find a very curious feature about the inaccuracies commonly found there. In a given account, the amount of error varies within its different parts; not all is equally in error. If we divide the story into the seven elements of the dimensions of the tamping-iron, the nature of Gage's work, the circumstances of the accident, the damage done Gage's skull and brain, his treatment and recovery, the changes to his personality and behaviour, and his subsequent history and fate, it is rarely the case that a single account contains major errors in more than three elements. Partly because of this variability, partly because not all the accounts include all seven elements, and partly because the amount of detail in each element also varies, it is impossible to arrive at meaningful quantitative estimates of overall accuracy or of the accuracy of the components. Remembering that the general level of accuracy is low, the elements that seem to be most accurately reported are the dimensions of the tamping iron, the fact of the explosion, the length and difficulties of the treatment (if reported at all), and the fact that Gage's behaviour had changed. The most inaccurate components are those about his work before the accident, the details of the changes in his behaviour, and his subsequent history.

To examine this feature further, I added a further 30 pre-1984 books to the earlier set, this time including textbooks, specialised monographs, and general works drawn from psychiatry, medicine, physiology, linguistics, and the neurosciences as well as psychology. Finer analysis revealed that the basis of this variable accuracy was the authors' ignorance or disregard of Harlow's 1868 paper. Most writers seem to have been content to summarise or paraphrase accounts that were already seriously in error, and/or to fit into their own conceptual frameworks the little they had gleaned. Contrariwise,

where accuracy was achieved, it was by quoting or paraphrasing Harlow, sometimes Bigelow, extensively. The grossness of some of the inaccuracies will be seen in the following comparisons with Harlow's original. (In the Appendix will be found verbatim reproductions of the important parts of what Harlow wrote, and some other primary source material).

WHICH IS PHINEAS GAGE

Consider now the 'pictures' we have of Phineas Gage – the four illustrations in Figure 1. Each is used in the current literature to represent him and the damage to his skull. But which is he? Clearly not Figure 1(a), for that is actually the skull prepared in late 1849 or early 1850 by Bigelow to demonstrate that such a passage of the iron was possible. It is often represented as Gage's skull (e.g., Singer & Hilgard, 1978; Zimbardo & Ruch, 1979; Crider et al., 1990; Lahey, 1992), a tradition that is at least as old as Raymond (1905), and which also seems to be the basis for Ripley's famous 1930 cartoon. It is possible that Gage was like Figure 1(b), which is a drawing by Russell Windsor used by her husband in his book on phrenology (Windsor, 1921). Her initials on the drawing and the late date of the book shows it cannot be directly from life, but no other source is known. The skull in Figure 1 (c) does look like Gage's, if only because it is a woodcut prepared in 1868 for Harlow from either his original photograph of the skull (Figure 2) or from the skull itself. Mostly used correctly, it is nevertheless not infrequently printed with a right-to-left reversal, so making Gage suffer *right* frontal damage (e.g., Davison & Neale, 1974; Bootzin & Accolla, 1984; Bootzin et al., 1993), and sometimes in an adapted form showing a right parietal exit (Beaumont, 1983). Note, however, that Harlow's original photograph of Gage's skull (Figure 2) does not have the tamping iron *in situ*, as many, including me (Macmillan, 1986), have said, and there are, of course, no traces of the iron having been so placed in it. The skull is most often reproduced from the more modern photographs held by the Warren Museum but

even then the written descriptions are sometimes wrong. Thus Adey (1974) has the iron entering *through* the left eye. Figure 1(d), probably the closest to what Gage looked like after the accident, is the life mask prepared for Bigelow in 1849–1850 (Anonymous, 1869).

Gage's Work

What exactly was Gage doing at the time of the accident? Although a number of the erroneous accounts say he was a miner or was working in a mine, he is more usually pictured as building a road, rather than a railroad, and he does this by clearing rocks away, blasting a rock, some rock, or large rocks blocking the tracks, or levelling the terrain generally. He packs gunpowder into a crack in the rock, or, anachronistically, uses dynamite and/or detonators, before making a careless mistake over the tamping. These errors themselves are minor but they betray a point of considerable importance, one to which I will avert later: an ignorance of what Harlow and Bigelow, our primary sources say about circumstances of the accident (Harlow, 1848, 1849, 1868, 1869; Bigelow, 1850a, 1850b). Examples of these minor errors are in Tow (1955), Smith (1970), Robin and Macdonald (1975), Altrocchi (1980, quoting Wooldridge, 1963), Treisman (1968), McMahon and McMahon (1982), Crider et al. (1983), Fromkin and Rodman (1983), Dworetzky (1988), Fromkin et al. (1990), Sdorow (1990), Smith (1993), Damasio H et al. (1994), and Damasio AR (1994), Carlson (1994, 1995), and Hockenbury and Hockenbury (1997).

The immediate effects

The accounts of the more or less immediate effects of the passage of the tamping iron also show considerable variation. About one half are quite accurate, consisting for the most part of direct quotations or paraphrases of Harlow, either from him directly or *via* Bigelow. Gage is correctly described as being knocked over, possibly not losing consciousness, walking with assistance to an ox-cart, sitting in it as he was driven to the tavern where he sat on the piazza [New England English for 'verandah'] waiting for medical assistance. If Harlow's treatment is mentioned at all (usually it is not), its length is

usually stated correctly and its stormy nature summarised accurately. Minor errors, like Suinn's (1970) expanding Harlow's account of Gage giving a few convulsive movements, to he 'convulsed a bit', or Restak's (1984) 'his body began to shake in a convulsive seizure', are relatively infrequent.

Many other accounts show puzzling if not bizarre variations from Harlow and Bigelow. Thus, although Hart (1975) has him not even fainting, Altrocchi (1980, quoting Wooldridge, 1963), has him stunned for an hour before walking with assistance to the surgeon; Brown (1976) has him 'a bit stunned' but recovering after lying down in his room 'for awhile', apparently without treatment, Treisman (1968) has the surgeon remove the tamping iron in his office after Gage walked there, and Aitchison (1989) manages to have him surviving for twenty years with the tamping iron still embedded in his head. Kalat (1981) implies some immediate but minor dysfunction in having Gage being without speech for part of the day, Kolb and Wishaw (1985) pass over the immediate effects saying only that he walked to medical assistance after being stunned for a few seconds, Smith (1970) has him walking to a hospital, but, like Rosenhan and Seligman (1984) who mention only a loss of consciousness, says nothing about the infections or the treatment.

Together with these aberrations, there is also a profound ignorance about just what damage was done to Gage's brain. A goodly number of writers describe Gage as suffering only a head injury, a laceration of the brain, or an injury that resulted in diffuse damage, while others are *vague* or *general* and say nothing about the site of injury other than that it was in 'the brain' or 'the frontal region' (e.g., Suinn, 1970; Davison & Neale, 1974; Mowbray et al., 1979; Zimbardo & Ruch, 1979; Lefrancois, 1980; Groves & Schlesinger, 1982; Fromkin & Rodman, 1983; Bootzin & Acocella, 1984; Bootzin et al., 1993; Coleman et al., 1984; Rosenhan & Seligman, 1984; Walsh, 1985; Dworetzky, 1988; Sdorow, 1990; Fromkin et al., 1990; Lahey, 1992; Smith, 1993; Kalat, 1996). Some do specify a *single* lobe, either an unspecified frontal lobe or the left frontal lobe (e.g., Rosenzweig & Leiman,

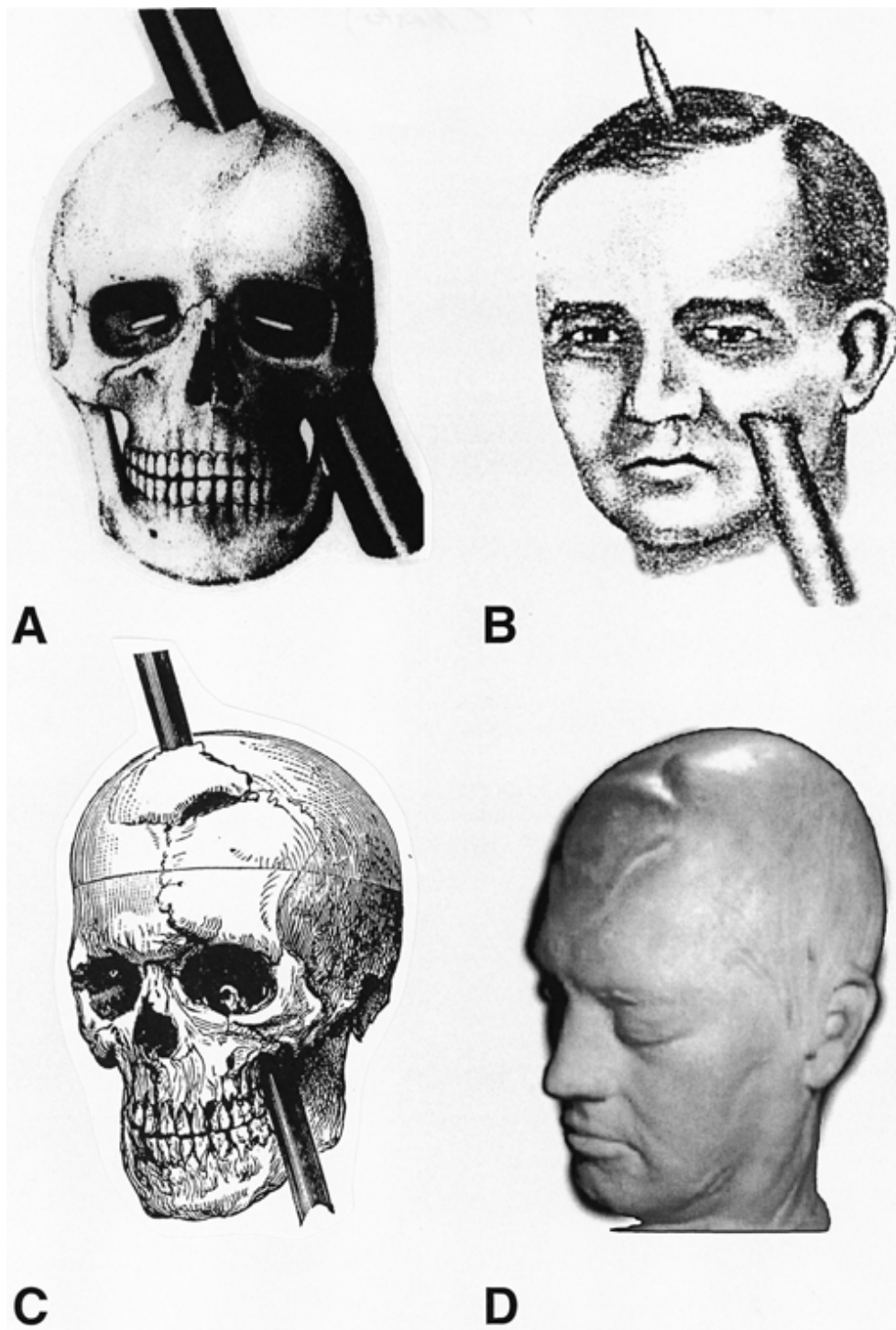


Fig. 1. Representations of Phineas Gage
Sources: 1a Bigelow (1850a and b); 1b Windsor (1921); 1c Harlow (1868, 1869); 1d Warren Anatomical Museum (reproduced by kind permission)



Fig. 2. Harlow's original photograph of Gage's skull
 Source: Minutes of the Middlesex East District Medical Society held by the Woburn Public Library and reproduced with the kind permission of the Trustees of the library.

1982; Crider et al., 1983; Myers, 1986; Bloom & Lazerson, 1988; Plotnik, 1996; Morris, 1996). But *bilateral* damage is also indicated (e.g., Luria, 1962/1966; Treisman, 1968; Eckstein, 1970; Adey, 1974; Brown, 1976; Altrocchi, 1980, quoting Wooldridge, 1963; Walsh, 1978; Dimond, 1980; Kalat, 1981; McMahan & McMahan, 1982; Damasio & van Hoesen, 1983; Stuss & Benson, 1983; Beaumont, 1983; Morris, 1988; Carlson, 1994, 1995; Hockenbury &

Hockenbury, 1997; Tavris & Wade, 1997; Myers, 1998). The uncertainties of Kalat and Walsh, who shift from a bilateral to a vaguer siting of the damage, Myers, from singular to bilateral, and Morris, from bilateral to singular, are especially worth noting. Quantifiers are sometimes added to the claims of damage to both lobes. They range from being extensively or massively damaged, through being nearly obliterated, to being removed or extirpated (e.g.,

Brown, 1976; Singer & Hilgard, 1978; Levitt, 1981; Atrens & Curthoys, 1982; Kolb & Whishaw, 1985; Bloom & Lazerson, 1988; Myers, 1998), but Henderson and Gillespie (1944) have only the prefrontal cortex damaged.

THE PSYCHOLOGICAL AND BEHAVIOURAL EFFECTS

To judge the psychological and behavioural effects of the damage, one needs to know what Gage was like before the accident. Most of Harlow's 'before' descriptors come from his 1868 report but a few come from 1848. They are limited to his saying that Gage was temperate in habit, strong and active, a great favourite with his men, and having considerable energy of character. He had an iron will and iron frame, a well-balanced mind, and was regarded as a shrewd, smart business man, who executed his plans with energy and persistence. His contractors said he was the most efficient and capable of their foreman (see also Appendix).

The Pre-Accident Gage of Fable

When there are accurate descriptions of the pre-accident Gage, they are based solely on Harlow, usually by way of quotation or paraphrase. Minor variations are seen in the omission of some of these characteristics, usually not more than one or two, and the addition of others that are not too discrepant from those given by Harlow. Others make considerable modifications to Harlow's pre-accident picture. From Gage being a great favourite with his men, he is painted as one who is 'friendly' or 'affable' in general. Other descriptors are then added with the result that Suinn (1970) has a Gage who enjoys the respect as well as the favour of his men, Plotnik (1996) has one who is popular and friendly, and Crider et al. (1983) have an all round considerate and friendly person, that is, A. Smith's (1984) 'genial fellow'. More traits are added. Gage is also dependable and industrious (Bloom & Lazerson, 1988), and competent, and responsible (Hockenbury & Hockenbury, 1997). Other descriptions can be thought of as beginning with Gage's efficiency, and adding, as do Groves and

Schlesinger (1982), and Tavris and Wade (1997), qualities that make him friendly and mild-mannered, or, with Altrocchi (1980), considerate and well-balanced. Unsurprisingly, with transformations like these, Mowbray et al. (1979) make him reliable and industrious, Kalat (1981) steady and conscientious, and Carlson (1994, 1995) serious, industrious, and energetic.

When Sdorow (1990) describes this Gage as hardworking, Stevens (1971) and Myers (1998) as soft-spoken, and Lahey (1992) as polite and reasonable as well as hardworking, we see a Gage who is what the authors always knew or wanted him to be, namely, the brave, hardworking, responsible, conscientious, and excellent foreman pictured by Atrens & Curthoys (1982), Ruch (1984), and Vincent (1996) – even if Harlow did not use any or many of those terms to describe him. But when Dimond (1980) sees a peaceful, happy, and tranquil Gage, I sense a very different tint to his glasses.

The Post-Accident Rendering

It will now come as no surprise to find that the post-accident picture of Gage so overlays Harlow's that his is virtually unrecognisable. The characteristics Harlow gives Gage after physical recovery are restricted to the destruction of the balance between his intellectual faculties and his animal propensities, to his becoming fitful, irreverent, grossly profane, showing little deference for his fellows, impatient of restraint or advice that conflicted with his desires, obstinate yet capricious and vacillating, devising many plans and abandoning them, and a child in his intellectual capacity with the animal passions of a strong man.

Balance

Apart from its inclusion in the direct quotations of Harlow's summary, I found only four uses of Harlow's famous phrases about Gage's equilibrium or balance being destroyed, or his being intellectually a child possessed of adult animal passions. Levitt (1981) mentions Harlow's phrase but does not expand on it in any way. Luria (1962/1966), presumably the victim of a translation back into English from a Russian rendering of Harlow's original, has the distur-

bance as one of the balance between his ‘intellectual and animal traits’, and he also mentions the release of Gage’s ‘primitive animal instincts’. With less excuse, Bootzin & Acocella (1984) and Bootzin et al. (1993) incorporate a similar notion into the way they describe the balance between what they term Gage’s intellectual faculties and his instincts. Peculiarly, none of these authors goes on to make use of the concept that his balance was disturbed. Eckstein (1970) explicitly equates and restricts to sex, the animal ‘passion’ that is released by the lack of balance, and sex is the only animal propensity or passion that anyone else mentions. Actually we know absolutely nothing about Gage’s sexual life, but I defer discussion on what is claimed until later.

As distinct from his remarks on balance, the other parts of Harlow’s summary are quoted more or less fully in a number of texts. Peculiarly, there are also five lists of Gage’s characteristics that are reasonably close to Harlow’s, although they are not quoted from him. Thus Mowbray et al. (1979) quote an unnamed source to have a Gage who is “a ‘fitful, irreverent, profane, impatient, obstinate and vacillating,’ fellow”. Bootzin and Acocella (1984) and Bootzin et al. (1993) are reasonably accurate with their Gage being inconsiderate, impatient, obstinate, and yet at the same time capricious and vacillating in decision making. They also have him beginning to engage in the grossest profanity and showing so great a change in temperament that his employers had to replace him. Altrocchi (1980, quoting Wooldridge, 1963) has Gage as grossly profane, showing little consideration for others, and no longer trusted to supervise others, as well as having some of the other characteristics Harlow does give him. Lefrancois (1980) keeps most of Harlow’s qualities but modifies or adds to them so that his Gage is moody, selfish, impulsive, and stubborn, and highly profane, even in front of ladies. Kalat (1981) has a Gage who is restless, unreliable, changing his plans suddenly, persisting to the point of obstinacy, and resisting advice or restraint opposed to his impulses, but is apparently neither profane, irreverent, nor lacking in deference. In most other instances there is a similar use of some part of

what Harlow actually said with the addition of qualities that are different.

Profanity

Profanity is almost always included in the characteristics. Nowadays this is more often placed alongside terms like inconsiderate, or phrases referring to a lost sense of decorum, rather than with Harlow’s irreverence and lack of deference. Elaborations of Gage’s profanity are frequent, beginning with the simple one of Myers (1998), that has Gage irritable and profane, to the more complex of being unbearably or grossly profane as well as irritable (Shutts, 1982; Crider et al., 1983), with the latter adding ‘inconsiderate’ for good measure. Others, like Damasio H et al. (1994) simply refer to Gage’s now abundant profanity, or, like Fulton (1949a), have him indulging in profanity that would have embarrassed an eighteenth-century British sea captain. But the more considerable elaborations of his profanity begin with Stevens’ (1971) bombastic and purposeless Gage who is continually cursing, move to the restless, profane, loud, and impulsive Gage of Bloom and Lazerson (1988), continue with Plotnik’s (1996) impatient Gage who curses his workers and refuses to make good on his promises, and finish with one who is a depraved child, capricious, lacking in respect, as well as proffering obscenities (Vincent, 1996).

Fitfulness

Similarly ‘fitful’ is almost always included, although the terms now used are more likely to be restless, unreliable, or irresponsible. Often these qualities are only implied by reference to Gage being ‘reliable’ beforehand. Sometimes the Gage who results is, like Aitchison’s (1989), unpredictable, presumably in some general sense, as well as unreliable, or as Kalat (1996) has it, unreliable in his work and personal habits, following each whim of the moment, and unable to follow ‘any’ long term plans. Other Gages are represented as developments of the ‘personal habits’ deficit and become so different from Harlow’s description that we have difficulty in recognising him: slovenly, unreliable, and feckless (Smith CUM, 1970), exhibiting

dramatic changes in his personal habits (Rosenzweig & Leiman, 1982), and slovenly, careless, and easily distracted (Atrens & Curthoys, 1982). In short, Dimond's (1980) peaceful, happy, and tranquil person of former days is now aggressive and violently quarrelsome, or has become Ruch's (1984) argumentative and untrustworthy one. A. Smith's (1984, 1985) once genial fellow turns into a capricious, obstinate, ne'er do well drunkard, and the mild mannered, friendly, efficient worker of Tavriss and Wade (1997) changes into a foul mouthed, ill-tempered, undependable lout. He who had been Sdorow's (1990) friendly, popular, and hardworking foreman, is now an ornery, disliked, irresponsible bully. Most of all, according to Damasio H et al. (1994), and also to Damasio AR (1994), he who had been the favourite of his peers and elders, who had made progress and shown promise, is now irreverent, capricious, and without respect for the social conventions by which he had previously abided. He often drank and brawled 'in questionable places', and when he returned to San Francisco, he was under the custody of his family. As A. R. Damasio has it, Gage virtually became a psychopathic personality who lied and could not be trusted to honour his commitments (in Blakeslee, 1994).

Irritability

Whether 'irritable' is implied by Harlow is doubtful in my view. But if cranky and inconsiderate are acceptable synonyms, as Fromkin and Rodman (1983) and Fromkin et al. (1990) seem to think, not much of Lahey's (1992) impossible to reason with, and unable to think rationally and plan, is. Neither, it seems to me, is Hockenbury's and Hockenbury's (1997) substitution of bad-tempered for irritable, nor their addition of unreasonableness as well as stubbornness. McMahon and McMahon (1982) develop this theme rather more than anyone else. Their Gage not only makes elaborate plans that he then cancels, and swears profusely 'at any time or place', but he loses control of much of what is called decorum, becomes like a child, and has fits of temper when he doesn't get his own way.

Obstinate, impatient of restraint or advice that conflicts with his desires

Again, apart from being included in quotations from Harlow, neither Gage's obstinacy nor his being impatient of restraint or advice that conflicted with his desires are often commented on. When they are, it is in ways quite different from Harlow. It is not often remarked that Harlow implies that Phineas was as obstinate *after* the accident as he had been *before* it, and, because J. B. S. Jackson (1870) explicitly says he was, it is possible that this trait was not a consequence of the damage to his brain. Nevertheless, even without this qualification, linking his obstinacy and incapacity for planned activity seems arbitrary (Groves & Schlesinger, 1982). Similarly, according to Levitt (1981), his paying little heed to advice from others when it interfered with his own wants and desires, had one special peculiarity: Gage experienced great difficulty in planning an action and carrying it through.

The Shrewd, Smart Business Man

Many include Harlow's characterisation of Gage as a 'shrewd, smart business man' within a quote or paraphrase, but only Levitt (1981) specifically singles it out. Levitt modifies the phrase to a 'shrewd efficient businessman', when 'smart' in the New England English of the time meant 'clever' rather than 'efficient'. No matter. After making it Gage's only pre-accident quality, he never refers to it again.

I assume this peculiarity and the general rarity of reference to the phrase is because so little can be made of it in the context of what people suppose the role of a foreman to be nowadays. However, in the context of the time, it is possible that Gage was actually a sub-contractor, tendering for the work to be done by the gang he recruited, and paying them from what he was paid. This mode of work was as common in the construction and transportation sides of the US railroad industry as it had been in the canal industry preceding it (Coleman, 1965; Licht, 1983; Way, 1993). It was also a peculiar feature of New England manufacturing industry that lasted until the end of the nineteenth century (Patten, 1968; Chandler, 1977; Clawson, 1980). Even were Gage not a subcontractor, his respon-

sibilities for such tasks as determining where charges were to be placed, supervising the drilling, charging the explosives, and keeping various records suggest a level of skill and responsibility above that of the foreman of such a gang today. To Levitt, as to most others, the context of Gage's work is a very dark continent indeed.

GAGE'S SUBSEQUENT HISTORY

The part of Gage's story that is told with the greatest inaccuracy is what happened to him after the accident. Real events are exaggerated, events that are not documented anywhere are included together with others that almost certainly did not happen, while others that are important and which did happen are not mentioned. The central core of what is said is based on Harlow saying that he visited the larger towns in New England exhibiting himself and the tamping iron, and spent some time in New York with Barnum's.

Familiar elaborations, if not fabrications, are also found here. Gage drifts around in a more or less purposeless way, in geographically vague or unspecified locales, hardly ever just in New England. When he does not exhibit himself on his own, he does so as a circus or fairground attraction. Gage is motivated to do these things because he loses his job, cannot settle to another, and is unable or unwilling to work. The unreal events include the time and route of his travels, how he earned a living, and the circumstances of his death.

What is hardly ever taken into account by the authors of these fables is the time available in which Gage might have done these things. At the very most, this period could not have been longer than two years; it could have been about nine months, but it was probably more like one year. The very earliest that Gage could have commenced visiting the larger New England towns is January, 1849. We can also deduce that he must have gone to work for Jonathan Currier in Hanover near the beginning of 1851, because Harlow (1868, 1869) says he stayed there for nearly eighteen months until August, 1852. However, J. B. S. Jackson (1849) had it from the

family that Gage was not fit enough physically for a full day's work on the farm as late as May or June of 1849, and although well enough to search for employment in Montpelier that August, he seems not to have been fit enough to go to Boston and see Henry Jacob Bigelow until November. His physical weakness (loss of 'bodily powers') was commented on as late as April 1850, in a letter to the AMA Standing Committee on Surgery (1850). Had Gage commenced visiting the larger New England towns early in 1850, he could have been travelling, therefore, for only about a year – nine months if his journeys started in the April of that year.

Despite what Harlow tells us about Gage's employment, and despite these time constraints, the Gage of fable never works again. He becomes a vagrant (Tow, 1955), a circus exhibit (Groves & Schlesinger, 1982; Tavis & Wade, 1997), or solo travelling attraction (Kalat, 1981). Our story-tellers are uncertain if this is because he does not want to work (Altrocchi, 1980, quoting Wooldridge, 1963; Morris, 1996), or wants to work but cannot hold a regular job (Kalat, 1981; Smith A, 1985; Lahey, 1992; Hockenbury & Hockenbury, 1997), or simply because he cannot be trusted to supervise the work of others (Restak, 1984). Whatever the reason, he does not work. Although Kalat (1981) has him making a living on his own as he tours the country charging admission to see the holes in his head, Damasio H et al., (1994) have it that he 'never returned to a fully independent existence'. After having begged for a time, Restak (1984) says, Gage became 'a pathetic sight' as he exhibited himself. According to Tavis and Wade (1997) it was because he could neither hold a steady job nor stick to a plan that he was reduced to exhibiting himself as a circus attraction. On the other hand, Groves and Schlesinger (1982) allow him to hold many jobs while travelling, and seem to make his 'even' participating in a circus a minor matter.

The accounts of Ruch, (1984), Myers (1998), and Bloom and Lazerson (1988) are so geographically challenged that they not only do not say where Gage went, but leave out the travels altogether, and mention only the freak or fairground part of the story. Those who are a little

more specific about where Gage went are still vague. After he lost his job, Blakemore (1977), and Crider et al. (1983) say he drifted around the United States and South America, exhibiting himself and the metal rod as a fairground attraction. Brown (1976) has him 'drift' from Chile to San Francisco and spend some time as a Barnum Circus exhibit. A different voyage, geographical as well as psychological, is described by Damasio AR & van Hoesen (1983), who have Gage travelling 'from New England to California' where he dies 'in careless dissipation'. Although Fromkin et al. (1990. cf. Fromkin & Rodman, 1983) say Gage gained monetarily when he toured all over the country charging admission to his one man circus, they have him dying penniless in an institution 12 years after the accident.

A. Smith (1984, 1985) has it that before he died, Gage had the wit to sell his skeleton, cash in advance, to two medical schools. Whenever and wherever Gage finally comes to rest in these fables, Damasio H et al. (1994. cf. Damasio AR, 1994), as well as Hockenbury and Hockenbury (1997) have him buried with his tamping iron. Eckstein (1970) manages to find evidence for an autopsy, with a finding that the damage matched that of a lobotomy, and Altrocchi (1980), that the damage had spread from the left frontal lobe to the right.

THE BASES OF THE MISREPRESENTATIONS

The limited circulation of Harlow's address, in both its periodical and pamphlet form, suggests that ignorance could be one source of the fabrications that overlay his original portrait of Gage. When Miller (1993) introduced his partial reprint of Harlow's 1868 report, he noted that Harlow's publications were not easy to obtain and were more frequently cited than read. My searches of various databases, and of the *National Union Catalogue, Pre-1956 Imprints* and the *Index of National Library Medical Serial Titles* located fewer than ten copies of the *Publications* and eleven of the pamphlet form of Harlow's paper in US libraries. From personal

knowledge of holdings other than these, I know this total to be an underestimate, but it is probably not a gross one. Further, little or nothing of what got into the secondary literature concerned the exact nature of Gage's work, the supposed damage to his brain, the details of the changes in his behaviour, and what happened to him after recovery. And it is about those aspects that the ignorance is most profound. What is reported most accurately (and frequently) are the dimensions of the tamping iron, its general trajectory through his skull, and the mere fact that his behaviour was radically changed.

Ignorance of the Sources

Ignorance of those sections of Harlow's 1868 paper in which he described the damage, the treatment, and the subsequent history leads directly, in my view, to such things as the variation in the reports of the nature and locale of the damage and to such vague portrayals as Gage drifting about in a kind of geographical wasteland after he recovered. Interestingly, as compared with the papers of Beekman (1945) and Steegmann (1962) in which the clear aim was also to reproduce or summarise most of Harlow's 1868 paper, only Miller (1993) covers the post accident history in any detail. With the exception of Restak (1984), many of the other works that quote the changes in detail from Harlow's 1868 report, or make comprehensive paraphrases of what he says, do so in isolation, without saying anything, or only a little else, about his post accident history (e.g., Treisman, 1968; Suinn, 1970; Harmatz, 1978; Davison & Neale, 1974; Blumer & Benson, 1975; Zimbardo & Ruch, 1979; D. Morgan, 1981; Stuss & Benson (1983; Coleman, et al., 1984; Rosenhan & Seligman, 1984; Bloom et al., 1985).

The most striking instance of this separation of the changes from any sort of context is Fulton's (1949a) quoting Harlow's 200 words describing the changes in full but saying absolutely nothing else about Gage. The same kind of separation is responsible for the odd contrast found in Walsh's two texts. In both he gives reasonably accurate accounts of the changes, but in one is vague about the locale of the damage (frontal 'region') and shifts it in the other (fron-

tal ‘lobes’). Walsh’s source is Kimble’s programmed introductory text, which contains much of Harlow’s description of the changes (attributed vaguely to a ‘medical journal of that time’) but gives only the barest information about the site of the damage (Walsh, 1978 and 1985. cf. Kimble, 1963).

The Instability of Gage’s Employment

The fables of Gage’s unstable work history may also have their origins in the rarity of Harlow’s 1868 report. The facts are that apart from the last few months of Gage’s life, we know of only one employer and one occupation. In the nine and a half years between the time he was well enough to resume work (early 1850) and his leaving Chile to rejoin his family (mid-1859), Phineas worked for nearly a year and a half in Hanover, and for nearly seven caring for horses and driving coaches in Chile. In the first job he was employed only by the one employer (Currier), and while we do not know how many employers he had in Chile, Harlow only writes of one occupation.

A careful reading of what Harlow does say about Gage changing jobs suggests that that characteristic emerged only after his first convulsions in February 1860. Harlow says that following his return from Chile, and after he had regained his health, Phineas worked for ‘a farmer’ in Santa Clara. The sentence in which he says this ends with the phrase ‘he did not remain there long’, and occurs immediately before the next sentence in which the first seizures are described. Now, if Gage did return on about 1st. July, 1859, and took, say, two or three months to recuperate, the three or four months that elapsed before the convulsions would qualify as the relatively short period for which he worked for that farmer. Further, Harlow places his only mention of Gage changing jobs in the next sentence where he quotes verbatim from a letter from Gage’s mother or brother-in-law, emphasising that Phineas ‘Had been ploughing the day before he had the first attack; got better in a few days, and continued to work in *various places*’; could not do much, *changing often*, ‘and always finding something that did not suit him in every place he tried’.

J. B. S. Jackson’s (1870) account supports this reading. Jackson follows Harlow in saying that Gage ‘went to work upon *a farm*’ (my emphasis) when he had regained his health, but uses the plural after the first convulsions, ‘In a few days he was better, and did at different times, various *kinds* of work’ (my emphasis). At no other place does Harlow, Jackson, or any other contemporaneous writer say anything other than this about Gage changing employers.

Gage as Other Patients

Some of Gage’s alleged behaviour clearly comes from the characteristics of other cases being attributed to his. Thus, although there is absolutely no data on Gage’s sexual life, Vincent (1996), for example, pictures him as suffering from decreased sexual activity while at the same time being disinhibited in his ‘moral attitudes’ to sex. Vincent is here virtually repeating what Brickner (1934, 1936) strongly implied about his patient, Joe A., what was actually said by Russell (1948. cf. Fulton, 1949b) about one of his patients, and by Freeman and Watts (1950) about some of their lobotomised patients.

Other characterisations of Gage’s sexuality come from a more complex slippage in reasoning. Thus Dimond (1980) draws a parallel between Gage and an aggressive and violently quarrelsome patient of Welt’s. A few paragraphs later Dimond places Harlow’s 1868 paper in a set of papers apparently providing evidence for the facts that (1) frontal damage often causes the puerile sense of humour to which Jastrowitz had drawn attention, and named *Witzelsucht* by Oppenheim, and that (2) leucotomised patients often become irresponsible over business decisions, exhibit abusiveness and uncontrolled profanity, and are promiscuous and overbearing in sexual behaviour. Somewhat similarly, in the earlier edition of his text, Myers (1986) introduced Gage in the context of his being a classic case of frontal damage that left people more uninhibited, profane, or even promiscuous (the 1998 edition drops the reference to promiscuity). Crider et al. (1983) make the same kind of connection, Beaumont (1983) comes very close to it, and I suspect a similar source to the unspecified alterations in sexual behaviour that

Fromkin et al. (1990) include among the 'major changes' to Gage.

Many of Gage's other characteristics come from the brain surgery and psychosurgery literature of the 1930's. Gage's slovenly personal habits seem to come from Mettler's summary in the Columbia-Greystone Associates (1949) research of the changes produced by lobotomy. After mentioning Gage, Mettler immediately goes on to describe a patient of Welt's who changed from a gay, polite, and cleanly person to a violently quarrelsome 'sloven'. Read quickly, it is easy to attribute Mettler's description of the changes in personal habits of this other patient to Gage. Similarly, when Zimbardo and Ruch (1979) say it was Gage's family and friends and not his doctor who noticed the changes, they are undoubtedly referring to what was sometimes said about the effects of some of the early operations in which whole lobes were removed to control epilepsy or the spread of tumours. For example, Penfield (Penfield & Evans, 1934, 1935) said almost this about the changes in his sister, and Rylander (1939) certainly did so in retelling the story. Gage's supposed general lack of concern (Walsh, 1978), his curious lack of concern for matters he had formerly cared about (Rosenzweig & Leiman, 1982), and his showing little emotion, losing his former values, and becoming unreliable in his personal habits (Kalat, 1996) almost certainly seep in from those sources.

Note that Harlow's Gage who was a 'child in his intellectual capacity' has become like a child, or is childish, and that this quality also seems to come from this other literature. In describing Joe A., Brickner (1934) drew a parallel between 'the puerile quality of practically every act and expression' of his patient and the associations and behaviour of children. He attributed puerility to Joe A.'s lack of restraint (Brickner's term for loss of inhibition) making it impossible for him to utilise the 'adult' knowledge he once had had. Some years later, Brickner (1938, and his discussion in Ackerly & Benton, 1948) made the parallel even more explicit. However, where Brickner, and perhaps others, was referring to the functional similarity between the child lacking knowledge and the frontal patient having it

but not being able to use it, later writers have made the comparison a global one. For them, Gage was simply childish. Thus Henderson and Gillespie (1944) outlined childishness, the loss of the finer feelings, and intellectual and emotional decay as the main changes brought about by frontal lesions, and illustrated their point with Gage. Taking the point even further, Freeman and Watts (1950) implied there was a parallel between the changes in Gage and what they termed 'surgically induced childhood' they said they sometimes saw for a short time after frontal leucotomy.

Could this be the child described by McMahon and McMahon (1982) who has the fits of temper? The not-now-understood 'animal passions' of yesteryear are replaced with the sex of today, and the sexual life of others attributed to Gage. Could it be this combination of child-like intellect and sexual passion that turns Gage into a depraved child?

From the contexts in which the remarks occur, I also suspect that the observations of patients undergoing radical surgery or lobotomy are the source for what is variously referred to as Gage's inability to plan (Lahey, 1992), to make or follow any consistent life or long term plan (Kalat, 1996; Bloom & Lazerson, 1998), or to make and carry out any plans (Carlson, 1994, 1995; Tavris & Wade, 1997). All of these descriptions seem to me to be different from Harlow's 'devising many plans of future operation, which are no sooner arranged than they are abandoned in turn for others appearing more feasible'.

Gage as Metaphorical Alcoholic

Harlow says nothing about Gage's drinking but there are two little-known mentions of it in the nineteenth century literature, so that the picture of Gage as drinking heavily almost certainly has a more modern source. The earliest of the modern references that I came upon is that by Treisman (1968) who gives Fulton as the source of his description of Gage being 'frequently drunk'. However, neither in that work, nor another of the same year with which it may have been confused, does Fulton say anything at all about Gage's drinking (Fulton, 1949a, 1949b). In this second work there is a more general ref-

erence to the effects of alcohol. Endeavouring to convey what the behaviour of their chimpanzee subjects was like after removal of the frontal areas, Fulton drew a parallel, rather as Elder and Miles (1902) had done with their patient, between ‘the fatuous equanimity of spirit’ shown by the chimpanzees and that of ‘the good natured drunkard’. The parallel might just be the basis of Treisman’s attribution.

Turning to the two nineteenth century references to Gage’s drinking, we find they do not constitute very strong evidence. The earliest is that of Wilson (1879), and was found by Dr. Fred Barker (1995). It occurs in the course of an attack on phrenology in which Wilson asserted that Gage’s intelligence had not been affected, and then claimed that few would attribute ‘the drinking habits which finally beset him’ to his damaged brain. The other reference is one I found and is some twenty years later than Barker’s. Hughes (1897), giving no source, wrote that Gage had led ‘an irregular life, in which intemperance played a part’. We are entitled to be suspicious of Hughes’ statement because he also says that whichever of Bowditch or Warren showed him Gage’s skull at the Boston General Hospital in 1868, told him that Gage ‘was actually intellectually a brighter man after than before the accident’.

Neither of these references seems to be cited by anyone else who has written on Gage, including those who class him as an excessive drinker. I know that Dr. Barker regards the context of Wilson’s remark, as well as the remark itself, as being very weak evidence that Gage was a heavy drinker. Nor is Hughes’ saying that intemperance ‘played a part’ in Gage’s alleged irregular life quite the same thing as saying he was a drunkard. Together the references are far from compelling. In the absence of other evidence, it seems to me that the twentieth century attribution of excessive drinking to Gage may be based on a misinterpretation of Fulton’s parallel. There is certainly no evidence for the fable of Gage drinking and brawling in questionable places, being frequently drunk, becoming a drunkard, or dying in careless dissipation (Smith A, 1984, 1985; Damasio H et al., 1994; Damasio AR, 1994).

Barnum’s Museum as Circus

Rather in the manner that a Bartlett might have predicted, there are elaborations of Gage’s post-accident history based on interpretations of those parts of the story, usually the parts less well-known to the authors, that can be fitted into their existing cognitive frameworks. Thus, if the circus in which Gage appears is specified, it is Barnum’s Circus – because it is his circus and not his earlier and once permanent museum in New York City for which Barnum is now remembered. Beekman, Restak, and Steegmann provide excellent examples of this point. Steegmann (1962) quotes extensively from and accurately summarises Harlow’s 1868 paper, but errs in giving ‘Barnum’s Circus in New York’ as one of the places to which Gage wandered. Similarly, at the same points of their otherwise detailed accounts, Restak (1984) says Gage ‘hooked up with P. T. Barnum and performed in fairgrounds and circus tents around the country’, and Beekman (1945) lapses into the vagueness of having Gage exhibit himself ‘about the country’. More generally, if Gage is an exhibit or a freak in an unspecified fairground, it is probably because it is in that kind of place that one sees (or once saw) exhibitions of freaks.

Similarly if Gage is untrustworthy, a liar, or psychopath, that seems to be because his ‘recitals of his wonderful feats and hairbreadth escapes’ to his nephews and nieces have been fitted into frameworks that place these larger kinds of alterations among the consequences of frontal damage. Incidentally, the family history (which I have traced) shows he had acquired no ‘little nephews and nieces’ until returning from Chile, and the stories he told them are the only indications of his untruthfulness.

One of the most interesting elaborations to fit Gage into an existing theoretical framework gives a pseudo-biological explanation of the changes. Weisfeld (1997) argues that orbito-frontal damage generally causes an impairment in pride and shame, the loss of concern for conscientious job performance, and the loss of the most basic social courtesies. He then draws an analogy between Gage’s behaviour and that of monkeys with posterior orbito-frontal lesions. Lesioned monkeys lose their positions in their

dominance hierarchies, and show less aggressiveness and more inappropriate reactions to the ranks of their cagemates. Weisfeld supposes these changes parallel Gage's reduced sensitivity to the reactions that others had to his reactions toward them, and that it explains the lack of deference he showed his fellows. Although Weisfeld does not refer to it, there is considerable mention of a similar impairment in emotional functioning as among the secondary psychological effects that add to the fairly direct effect of the brain damage on Gage's social behaviour (e.g., secondary effects in Altrocchi, 1980; Ruch, 1984; Bloom et al. 1985; Bloom & Lazerson, 1988; Dworetzky, 1988; Sdorow, 1990; cf. Dimond, 1980, Beaumont, 1983 for the direct effect). While all these explanations are plausible, most of Gage's behaviour here is supposition: we actually know nothing about Gage's aggressiveness, and most other artists paint Gage as *more* aggressive, not *less*.

HARLOW AS FRONTAL LOBE THEORETICIAN

Lately there is another attribution in the Gage case of knowledge obtained elsewhere. Only this time the attribution is to Harlow rather than to Gage. Hanna and Antonio Damasio and their colleagues attribute to Harlow 'the perceptive insight' that there were 'structures in the brain dedicated to the planning and execution of personally and socially suitable behavior, to the aspect of reasoning known as rationality'. They assert that Harlow's suggestions were not accepted at the time because (1) unlike the data through which the lesions in Broca's and Wernicke's aphasia were located, there were no autopsy data on the precise position of Gage's lesion, and (2) reasoning and social behaviour, not being extricable from ethics and religion, were 'not amenable to biological explanation' (Damasio H et al., 1994; cf. Damasio AR, 1994). Expanding on this suggestion, Hockenbury and Hockenbury (1997) have Harlow suggesting or proposing explicitly that the frontal lobes were involved in emotional behaviour, in reasoning, in the capacity to plan and think, and

in decision-making. They add a third reason for Harlow's theoretical ideas not being accepted: they were too close to the phrenological insistence that the brain did have functions.

Pleasantly plausible as this story may seem, there is absolutely nothing in Harlow's published or unpublished work that even hints at his formulating a theory of frontal lobe functioning, let alone an emotional/reasoning one. In his 1868 paper, Harlow neither made an explicit case for 'moral qualities' being localised in the brain nor put forward a theory that would explain how that could be. This was not because thinking along those lines was not acceptable at the time. Leaving the theories of Gall and the phrenologists aside, there was a host of physiologists and psychologists from Marshall Hall onward who proposed that conscience and the will were functions of the cerebral hemispheres. True, many of these were philosophical dualists opposed to localisation; but many were not. Even if the medullary keyboard on which Johannes Müller's mentalistic pianist played was situated below the brain proper, it was the role Müller (1833–42/1833–1840) gave spontaneous foetal movement that Bain (1855, 1859) eventually developed into a physiological theory of the will (Macmillan, 19992a, 1992b).

If it were the merit of Bain to develop Müller's suggestion that the basis of the will was spontaneous movement, it was Ferrier's (1876) to found its mechanism on a physiological inhibitory process. That Bain's and Ferrier's ideas on conscience and will were not accepted had nothing to do with resistance based on ethics or religion. Bain's notion of conscience being acquired through fear, rather than being a God-given quality, was not objected to on those grounds. Nor was special exception taken to his notion that conscience reflected the world of the child in its mind and that that mind was located in the child's brain. A physiological basis for the will like that proposed by Ferrier was accepted explicitly and wholeheartedly by the most influential writers of the day, for example, Ribot (1874, 1894) in France, and Wundt (1896/1897) in Germany.

What the theories of that time lacked was an acceptable physiological mechanism that would

explain how the brain performed such ‘higher’ psychological functions. What practically guaranteed their explanatory failure was the vagueness of the mechanisms then proposed. It is hard to see how ethical or religious objections could be relevant. Similarly with Ferrier’s later alternative – the attentional mechanism that he located frontally (Ferrier, 1886). Was it any more acceptable or unacceptable on religious or ethical grounds? I know of no attacks on either theory of will, let alone that they were grounded in ethical or religious considerations.

Nor is it really possible to argue that the localisation of supposedly simpler functions like movement and language was more readily accepted at that time. Even in 1868, one could not be certain what was meant by their localisation, and what the clinical evidence showed about language was as debatable as H. Damasio et al. claim the localisation of moral qualities to have been. In fact, as both the papers of Marie (1906a, 1906b) critical of Broca, and the more than 1,200 studies considered by Moutier (1908) in his massive evaluation of the literature indicate, whether language was localised in any way was still being debated very vigorously at the beginning of the twentieth century.

CONCLUSION

Almost everyone agrees that science is different from art. From the artist we expect that the essentials of a serious subject will be conveyed with power and conviction, and, terming it artistic licence, we forgive or allow that some aspects of the truth may be sacrificed for artistic effect. Scientific reports and interpretations are governed by very different rules; one expects the scientist to investigate phenomena without prejudice, to collect data comprehensively, and to weigh conclusions judiciously. Scientific representations are supposed to portray things as they really are. Phrases that would correspond to an essential feature of the end point of artistic endeavour, such as ‘scientific licence’ or ‘scientific effect,’ not only do not exist, it is hard to see what meaning they could have if they did.

Yet we are forced to draw on some such notions if we are to understand the pictures of Phineas Gage we find in much of the psychological, psychiatric, medical, physiological, linguistic, and general neuroscientific literature. To understand Phineas Gage properly we have no alternative but to do away with caricatures such as these and return to Harlow’s original portrait.

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APPENDIX: THE PRIMARY DESCRIPTIONS OF PHINEAS GAGE

Pre-Accident

(a) From Harlow (1848): Gage was of ‘vigorous physical organization, temperate habits, and possessed of considerable energy of character.’

(b) From Harlow (1868, 1869): Gage was a ‘perfectly healthy, strong and active young man ... possessing an iron will as well as an iron frame; muscular system unusually well-developed – having had scarcely a day’s illness from his childhood.’ His temperament was ‘nervo-bilious,’ and he was not given to profanity.

Educationally and psychologically, ‘although untrained in the schools, he possessed a well-balanced mind, and was looked upon by those who knew him as a shrewd, smart business man, very energetic and persistent in executing all his plans of operation.’

Gage’s contractors then ‘regarded him as the most efficient and capable foreman in their employ.’
 (c) From the Anonymous (1851) report in the *American Phrenological Journal*: Gage was ‘quiet and respectful’ before the accident.

Immediate Post-Accident

(d) From Harlow (1868, 1869): In April, 1849 ‘His physical health is good, and I am inclined to say that he has fully recovered.’

(e) From Gage’s mother and brother-in-law (August, 1849, via J. B. S. Jackson, 1849):
 ‘abt. February he was able to do a little work abt. ye horses & barn, feedg. ye cattle &c.; that as ye time for ploughing came [May or June] he was able to do half a days work after that & bore it well.’

‘He was weak and childish on getting home but now appears well in mind, exc. that his memory seems somewhat impaired; a stranger wd notice nothing peculiar.’

(f) Standing Committee on Surgery (1850), Report: ‘A friend writes us, April 27th., 1850, that it is certain his mental powers are greatly impaired. This is stated by the family to which he belongs, and it is their belief that this degenerating process is still going on. He has also lost bodily powers although this fact is not so clearly manifested as the deficiency of his mental faculties.’

(g) From the Anonymous (1851) report in the *American Phrenological Journal*: ‘after the man recovered, and while recovering, he was gross, profane, coarse, and vulgar, to such a degree that his society was intolerable to decent people.’

Psychological and Behavioural Changes

(h) Harlow (1868, 1869): ‘His contractors, who regarded him as the most efficient and capable foreman in their employ previous to his injury, considered the change in his mind so marked that they could not give him his place again. The equilibrium or balance, so to speak, between his intellectual faculties and his animal propensities, seems to have been destroyed. He is fitful, irreverent, indulging at times in the grossest profanity (which was not previously his custom), manifesting but little deference for his fellows, impatient of restraint or advice when it conflicts with his desires, at times pertinaciously obstinate, yet capricious and vacillating, devising many plans of future operation, which are no sooner arranged than they are abandoned in turn for others appearing more feasible. A child in his intellectual capacity and manifestations, he has the animal passions of a strong man. Previous to his injury, although untrained in the schools, he possessed a well-balanced mind, and was looked upon by those who knew him as a shrewd, smart business man, very energetic and persistent in executing all his plans of operation. In this regard his mind was radically changed, so decidedly that his friends and acquaintances said he was “no longer Gage.”’

In summary, ‘Mentally the recovery was only partial, his intellectual faculties being decidedly

impaired, but not totally lost; nothing like dementia, but they were enfeebled in their manifestations, his mental operations being perfect in kind, but not in degree or quantity.'

Subsequent History

(i) Harlow (1868, 1869): 'He took to travelling and visited Boston, and most of the larger New England towns, and New York, remaining awhile in the latter place at Barnum's with his iron. 1851 he engaged with Mr. Jonathan Currier, of Hanover, New Hampshire, to work in his livery stable. He remained there without any interruption from ill health for nearly of quite a year and a half.'

In August 1852 'he engaged with a man who was going to Chili to establish a line of coaches at Valparaiso. He remained in Chili ... nearly eight years, occupied in caring for horses, and often driving a coach heavily laden and drawn by six horses.'

His health failed and he left Chile for San Francisco. After 'his health improved, and being anxious to work he engaged with a farmer in Santa Clara, but did not remain there long. In February, [1860], while sitting at dinner, he fell in a fit, and soon after had two or three fits in succession. He had no premonition of these attacks, or any subsequent ill feeling.'

Harlow then quotes verbatim, with emphasis, from a letter by Gage's mother or brother-in-law 'Had been ploughing the day before he had the first attack; got better in a few days, and continued to work in *various places*;' could not do much, *changing often*, 'and always finding something that did not suit him in every place he tried.'

(j) From J. B. S. Jackson (1870): Phineas 'went to work upon *a farm*' (singular) but the plural is used after the first convulsion, 'In a few days he was better, and did at different times, various *kinds* of work.'

(k) From Harlow (1868, 1869): 'His mother ... informs me that Phineas was accustomed to entertain his little nephews and nieces with the most fabulous recitals of his wonderful feats and hair-breadth escapes, without any foundation except in his fancy. He conceived a great fondness for pets and souvenirs, especially for children, horses and dogs — only exceeded by his attachment for his tamping iron, which was his constant companion during the remainder of his life.'

(l) Three months after this first convulsion, on the 18th. of May, Phineas left Santa Clara to return to his mother. Two days later, at 5 a.m., he had a severe convulsion. Despite his being bled, the seizure was the first of a series that were repeated frequently over the next day and night and Phineas Gage expired, Harlow says, at 10 p.m. on 21st. May, 1861.

(l) From Macmillan (1986): Gage died on 21st. May 1860 [Funeral and interment records to be partly reproduced in Macmillan, 2000, in press] and no post-mortem study was conducted. The body was exhumed in [? December 1867], the skull removed, and taken to Harlow who reported on the damage to it and the changes in Gage in 1868.