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On the Margins of Science: The Social Construction of Rejected Knowledge

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Contents

		Page
Introduction	Roy Wallis	5
Reflections on Deviant Science	R. G. A. Dolby	9
On the Role of Interests in Scientific Change	Barry Barnes and Donald MacKenzie	49
Between Orthodoxy and Oblivion: The Normalisation of Deviance in Science	Brian Wynne	67
A Study in the Legitimisation of Knowledge: The 'Success' of Medicine and the 'Failure' of Astrology	Peter W. G. Wright	85
Professional Deviants and the History of Medicine: Medical Mesmerists in Victorian Britain	Terry M. Parssinen	103
Scientific Controversy and Socio-Cognitive Metonymy: The Case of Acupuncture	A. J. Webster	121
The Politics of Observation: Cerebral Anatomy and Social Interests in the Edinburgh Phrenology Disputes	Steven Shapin	139
In The Beginning: The Battle of Creationist Science Against Evolutionism	Eileen Barker	179
Between Scepticism and Credulity: A Study of Victorian Scientific Attitudes to Modern Spiritualism	Jon Palfreman	201
The Construction of the Paranormal: Nothing Unscientific is Happening	H. M. Collins and T. J. Pinch	237
Experimental Parapsychology as a Rejected Science	Paul D. Allison	271
Knowledge About Sea-Serpents	Ron Westrum	293
Ufology: The Intellectual Development and Social Context of the Study of Unidentified Flying Objects	Joseph A. Blake	315

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THE POLITICS OF OBSERVATION: CEREBRAL ANATOMY AND SOCIAL INTERESTS IN THE EDINBURGH PHRENOLOGY DISPUTES

Steven Shapin

Hamlet: Do you see yonder cloud that's almost in shape of a camel?
Polonius: By the mass, and 'tis like a camel, indeed.
Hamlet: Me thinks it is like a weasel.
Polonius: It is backed like a weasel.
Hamlet: Or like a whale?
Polonius: Very like a whale.

A widely distributed conception of scientific knowledge is that it is generated, and acquires its objective character, by processes of disinterested contemplation. The effect of social interests on knowledge would be to distort reality, hence such interests are not expected to attend the production of knowledge which we regard as reliably scientific.

In the past, historians of science wrote as if they universally subscribed to such conceptions. More recently, however, some historians of science have been able to exhibit in detail the political and social interests that have informed the general styles, orientations, metaphors and *Weltanschauungen* of certain pieces of scientific knowledge.[1] With few exceptions,[2] the newer social history of science leaves itself open to the sometimes legitimate (often pedantic) charge that it has not shown the presence of social interests in the esoteric and technically most detailed content of that knowledge.

Thus, the concrete practice of even the more sociologically-minded historians of science might serve to reinforce the following conclusion: social factors can inform only certain layers of scientific work—the 'theoretical scaffolding' of scientific work, but not the esoteric, and really detailed, scientific content. This wuold be to subscribe to a version of empiricism, with its well-known fact-theory dichotomy. The short-comings of such a dichotomy have been widely publicised by detailed demonstrations of the ways in which theory and fact, or style and content, are intimately connected in one interacting network of meanings Likewise the conclusion that a social analysis must stop at the point at which knowledge begins to reflect or correspond to directly

observed fact is not binding on historians. The present paper aims to display the influence of social interests on an esoteric body of scientific knowledge. Specifically, it treats the rapid growth of the knowledge of cerebral anatomy in the context of the disputes over the validity of 'phrenology' in the Edinburgh of c. 1800-c. 1830.

This paper also aims to bring out a further point. It is indeed difficult for historians of science to detect the operation of social interests in the detailed knowledge generated by their subjects. There may be a reason for this; one which relates the historian's predicament to the actual role of social interests in the generation of knowledge. In many cases the reason may be that for the actors, just as for most historians, the identification of such interests would have left that knowledge open to the charge of bias—of not being knowledge at all. In the Edinburgh disputes over phrenology, as in most other scientific contexts, a participant could hope to discredit the knowledge of his opponent by detecting the presence of social interests in it. Where the effect of social interests on knowledge is held to be corrupting, the display of the presence of such interests in knowledge seems a sound strategic move. Of course, a controversy between interested parties, both of whom subscribe to this conception of knowledge and who deploy this strategy, will be one where interests are either obscured or minimised.[3] That is, each party may actually encounter or prefigure an 'exposure of interest' by its opponents. Each party's reaction may then well be to produce accounts in which it becomes more and more difficult for its opponents to expose interests. There is a risk of apparent sophistry in making this point: one does not propose immediately to infer from the absence of apparent interests to their real presence, but, rather, to introduce a further tactic into the search for such interests, viz. the realisation that it may be the operation of such interests which has been responsible for their very invisibility. Of course, this process must itself be historically identifiable, and it will be one of the aims of the present paper to show it at work.

What follows is divided into eight parts. In the first I briefly introduce the nature and historical origins of phrenology. In the next two I situate certain controversies over the status of phrenology in a defined local social and ideological context—the Edinburgh of the first three decades of the nineteenth century. I then examine a series of four increasingly esoteric issues in cerebral anatomy which were objects of dispute in the Edinburgh context, and I conclude by offering

some speculations of general relevance to our conceptions of the relationship between social interests and esoteric bodies of knowledge.

Phrenology: Its Doctrines and Origins

The roots of phrenology may almost certainly be traced to Lavater's eighteenth-century physiognomical system of judging character from facial appearance, and probably penetrate even deeper, into folkloric techniques of psychological imputation. But the formal, codified corpus with which we are concerned here owed its origins to the work of two German-born, Vienna-trained physicians—Franz Joseph Gall (1758-1828), and his associate Johann Gaspar Spurzheim (1776-1832).[4] Working first in Vienna as a physician to a lunatic asylum, Gall developed a 'cranioscopic' system upon which he lectured to fashionable audiences, before the lectures were banned in 1802 by an Austrian government concerned about their tendency to the subversion of religion. From 1804 he was assisted in anatomical researches by Spurzheim, shortly undertaking a joint lecture tour through Germany, before settling in Napoleonic Paris, where Gall remained for the rest of his life. Spurzheim, who popularised the name 'phrenology' and who had major conceptual disagreements with Gall, was the main agent of the system's dissemination abroad, especially to Great Britain and the United States, where it developed in different directions from the Continental formulation and obtained massive popularity.[5]

The major tracts on the new system began to appear in Paris from 1810, but even as early as 1803 the *Edinburgh Review* could rhetorically ask its readers: 'Of Dr Gall, and his skulls, who has not heard?'[6] British medical men and scientists began to be apprised of the debate then raging in France over Gall and Spurzheim's claims in 1806,[7] and, in 1809, general publicity was given to the findings of an inquiry conducted into Gall and Spurzheim's neuro-anatomical work by a committee of the French National Institute, under the auspices of the eminent comparative anatomist Cuvier.[8] The massive *Anatomie et physiologie du systême nerveux en général et du cerveau en particulier* was published from 1810 to 1819, and from 1822 to 1825 Gall brought out his *Sur les fonctions du cerveau.*[9] In 1815 Spurzheim rendered the elements of the system accessible to English-speaking readers with his *Physiognomical System of Drs. Gall and Spurzheim,*[10] and, when, in 1816, he arrived in Britain for the first time, the controversy with which we are concerned here was set alight,

raging through the 1810s and 1820s until phrenology was effectively rejected as a scientific system in the 1830s.

As phrenology's intellectual structure and historiography have been fully detailed elsewhere,[11] I shall confine myself here to a brief synopsis of its three fundamental tenets. First was the contention that the brain was the organ of the mind. In itself an unexceptional proposition at the beginning of the nineteenth century, it might be seen (in Gall's case, quite rightly) as the foundation of a materialist programme, intended to assert the non-existence of an immaterial soul. Certainly, both Continental authorities and the Presbyterian Kirk in Scotland were put on their guard by this primary phrenological claim. Second, the phrenologists argued that the mind was not a single psychological entity, nor was the brain a single unified organ. Rather, the brain was a congeries of organs, topographically distinct, each of which subserved a distinct mental function. Thus, there was an organ of 'adhesiveness', the role of which was to manifest individuals' tendency to cling to surrounding objects, such as one's house. Another organ subserved 'hope'; yet another expressed 'philoprogenitiveness' (the tendency to procreate and nurture children). In various phrenologists' systems the number, naming and location of organs varied, but in the period we are discussing there were generally agreed to be from 27 to 33 such organs, displayed on phrenological busts and skulls like that shown in figure 1. The third basic dictum of phrenology was that, all things being equal, the size of the cerebral organ was a measure of the power of its functioning. In other words, if one had a large organ of 'amativeness', one might tend towards 'la disposition fortes à l'amour physique'. Similarly, an unusually small organ of 'tune' tended to render its possessor insensible to melody or even make him tone-deaf. An important corollary of this doctrine was that the contours of the skull were shaped by, and followed, the variations in the sizes of the underlying cerebral organs, so that one could diagnose innate mental make-up from the 'bumps' and depressions apparent on the exterior surface of the skull.[12]

Again, it is impossible here to go into great detail about how Gall and Spurzheim derived their 'organology', but it is important in this connection to stress that it was *not* by means of cerebral anatomy—the investigation of actual structures in the brain and on its surface. Three sources for the organology were repeatedly mentioned by Gall and Spurzheim. Gall himself liked to emphasise how he observed clear

correlations between the behaviour of his school-mates and their external cranial contours. Later on, he and Spurzheim displayed busts and portraits of individuals celebrated for certain traits and abilities, pointing out their possession of the appropriate 'bumps'. Thus, engravings of Chaucer ('ideality' large) and Locke ('ideality' small) were crucial visual confirmation of the organology. The second alleged line of research derived from cranial comparative anatomy. The skull shapes of various animals were displayed as evidence of their accurate reflection of the beasts' 'known' psychic and behavioural attributes. Thus, the 'bump' for amativeness is appropriately large in rabbits; that for 'cautiousness' is well-reflected in the crania of birds. And, finally, 'knowledge' of racial and sexual traits was also brought to bear in the construction of an organology. 'Veneration' was found to be large amongst the superstitious and credulous Negroid races; 'amativeness' was well-known to be small in women.[13] This sort of evidence, which correlated structure and function and made each illuminate the other, the phrenologists liked to term 'physiological', and it was by physiological, and not by anatomical, investigations that the enumeration and mapping of organs was achieved. The skull did *not* require to be opened up and the brain displayed in order for the system to be established. Gall, as Temkin reveals, made his conjecture about the multiplicity of cerebral organs years before he undertook anatomical research on the brain.[14]

Phrenology and Social Interests in Edinburgh

Phrenology was in one sense a system of psychological diagnosis, a technique for discerning mental characteristics from external appearances. But if it had been merely a diagnostic tool, phrenology would never have aroused the intensely polemical opposition, and gained the wide public acceptance, which we know it did. Nowhere was critical reaction to the phrenological system more virulent than in the Scottish capital of Edinburgh, which was likewise the capital for the dissemination of the British form of phrenology to a popular audience.

As we know, phrenology was not merely a diagnostic tool. It was very rapidly developed by Spurzheim and his Scottish disciples into the foundations of a far-reaching programme of social and cultural reform. This explicit development took time, although George Combe's characteristic interest in educational reform and the demystification of academic mental philosophy began to appear very

shortly after Spurzheim's 1816-17 visit to Edinburgh.[15] Gall and Spurzheim's Continental system was, as we have seen, well known in Edinburgh from at least 1803. At the time of Spurzheim's first English publication in 1815 phrenology already appeared as an anti-establishment 'breaker' of systems; as an anti-academic, scientistic de-mystifier of idealist philosophies; as a materialistic *bête noire* of spiritual religions; and as a deviant new body of neuro-anatomy. Although Scottish phrenology clearly developed in response to local social and cultural conditions, its initial image in the Edinburgh of 1815 situated it quite clearly in a system of conflicting social interests. It was this system which provided the context for the development of phrenology into an explicit social programme, and which was the background against which the Edinburgh disputes over technical anatomical issues occurred.[16]

The introduction and early career of phrenology in Edinburgh has been well detailed by Cantor.[17] The 1815 publication of Spurzheim's *Physiognomical System*, and his subsequent visit to Edinburgh to publicise the doctrine, triggered the initial outburst of local criticism and resulted in the recruitment of his major British convert, the lawyer George Combe (1788-1858). From 1815 until the end of the 1820s phrenology was under almost continuous siege from Edinburgh intellectuals. The city was very well equipped to combat a deviant new system of mental science. It was the home of a great scientific and philosophical University, with a world-renowned clinical medical school; it had Royal Colleges of Physicians and Surgeons, as well as numbers of highly qualified 'extra-mural' lecturers in anatomy and surgery. Edinburgh's politically and culturally dominant legal corporations were practically concerned with the springs of human behaviour, and their favoured schema was the Scottish Common-Sense philosophy taught in the University by Dugald Stewart, and defended in the *Edinburgh Review* by his Whig disciples.

In an earlier paper I offered an interpretation of the Edinburgh phrenology debate which linked conflicting social interests in the city to the career of the new system.[18] As I wish to use that analysis as background to the technical anatomical issues with which this paper is mainly concerned, I shall offer here only the most sketchy synopsis and refer the reader to that paper itself for substantiating evidence.

There were four main ways in which adherence to phrenology, and critical reactions towards it, were related to social interests in early

nineteenth-century Edinburgh.

(1) Phrenology can be fairly precisely located on a social map of the city from the 1810s to the 1830s. Phrenological doctrine (and practice) proved markedly more attractive to 'outsider' intellectuals, and to their audience of superior working-class and petty-bourgeois groups, than it did to establish elites. The University professoriate universally condemned it; as did the Established Kirk, the *Edinburgh Reviewers*, and the upper echelons (but by no means all) of the legal and medical professions. The ability to map phrenology in this way follows from its development into an instrument serving certain social interests.

(2) The phrenological system of Gall and Spurzheim was initially attractive to these 'outsider' intellectuals as a symbolic system which could be used as a juxtaposition to the institutionalised mental philosophy of local elites. Precisely because phrenology proceeded from the identification of what was innate in the human constitution, and because it identified the limits of human plasticity, it could be used to criticise the Enlightenment environmentalism of the Scottish Common-Sense philosophical tradition whose ideology reigned supreme among Edinburgh elites in the 1810s and 1820s.[19] Thus, phrenology furthered the symbolic expression of disaffected groups in Edinburgh, insofar as it could be seen as the 'not—x' to the 'x' of elites.

(3) Phrenology in Edinburgh was developed as the naturalistic basis for a programme of social change and institutional reform which served the interests of those groups which espoused it. The programme, broadly speaking, was to the right of the Owenites and to the left of the Whigs. The development proceeded in this manner: only when the actual innate constitution of an individual mind was scientifically diagnosed could rational and effective social policies be designed to improve individual behaviour, and, by extension, to ameliorate the social condition. Only when one knew the 'limits' could one move within what 'nature' allowed. George Combe and his Edinburgh colleagues thus elaborated a vast programme for the re-distribution of rights, privileges and priorities within British society, which followed from the premise that one could assess innate character scientifically, and then act to shift it in the desired directions. Edinburgh phrenologists

developed and lobbied for changes in the provision of education, for penal reform, the more effective treatment of the insane, 'enlightened' colonial policies, and a more humane system of factory production (identifying the disastrous consequences of capitalist exploitation of labour for the workers' psychic well-being).[20]

(4) Finally, the phrenological system of naturalistic psychology and sociology amounted in Edinburgh to an important social statement about the boundaries of participation in literate culture and commented upon the access of social groups to certifiable natural knowledge. One could, the phrenologists claimed, be fitted to employ the system in a day. The reason one could was that phrenology, like the other recognised natural sciences, was based upon observation, and, therefore, upon capacities common to *all* competent members of society. It was not, like the mental philosophy of the universities, based upon the mystifying and biassed 'method' of introspection. Hence, the ability of any competent member to 'read-off' innate character from the exterior of the skull was central to the phrenologists' social programme, and was in itself a proposition of great social significance. It re-defined the boundaries which had separated disaffected social groups from a source of crucial legitimation. An observation-based psychology opened up the social system, by opening up access to resources for its criticism and change.

These are the lines along which one can say that the debate that took place in Edinburgh during the 1810s and 1820s was basically structured by conflicts between social interests—even, to some extent, by 'class' interests. It was, in this interpretation, fundamentally a dispute over the distribution of rights and privileges in society, and it was as a symbolic and technical *instrument* in that dispute that the validity of phrenology as natural knowledge was assessed.

The Role of Anatomy in the Edinburgh Disputes

However much one feels it correct to stress the primacy of social interests in structuring the career of the Edinburgh disputes over the status of phrenological knowledge-claims, there is no reason to deny that many aspects of the controversy centred upon highly technical and esoteric cerebral anatomical matters. In certain of these issues it is extremely difficult for historians to discern the action of wider social

interests. Hence, there is the temptation to divide the Edinburgh disputes into those aspects influenced by social interests and those informed solely by idle curiosity. Before proceeding to discuss four increasingly esoteric issues in cerebral anatomy, it is necessary to make some general introductory remarks on the status of the phrenologists' anatomical work and the circumstances under which cerebral anatomy entered into the Edinburgh controversy.

Almost needless to say, no one currently believes that one can read-off character traits from the exterior of the skull, in the manner the phrenologists claimed. Phrenology is an approved object of laughter for psychologists and intellectual historians. But the cerebral and neuro-anatomy the phrenologists generated and defended is not, and was not then, entirely an object of derision. 'Truth', as historians of medicine and science are prone to use the notion, does not lie wholly on one side in the phrenology disputes. Especially as regards the fine structure of brain tissues, the phrenologists are frequently admitted to have 'got it right'. Some historians have argued that Gall and Spurzheim contributed to the progress of cerebral anatomy by focussing attention on the problem of cerebral localisation of function, which was then subjected to 'disinterested' inquiry later in the nineteenth century.[21]

Yet contemporaries and historians, while often disposed to 'give credit' to the phrenologists for acute observations, are prone to prise apart what they regard as true and worthwhile in the phrenologists' anatomy from the 'illegitimate' interests with which the observations were associated. Thus, Clarke and Dewhurst, amidst jocular references to cranioscopic claims, allow that Gall was 'an outstanding anatomist'[22] and the great medical historian Erwin Ackerknecht has gone so far as to say of Gall that 'his anatomy still stands, while his physiology has fallen long ago'.[23] The partisan biographer of one of the most bitter Edinburgh opponents of phrenology's anatomical basis admitted that, before Gall and Spurzheim, there was general 'ignorance of [the] minute structure of the brain.'[24]

Cuvier, one of the arbiters appointed by the National Institute of France to adjudicate Gall and Spurzheim's claims, credited the two with some original observations which were correct and further instances in which they provided confirmation of existing ideas of cerebral and neural structure. But Cuvier, like Ackerknecht and Clarke, was at pains to point out that 'the anatomical questions with which

we have been engaged in this report, have no immediate and necessary connection with the physiological doctrine taught by Dr. Gall . . .'.[25] What was true, in other words, had no apparent relationship to the 'illegitimate' interests of the observers.

The second prefatory point I wish to make is that the role of the phrenologists' cerebral anatomical work in the Edinburgh context was secondary and derivative. We have already seen that Gall himself developed the organology from other resources. Andrew Combe, the Edinburgh phrenologist-physician, after vigorous defence of the anatomical findings in phrenology's favour, asserted that the system 'rests almost entirely upon physiological evidence'.[26] In addition, no phrenologist (arguably including Gall himself) was primarily concerned to further disinterested advance in the knowledge of cerebral anatomy.[27] While knowledge of brain anatomy advanced during the Edinburgh controversies, no British phrenologist sought to do more than to master and defend the anatomical foundations laid down by Gall and Spurzheim. Spurzheim, who carried the system to Britain, made his interest in cultural warfare and institutional change apparent from the outset.[28] George Combe records how, in his first encounter with phrenology, at Spurzheim's 1816-17 Edinburgh demonstrations, 'he saw, from the first, that the new doctrines if true, were eminently practical; and he earnestly and deliberately, and through many difficulties, set about the task of ascertaining whether nature supported them or not.'[29] No Edinburgh phrenologist—not George Combe, his brother Andrew, Sir George Stewart Mackenzie, nor the numerous local contributors to the *Phrenological Journal*—undertook research in cerebral anatomy, except to *defend* specific components of the system. On the other hand, the Edinburgh phrenologists were assiduous in using the anatomical 'evidence' as a naturalistic resource in an increasingly elaborate and confident programme of social policy. Indeed, they constantly expressed their Baconian belief that the utility of knowledge was the only true test of its validity.[30] The success of the social programmes would prove the correctness of phrenology's anatomical basis. Thus, in terms of the founders' accounts of how phrenology was established, in terms of the motives of those who did anatomy in the phrenological context, and in terms of the hierarchy of interests in the phrenological movement, cerebral anatomical research was derivative and secondary.

What I shall do now is to present a series of four cerebral anatomical

issues discussed during the Edinburgh disputes. The issues are ordered so that each appears more esoteric and arcane than the one preceding; each takes us literally 'deeper' into the structure of the brain; and each seems more difficult to connect with wider social interests. So we can, if we like, conceive of the following as a trip into the interior of the brain, and a trip away from the apparent action of social interests on technical bodies of knowledge.

The Frontal Sinuses

The frontal sinuses are cavities between the two tables of the cranial bones, situated above and to the sides of the nose. Although their filling up with fluid is now known to contribute to the symptoms of many a 'common cold', the sinuses were not, at the beginning of the nineteenth century, subjects of medical interest nor of any significant anatomical curiosity. Alexander Monro, then professor of anatomy at Edinburgh University, depicted the frontal sinuses in 1783 as 'stylised', almost perfectly circular structures, no attention being paid to them in the accompanying text.[31] Gall and Spurzheim also paid little attention to the frontal sinuses prior to the Edinburgh controversies. Figure 2, taken from their 1810 *Atlas*, illustrates the *sphenoidal* and *ethmoidal* sinuses (situated below no.38), but the frontal sinuses are not indicated at all. Although Edinburgh phrenologists showed themselves to be generally aware of the frontal sinuses from very early on,[32] their local critics were far more intrigued by this feature of cranial anatomy. Figure 3 shows how anti-phrenologists in Edinburgh 'saw' the frontal sinuses. The relevant point to note here is that the sinuses, wherever they extend, create non-parallelism between the two tables of the cranial bones. It is also evident from figure 3 that care has been taken to depict them in a naturalistic, as opposed to a stylised, manner.

Notice the implications of structures which cause non-parallelism. Wherever there is cranial non-parallelism, at that point there is no reason to expect that the exterior contours of the skull reflect the contours of the underlying brain surface. And, if the exterior of the skull gives an imperfect account of what lies underneath, then phrenological diagnosis is impossible.[33] One might, for example, find an individual with a big 'bump' over 'individuality' which was caused not by a big cerebral organ of 'individuality', but by the appropriately shaped sinus. More generally, any instance of imperfect parallelism

between the two surfaces of the skull might be instanced as evidence of the futility of the phrenologists' diagnostic ambitions.

The Edinburgh anatomist John Gordon (1786-1818), in a scathing assault on phrenology in the 1815 *Edinburgh Review*,[34] maintained it to be common knowledge that 'the two surfaces of the bones which form the cerebral cavity of the cranium are not everywhere parallel to each other.' And, while Gordon, curiously, did not draw special attention to the frontal sinuses, he did generally contend that:

> . . . There are often considerable depressions within, where the corresponding surface without, does not exhibit the slightest appearance of projection, but is quite flat or even hollow; and that there are often large prominences without, where there are no corresponding concavities within . . .[35]

Gordon also faulted Gall and Spurzheim for failing to assign 'organs' to the inner surfaces of the temporal and occipital lobes, or to other surfaces of the cerebrum not facing the overlying cranial bone,[36] thus identifying other anatomical features which seemed to present problems for phrenological character diagnosis.

In 1824 the physician P. M. Roget critically reviewed 'Cranioscopy' in the *Supplement* to the Edinburgh-edited and published *Encyclopedia Britannica*,[37] pointing out difficulties in Gall and Spurzheim's claim that the 'bony processes' of the skull adapt 'themselves exactly to the form and size of the cerebral parts they are destined to inclose and protect'. Roget observed that there are several 'natural protuberances' on the skull which interfere with diagnosis—the mastoid processes (behind the ears), the zygomatic processes (just in front of the ears), the 'crucial spine of the occiput' (above the foramen magnum), and, most importantly, the frontal sinuses.[37a]

When, from 1826 to 1829, a sustained final assault on the anatomical basis of phrenology was mounted in Edinburgh, its leaders were the metaphysician Sir William Hamilton, Bart., (then professor of civil history and later professor of logic) and Thomas Stone (then a medical student). Both Hamilton and Stone focussed upon the issue of the frontal sinuses, their size, shape and distribution in the population.[38]

In a lecture at the University in 1827, Hamilton, who described himself as a 'mere interloper in anatomy', opened and displayed crania collected both by phrenologists and non-phrenologists. Hamilton contended (1) that no skull, including those collected by phrenologists, was totally devoid of the frontal sinuses; (2) that large sinuses

were a normal structural feature, not a feature associated solely with old age and disease; (3) that one could not tell from external signs (such as a bony ridge) whether or not the individual in question had large sinuses; (4) that the frontal sinuses were of great extent, covering as many as one-third of the phrenological organs and that they 'interpose an insuperable obstacle to observation'.[39] Hamilton, well satisfied with his anatomical findings, was

> . . . not afraid, if Phrenology is found a *phantom* as to one-third of its organs, that it will prove a *reality* in respect to the other two.[40]

Hamilton and Stone's findings did not go unchallenged in Edinburgh. George and Andrew Combe replied to their critics and enlisted the help of Spurzheim, who undertook a second visit to the city. Their responses took several tacks. Edinburgh phrenologists first of all alleged that anti-phrenologists were incompetent to judge of the anatomical issues 'through deficiency of elementary information' and through 'partiality'.[41] They maintained that the sample of skulls selected by Hamilton, even those derived from their own collections, was unsuitable for the purposes at hand, and that Hamilton had not prepared the skulls in such a way as to exhibit the true structure of the sinuses.[42]

Before his chosen audience (a public assembly for 'the relief of the distressed operatives'), George Combe displayed a collection of skulls belonging to the Edinburgh Phrenological Society and to Syme, a prominent anti-phrenological anatomist.[43] Here he showed, to the evident satisfaction of members of the audience, (1) that departures from parallelism in the two tables of the skull were negligible; (2) that the frontal sinuses did not exist in young children; (3) that they did exist after puberty, but even then to a very limited extent (such as to present some difficulty in determining perhaps two organs (fig. 1, nos. 23-24); (4) that the sinuses were occasionally found to be very large, but only in the elderly and the diseased (these categories being routinely excluded from the ambit of phrenological diagnosis anyway).

'Appeals to nature', to the 'evidence of one's senses', were made by both sides, in a vain attempt to secure public consensus and the conversion of the heathen. Skulls were sawn open, along one axis and then along another, as well as being probed by needles. They were displayed to the interested of all classes and standing. Accounts of what was seen were published in the popular press, in medical journals, in the organ of the Phrenological Society, and in books and

pamphlets for professional anatomists and the generally curious. Umpires to decide the issue by expert opinion were proposed by Hamilton and company, and an appeal to the general public was suggested by the phrenologists. A panel of umpires was duly appointed, but failed to come to a definitive finding.[44] A challenge to a *mano-à-mano* public dissection between Hamilton and Spurzheim was proposed by the latter, and declined. Exchanges grew increasingly acrimonious and undignified. Accusations of bad-faith and fraud mounted, as reality refused to be successfully negotiated, and the discussions finally collapsed in invective. Thomas Stone continued the assault into the 1830s, and George Combe intermittently responded, but it had by then long been clear that the phrenology controversy was not to be decided by appeals to anything so apparently problematic as 'nature' or the 'evidence of one's senses'.

The historian who wants to take advantage of modern knowledge in order to make his best *guess* as to how 'nature' figured in the accounts is in something of a quandary here. It is not easy to find modern medical texts which offer the sort of detailed information about the exact shape, size and demographic distribution of the frontal sinuses which (various) actors in the 1820s believed they possessed. One can argue that knowledge of these structures in fact reached its high point (although not consensus) in the context of these exchanges, and has since declined. No modern technical concern seems to require the sort of knowledge in which protagonists in the phrenology disputes evinced their interest. (In general terms, however, the standard modern teaching text *Gray's Anatomy* tends to support the phrenologists' account more than it does their opponents).[45]

That this knowledge was not generated by idle curiosity, and that this debate was not a manifestation of the intrinsic fascination frontal sinuses have for people, is readily apparent. If the sinuses were large and were universally distributed, then one could not *do* phrenological character diagnosis. And, if one could not do phrenological diagnosis, then one could not *use* it as a naturalistic resource for constructing a scientifically-legitimated social programme. This was a dispute in which anti-phrenologists attempted to demonstrate, through anatomical research, the impossibility of diagnosing structures (the cerebral organs) which, in any case, they did not believe *existed*. Hence, there is little problem in seeing what this anatomical dispute, in the course of which esoteric knowledge advanced so markedly, was, so to speak,

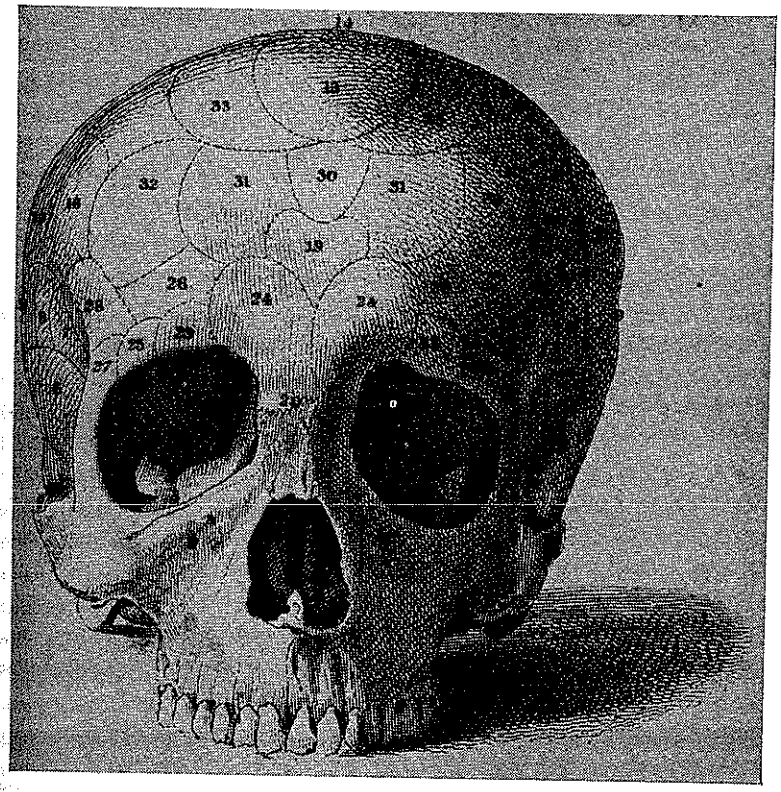

Figure 1

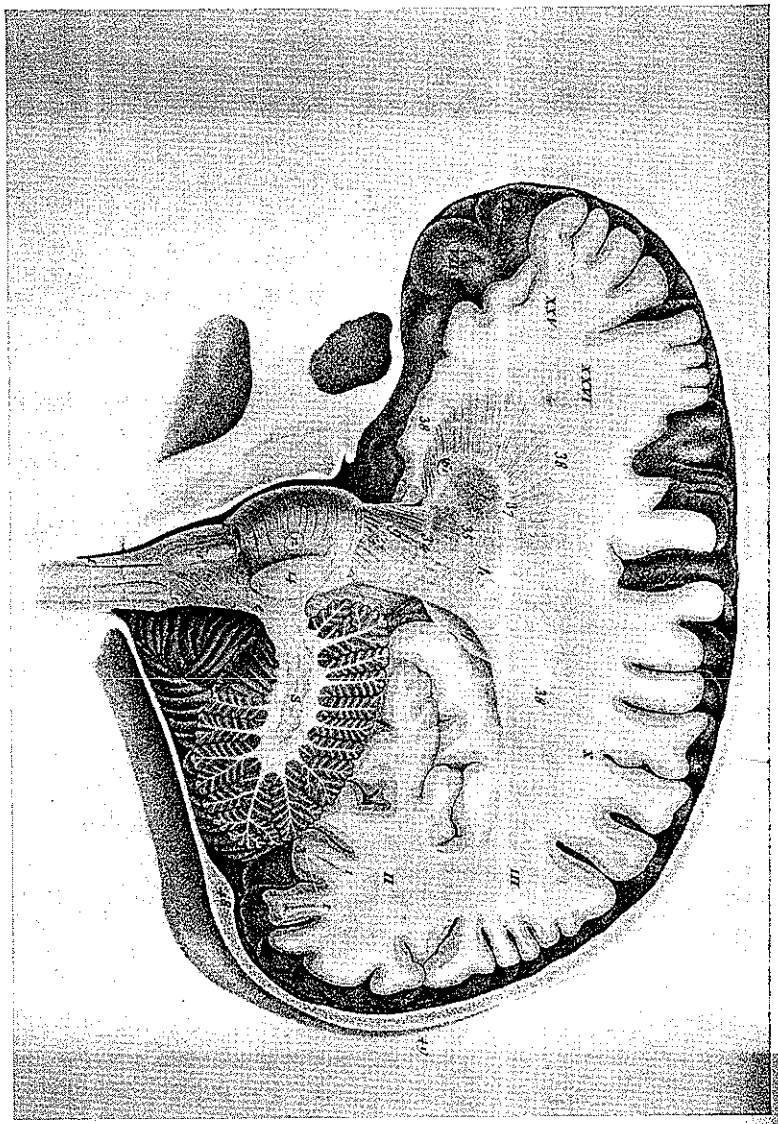

Figure 2

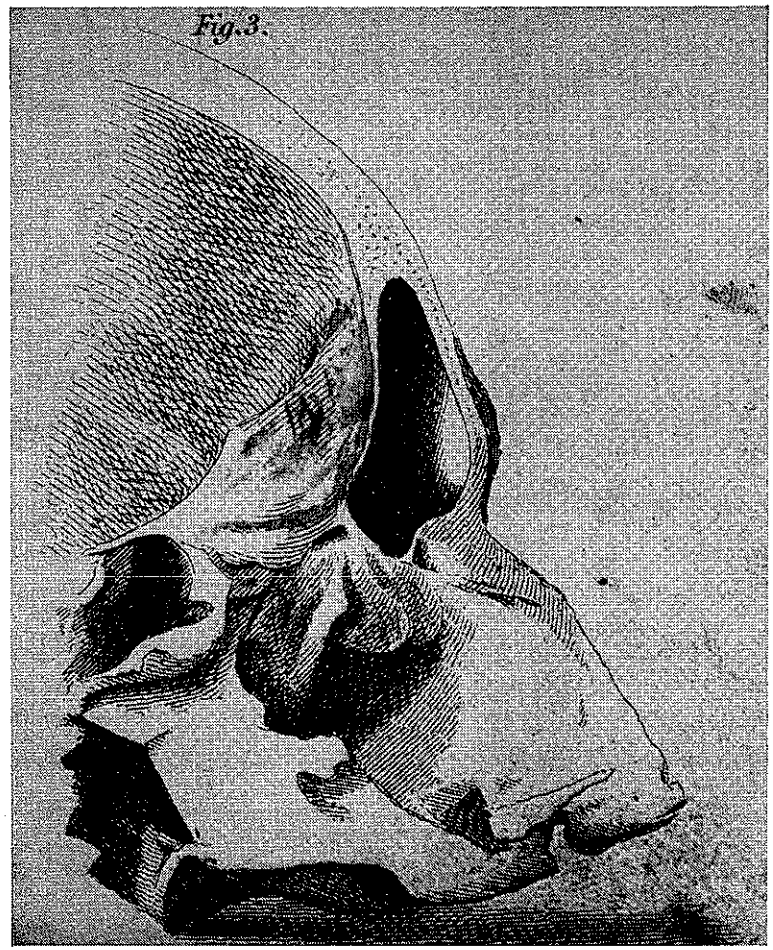

Figure 3

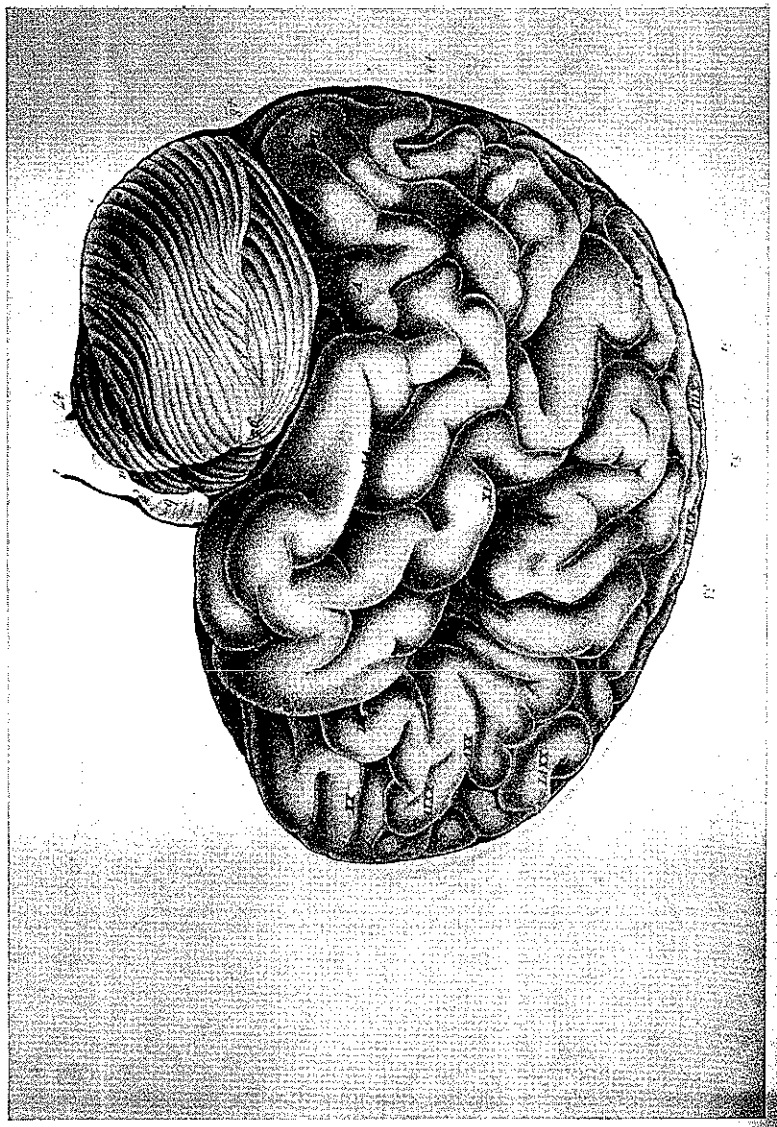

Figure 4

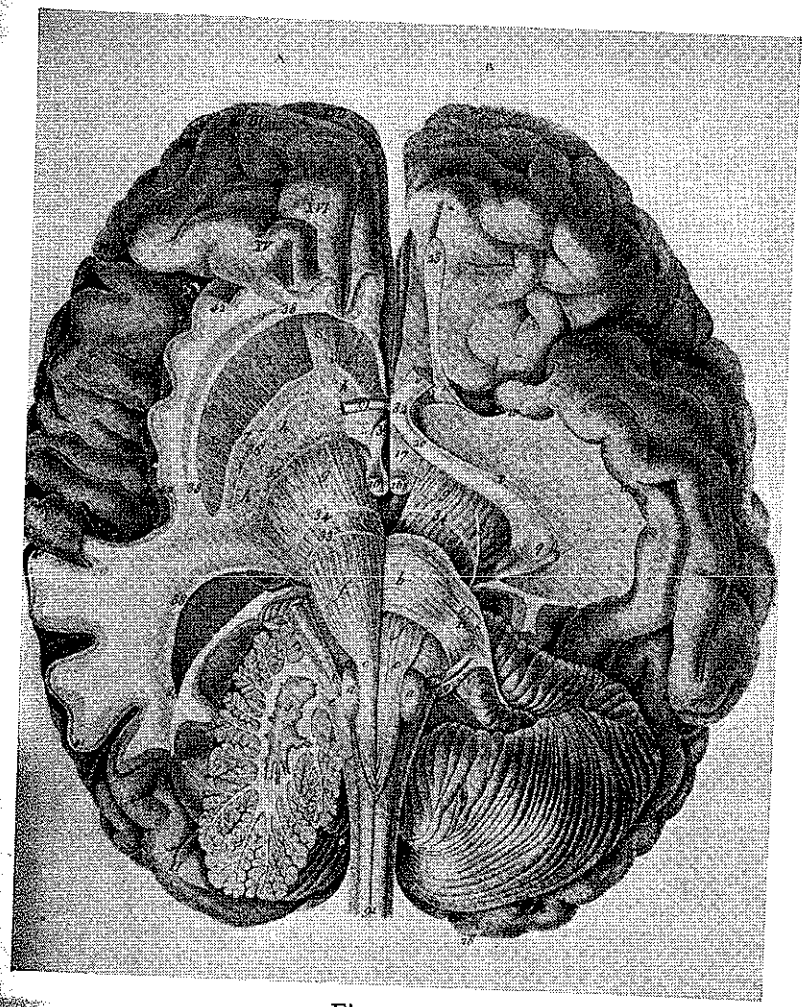

Figure 5

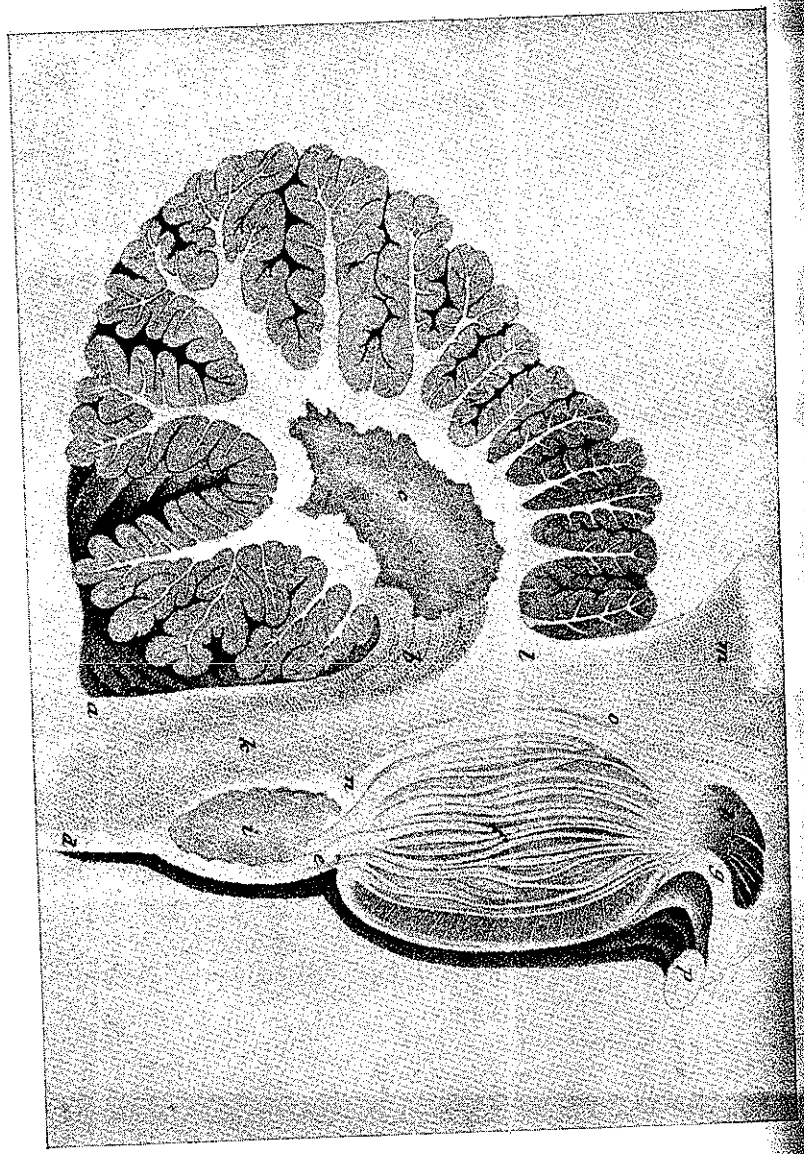

Figure 6

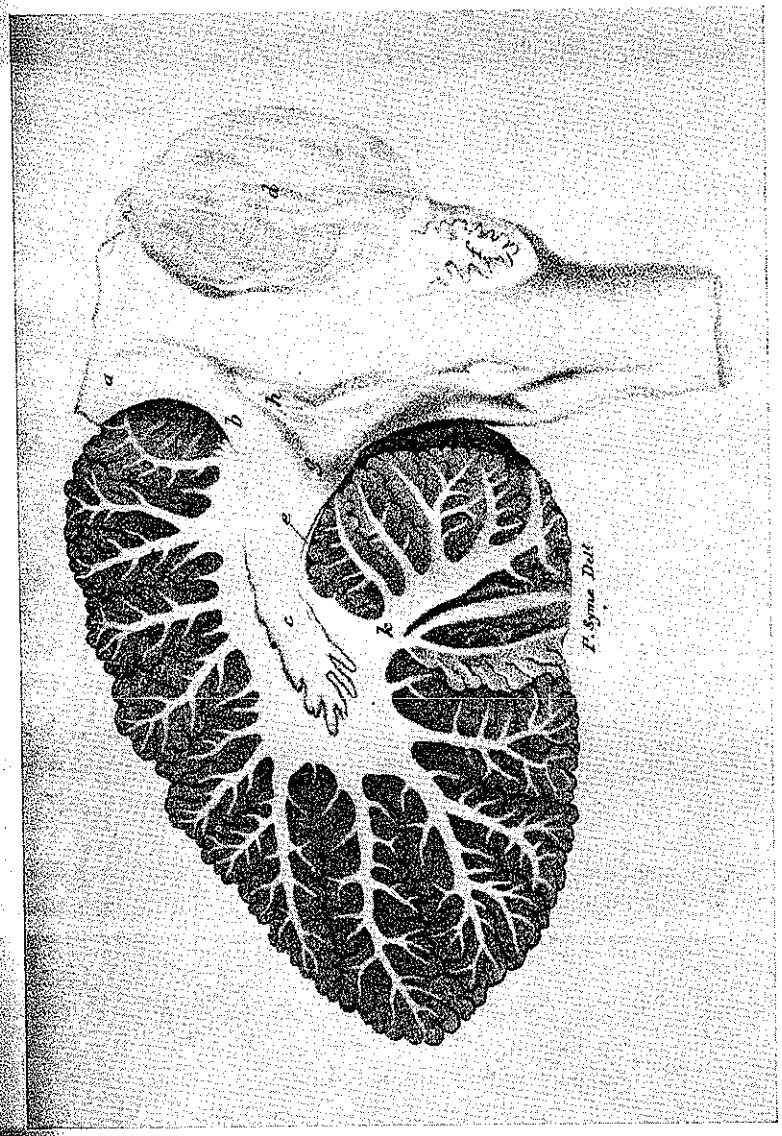

Figure 7

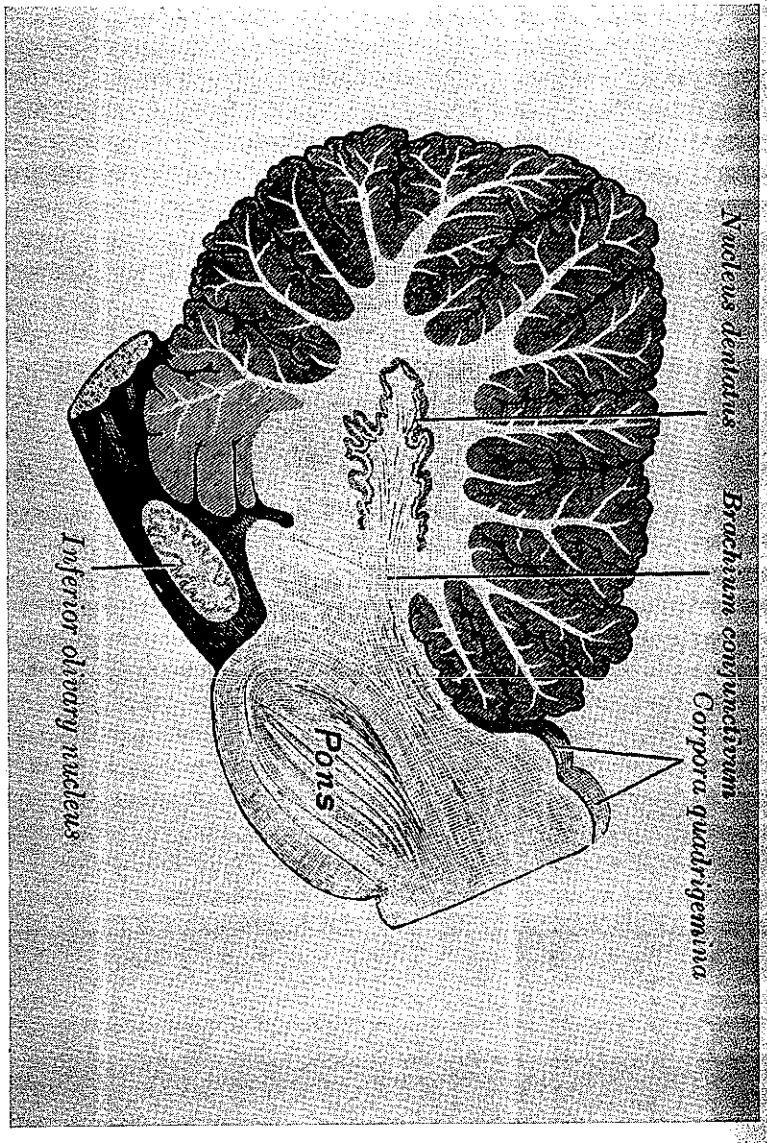

Figure 8

'all about'. The action of wider social interests in the controversy, and in the positions taken up by each side, are apparent. We see anatomical research as a clear deviation from normal practice for Hamilton, and to a lesser extent, for the Combes and Stone. Natural reality, as displayed by a properly sawn-open skull, would oblige one's opponents to accept as fact anatomical features uncongenial to their own interests. But as we have seen, perceptual accounts were quite open to question and the interests of the 'other group' were quite capable of being discerned in the accounts offered. Our 'anatomists' may have been common-sense realists, but perceptual accounts of reality were incapable of doing the job of social suasion the 'anatomists' required of them. This is a feature of all of the following anatomical issues to be discussed.

The Convolutions of the Cerebral Cortex

The convolutions of the cerebral cortex are the wavy surface features seen in figure 4. In previous centuries anatomists thought that the cerebral convolutions looked like intestines, and they used that 'syntax' to make pictorial statements about them.[46] The actual tissues of the convolutions are referred to as 'gyri' and the 'valleys' between them are called 'sulci or, if major, 'fissures'. At the beginning of the nineteenth century a few of the fissures had been recognised as constant from one individual to another, and symmetrical between right and left hemispheres, e.g. the fissures of Rolando and Sylvius.[47] But no functional significance was attached to the pattern of gyri and sulci, nor was it thought that there was a standard pattern of convolutions.

In his 1815 anatomy teaching text, written before Spurzheim came to Edinburgh, John Gordon expressed what seems to have been the general view:

> These Convolutions are seldom precisely alike, either in shape or size, in any two corresponding points of the opposite Hemispheres. In different Brains, I do not know that any two corresponding points, in either Hemisphere, have ever been observed exactly alike.[48]

This was all Gordon had to say on the subject; he did not offer a pictorial statement of how the convolutions appeared; there were no illustrations of any sort in the text. Despite the fact that Gall and Spurzheim's 1810 *Atlas* contained many engravings of the cerebral convolutions, Gordon had nothing to say on the subject in his

Edinburgh Review critique;[49] neither did he refer to the subject in his 1817 *Observations on the Structure of the Brain*,[50] which was a concerted attempt to discredit the phrenologists' cerebral anatomy.

However, in 1822 John Barclay, the distinguished Edinburgh anatomist who had taught both Gordon (now deceased) and George Combe, treated the convolutions in his *Life and Organization*,[51] a section of which sought to undermine the anatomical foundations of phrenology. The phrenologists, said Barclay, have claimed real existence for 'no fewer than thirty-three species of organs', yet

> If you ask for any ocular demonstration respecting the existence of these organs, you are told they are indicated by thirty-three modifications that have been observed in the form of the skull, and these occasioned by thirty-three modifications in the form of the brain . . .[52]

But, if one opened up the skull and inspected the cortical surface on which these organs were said to be situated,

> it seems to require no small share of creative fancy to see any thing more than a number of almost similar convolutions, all composed of cineritious ['grey'] and medullary ['white'] substance, and all exhibiting as little difference in their form and structure as the convolutions of the intestine . . .

How could distinct cerebral organs be said to exist if there were no cortical areas which were distinct in their appearance?

And what of the neat lines which bounded off one organ from another on the busts manufactured by the phrenologists (e.g. fig. 1)? 'No phrenologist,' Barclay ventured, 'has ever yet observed the supposed lines of distinction between them.' Where were these lines on the gyri of fig. 4? Why had no phrenologist, during public dissection, endeavoured to map the organology shown on busts on to the actual cerebral cortex? The reason, Barclay was confident, was that it could not be done.[53]

Moreover, Barclay argued that these supposed distinct organs could not be morphologically distinguished. If one dissected a brain, and separated out all the putative 'organs', then mixed them up and presented them to a phrenologist, could he tell the dissociated organ of 'sentiment' from that of 'reflection'? Again, Barclay wagered that it could not be done. Here, as in the instance of Hamilton and Stone on the frontal sinuses, we have an attack upon the possibility of discerning organs which were not even believed to exist.

The actual stand of the phrenologists on the connection between their organology and the convolutions is not readily evident. None

of the engravings in Gall and Spurzheim's *Atlas* manifests an attempt to display bi-laterally symmetrical standard pattern (e.g., Plate IX), nor was there much of an attempt to display even the 'known' fissures. Figure 4 clearly shows the fissure of Sylvius (running from roman numeral IX to the lower right), but the fissure of Rolando is not clearly indicated. Moreover, there are signs of an unwillingness to associate specific organs with specific gyri. Note, for example, in fig. 4 that several roman numerals, indicating the area of an organ, straddle gyri, e.g. VI, VIII, X and XI. Gall himself, long after the 1810 engravings were made, confirmed this:

> We acknowledge ourselves not yet in a condition to specify the precise limits of all the cerebral organs . . .[54]

This all appears to suggest that the phrenologists, initially at least, were not ready to make a wager as to how the convolutions related to their organs.[55]

Whatever Gall and Spurzheim's initial position had been, it was the responsibility of their Edinburgh disciples to deal with Barclay's objections. Andrew Combe, not unnaturally, turned to Spurzheim for assistance. Quoting a personal letter from Spurzheim, Combe sought to refute Barclay's suggestion that the brain appeared to be composed of nothing more 'than a number of almost similar convolutions'.[56] How should Barclay decide that distinguishing gyri was 'impossible, merely because he has not examined it with due attention in nature'. Surely, there was no difficulty in distinguishing the *lobes* of the brain from each other? And could not all agree that the organ of amativeness, which was the cerebellum (fig. 4, roman numeral I), was distinct from the cerebrum proper? Perhaps, *close* observation would similarly reveal morphological differences between gyri which had hitherto been ignored. 'Dr. Barclay may be sure,' Spurzheim continued, 'that, if he makes it a study to compare the configurations of the cerebral convolutions, and of the different organs, he will find great differences, which he has hitherto overlooked.' 'It will not be denied', Spurzheim was quoted, 'that frequently some convolutions of the brain are much more developed than others . . .'

Andrew Combe went on to describe a number of instances in which phrenologists correctly diagnosed an individual's character, not from his living skull, but from the appearance of his *brain* after death. He himself was inclined to Barclay's view of the convolutions as 'nonsense' until his 'attention was directed particularly to this subject',

and he had 'seen many brains'. He had *learnt* to see 'the characteristic differences' to which he 'had not previously attended'.[57]

But what of the thought-experiment of identifying dissociated cerebral 'organs'? Here Spurzheim was bold in reply:

> . . . I maintain that he who has studied the forms of the peripheral expansions of the cerebral organs, will always be able to distinguish, in man, the organ of acquisitiveness from that of destructiveness . . . as easily as an ordinary observer will the olfactory from the optic nerve. I am ready at any time, personally, to verify the above statement.[58]

But there is no record that he did, or that anyone required him to do so.

On the question of a standard pattern of convolutions, the 'joke', as it were, was on both sides. What the phrenologists, under attack, weakly asserted, but always declined to display, was, within forty years, firmly established by Turner in Edinburgh and Ecker in Germany. To be sure, the patterns they mapped corresponded in no way to the phrenological bust, but then, perhaps the bust would have looked differently had the phrenologists endeavoured to map the convolutions. Later in the century, histological studies (by Betz, Lewis and Ramón y Cajal) established differences in the cellular constitution of different cortical areas.[59] Historians of medicine are almost right when they claim that phrenology focussed attention on the problem of the convolutions.[60] However it was not the phrenologists, but their opponents, in an attempt to discredit the system, who focussed their attention on the convolutions, and *they* made a 'wrong' guess about the possibility of discerning an 'image in the clouds'. The phrenologists, under duress, ultimately made the 'right' guess, but either were not confident enough to pursue it, or felt its pursuit might jeopardise their investment in the existing organology. In the end, their strongest statement was this:

> The general form and direction of the convolutions, even of the human brain, in its complications, are, in fact, remarkably regular.[61]

The connection here between social interests and the anatomical matters discussed should be evident, although perhaps it is less clear than in the preceding case. If the phrenological organs existed, and existed in the mapping offered, then there ought to be morphological support for them. If they didn't, then there should not be. Hence, opponents of phrenology could point to the convolutions as nonsense, to the lack of differentiation between gyri and to the absence of dividing lines between organs situated on a single gyrus, as evidence

for the non-existence of any such things as the 'organs'. The phrenologists made the best 'bet' they felt they could in linking convolutions and organs, but, as we have seen, that 'bet' was never very confident. The question at issue was not the convolutions as objects of disinterested inquiry, but the brain as a legitimating resource for the policies the phrenologists espoused, and the responses their usage elicited.

The Cerebral Fibres

Until the advent, in the 1870s, of microscopic instruments and staining techniques adequate to the task, cerebral anatomists had to content themselves with making mainly macroscopic observations of the constitution of the two main tissue types of the brain—the 'grey' (cortical, or 'cineritious', matter) and the 'white' (medullary) matter. Hence, the debate with which we are now concerned occurred on what anatomists recognised to be the margin of their perceptual resources.

The general contention that the medullary substance of the brain (the main mass of the hemispheres) was fibrous in appearance was by no means novel or contentious at the beginning of the nineteenth century. The conception goes back at least to the seventeenth-century anatomist Malpighi, and may be found, in one or another form, in Willis and de Vieussens, and in Vicq-d'Azyr and Reil, who were roughly contemporary with Gall.[62] It should, however, be pointed out that when anatomists in the early nineteenth century referred to 'fibres', they might have had various structural notions in mind, but they were certainly not aware of the more modern concept of the 'neuron' and its functions.

Thus, the basic assertion that the white matter was fibrous in appearance and was in fact composed of fibres was unoriginal when, in the first decade of the nineteenth century, Gall and Spurzheim articulated and refined the notion in their phrenological context.[63] What precise relationship existed between their view of the fibres and their phrenological system is not only problematic for historians, but was equally puzzling to contemporary anatomists. The committee of the French National Institute requested to judge their anatomical claims credited Gall and Spurzheim as being the 'first to have distinguished the two orders of fibres, of which the medullary matter of the hemisphere appears to be composed', but added the caveat that 'the anatomical questions with which we have been en-

gaged . . . have no immediate and necessary connection with the physiological doctrine taught by Dr. Gall . . . All that we have examined with respect to the encephalon might be equally true or false, without any conclusion being drawn for or against this doctrine'.[64] And the medical historian Erwin Ackerknecht, while palpably overstating Gall's claim to originality, praises him for recognising 'the fibrous nature of the white matter, hitherto regarded as a kind of gruel, and its conductor function', but does not say what relation the phrenologists' 'contribution' bore to their system.[65]

Let us now briefly outline the phrenologists' view of the fibres of the medullary matter. Gall and Spurzheim discerned two distinct types of fibre in the white matter of the brain. The one they called the 'diverging system' (what is now termed 'projection' fibres) and the other the 'converging system' (now called 'association' fibres).[66] The diverging fibres may be clearly seen in figs. 2 and 5. Gall and Spurzheim contended that the diverging fibres took their origin from 'grey' ganglia in the medulla oblongata (or brain stem) (fig. 2, no. 1; fig. 5, no. 91). One set going out of the cerebrum proper emerged from grey ganglia in the pyramidal bodies (figs. 2 and 5, 'e'), then continued upwards through the pons Varioli (or annular protuberance) (figs. 2 and 5, 'b') and crura cerebri (figs. 2 and 5, 'g'), to the inner surfaces of the convolutions on the frontal and parietal lobes (follow nos. 34-38 in both figures). Another set of diverging fibres emerged, they claimed, from grey ganglia in the olivary bodies (figs. 2 and 5, 'a'), passing upwards behind the pons and through the crura, the optic thalami and corpora striata, to the convolutions of the 'posterior' (temporal) lobe (fig. 2, 'II'). The two diverging systems of Gall and Spurzheim therefore go from brain stem to convolutions, functionally connecting the surfaces of the 'organs' to the motor apparatus of the spinal cord.

The 'converging' system of medullary fibres was held to originate from the convolutions of one hemisphere, proceeding medially, where they unite and connect opposite hemispheres in the great 'commissures' of the brain, such as the corpus callosum (not shown in our figures, but see Gall and Spurzheim's *Atlas*, Plates VI and XI, '$\lambda-\mu-\lambda$'). The converging system thus served the function of bringing organs on opposed areas of the bi-laterally symmetrical brain into systemic connection. At the bottom of each convolution, the two systems cross each other and form a tissue. Distal to this tissue the

convolutions may be separated along their median line (fig. 2, '1—2', '1—3'). Hence, the phrenologists' system of medullary fibres was involved in long debates over the tissue composition of the convolutions and the processes involved in the disease of hydrocephalus.

The phrenologists' anatomical findings about the cerebral fibres encountered, as we have seen, relatively little disapproval from the French Institute, but John Gordon, in Edinburgh, reacted hostilely to their claims. Gordon's position on these matters was both idiosyncratic and ambiguous, but a quotation from his 1815 anatomy text provides a succinct expression of his views:

> It is difficult to convey any accurate idea of the consistence of the White Nervous Matter. It varies a little in different parts. In general it is less elastic than Jelly, but somewhat more glutinous or viscid.
> When we make a section of it in any direction, with a sharp scalpel, the surface of the section is perfectly smooth, and of a uniform colour. There is no appearance of any cells, or globules, or fibres whatever.[67]

Gordon recognised, however, that when the white matter was subjected to various preparatory treatments, e.g., maceration in acid or alcohol, or when it was 'scraped' rather than sliced, it might be 'made to exhibit a fibrous appearance'.[68] Here, in a context in which he was not concerned to discredit the phrenologists, but to provide learning materials for his extra-mural classes, Gordon strongly suggested that the fibrous 'appearance' thus induced is an indication of the white matter's actual fibrous nature.[69]

However, in his *Edinburgh Review* assault on phrenology, as well as in his critical pamphlet occasioned by Spurzheim's Edinburgh demonstrations, Gordon now adopted a more suspicious posture on the question of the cerebral fibres. 'We are by no means satisfied,' he cautioned,

> . . . how much of the White Matter throughout the brain is capable of exhibiting this fibrous appearance when coagulated. This point, as well as the cause of the fibrous appearance in general, requires to be further investigated . . .[70]

Where Gall and Spurzheim 'scraped' and 'tore' the white matter to display its 'real' fibrous nature, Gordon now asserted that their techniques resulted only in the display of artifacts, and that his (the traditional 'slicing') technique showed the matter as it naturally was. Thus, even the phrenologists' display of a fibrous appearance was insufficient evidence of a real fibrous nature: 'a fibrous appearance, and a fibrous structure, are two different things . . . the former is

not always caused by the latter'.[71] And even if Gall and Spurzheim happened to have hit upon the truth, Gordon was keen to ensure that the credit was not to be theirs. These fibrous 'appearances', whose correspondence to structural reality was queried, had in fact been observed and recorded by previous anatomists, most particularly by Gordon's favourite authority the German *Naturphilosophe* J. C. Reil.[72]

To all this, Spurzheim, then in Edinburgh, responded that the procedures by which the fibrous 'appearances' were produced were those which displayed the structures in their most natural state:

> We seldom cut, but mostly scrape; because the substance, on account of its delicacy, when cut, does not show its Structure.[73]

Fresh brains as well as coagulated ones might be used, if that was insisted upon, but here one ran the risk of meeting up with a bad brain, so soft and pulpy that it was 'entirely unfit for demonstration'.[74] In any case, what could one do with a man like Gordon who, when asked at a public dissection to 'give a name to what he saw, called it a "fibrous appearance"?'[75] It was an idiot's ontology. Yet phenomenological gymnastics of that sort were in part responsible for the considerable refinement and clarification of the phrenologists' accounts which occurred during the Edinburgh disputes.

While anti-phrenologists showed themselves quite capable of discerning the 'interests' which lay behind the phrenologists' views of the frontal sinuses and the convolutions, neither Gordon (who contended that Gall and Spurzheim 'got it wrong' on the fibres), nor the French Institute (which generally agreed they 'got it right'), provide evidence that they saw any connection between the phrenological system and particular accounts Gall and Spurzheim offered of the cerebral fibres. Yet it is possible for a historian to suggest such a connection.

It must be emphasised here, as the phrenologists themselves frequently did, that the 'organs' were not merely composed of the surface layer of grey matter but were, rather, the whole mass of the brain. They were to be viewed as 'wedges', of which only the distal surface faced the skull, and which 'extended from the pyramidal bodies of the medulla oblongata, to the external surface of the convolutions'.[76] They ran, as it were, from the 'bumps' down to the spinal cord, connecting the visually apprehensible contours of the head to the motor apparatus for translating 'faculties' into behaviour.[77]

It is arguable that the major concern connecting the phrenologists' cranioscopic system to their work on the anatomy of the brain was to find and display any anatomical bases for a conception of the brain as a congeries of distinct organs. While they were evidently unwilling to make such a display of the cerebral convolutions, they were more certain that visible nature was on their side in the matter of the medullary fibres, and they pursued this line of research with great vigour. To those philosophers and psychologists who contended that the mind was a unity, and that the brain itself appeared as an undifferentiated mess of porridge where 'all the parts are blended together in common union', Gall replied:

> The whole substance of the brain, moreover, is far from exhibiting such a commingling of its parts as is affirmed; no such blending exists: on the contrary, fibres and fibrous fasces are in every part very distinctly visible . . ., they form their own expansions and convolutions . . . It is true, that all these parts are connected; but this connection does not prove the impossibility of each being an independent organ.[78]

Gall claimed that 'there is no common centre for all the cerebral fibres' and that the 'fibrous fasces are really distinct'.[79] Indeed, they do appear as 'really distinct' in the engravings—far more distinct than fibres do in the pictures of non-phrenological contemporaries or of more modern neuro-anatomy texts. It is quite possible, then, that the phrenologists' work on, and accounts of, the cerebral fibres was linked to their interests in displaying a pluralistic brain, as naturalistic basis for their pluralistic psychology, the diagnostic system erected thereon, and the programmes advocated on the possibility of such a diagnosis. Hence, at a highly mediated level, the phrenologists' view of the cerebral fibres was generated and developed in a context of conflicting wider interests, for the purpose of making the system more plausible by securing for it a naturalistic base consistent with their other anatomical contentions. And, although we have no evidence that John Gordon discerned the posited connection between interests and fibres, his developing notions of the medullary substance were hardly impelled by disinterested contemplation or the inherent interest of these 'appearances'.

The Corpus Dentatum of the Cerebellum and Related Matters

The cerebellum (the 'hind brain', or what the Germans call the 'kleines Gehirn') is a bi-lobed structure, situated below the posterior

portions of the two cerebral hemispheres and lying on the dorsal surface of the medulla oblongata. It is easily distinguished from the hemispheres proper by its closely ridged laminar surface (see fig. 4, 'I', and also the cross-sections in figs. 2 and 5), which contrasts markedly with the convolutions of the rest of the brain. Like the cerebrum, the cerebellum is composed of an exterior capsule of grey matter, enclosing a central core of white, medullary matter. Within its white core, the cerebellum contains a number of ganglia or nuclei whose existence was not disputed in the early nineteenth century but whose tissue composition was a matter of divided opinion. The fibrous connections extending from the medulla oblongata to the cerebrum (views of which were described in the last section) have their counterparts in the cerebellum. Again ,it was not doubted that there were such connections between cerebellum and brain stem, but, in the setting we are dealing with, the precise nature of these fibre bundles and their pathways were disputed.

Phrenologists devoted much of their anatomical work to the cerebellum, its internal structure and fibrous connections. Seven plates in the 1810 Gall and Spurzheim *Atlas* were specifically concerned to display these aspects of the cerebellum. In 1838 George Combe translated from the French a series of essays by phrenologist-anatomists on the structure and functions of the cerebellum, this amounting to the single most sustained and focussed effort by phrenologists to study a part of the brain.[80] Not surprisingly, the accounts the pherenologists offered of cerebellar structure were severely criticised in Edinburgh, most particularly by John Gordon.

One of the most noteworthy features of the Edinburgh debate on cerebellar structure was that, for the first and only time during the Edinburgh phrenology controversies, we have the purposeful juxtaposition of published *pictorial* statments of what the disputed structures 'really' looked like; in this case, of two almost exactly comparable copper-plate engravings prepared under the respective supervisions of Gordon and Gall and Spurzheim.[81]

Fig. 6 is a reduced copy (commissioned by Gordon) of Plate XII from Gall and Spurzheim's 1810 *Atlas,* showing a section taken through the cerebellum and medulla oblongata. Fig. 7 was specifically done for Gordon to display the 'actual' appearance of these parts. The two were published on the same page in Gordon's 1817 examination of Gall and Spurzheim's anatomical claims.[82] It was the

first and only time that John Gordon published a *picture* of any brain structure.

Let us first summarise some of the features of the cerebellum and its connections as seen by Gall and Spurzheim:

(1) They noted a fibre bundle ('e-e' in figs. 2 and 5; 'a-b' in fig. 6), running from a grey ganglion (not shown) in the medulla oblongata (called the corpus restiforme) to the entrance to the cerebellum, thickening as it ascends. These are Gall and Spurzheim's 'diverging fibres of the cerebellum', analogous to their diverging system of cerebral fibres.

(2) As this fibre bundle enters the cerebellum it meets with and enters a mass of grey matter (fig. 6, 'c'; figs. 2 and 5, 's') called the corpus dentatum (or dentate nucleus) of the cerebellum. The function of this grey nucleus, like that of grey ganglia generally in Gall and Spurzheim's schema is to increase, 'nourish' and thicken the (white) fibres along their course.

(3) From the serrated edges (the 'teeth') of the corpus dentatum issue forth augmented white fibre bundles (not shown), proceeding in several directions. One set proceeds medially to form the central vermiform process of the bi-lobed cerebellum; another proceeds outwards to form the laminae (the convolutions) of the cerebellum.[83]

(4) Other features of fig. 6 of relevance to the Edinburgh debate included the appearance of the fibre bundles passing through the pons ('f') and the appearance of the grey mass ('i') which is the dentate nucleus of the corpus olivare.

Having reproduced this portion of a Gall and Spurzheim account as an exemplar of error (bearing 'no resemblance to nature'), Gordon commissioned the artist-anatomist P. Syme to produce fig. 7 as a representation of the 'real appearance' of these structures.[84] *This,* according to Gordon, was how the cerebellar and brain-stem structures actually appeared:

(1) The corpus dentatum of the cerebellum 'has no connexion whatever with the corpus restiforme'. Except at one point, 'it is impossible to demonstrate a single filament either entering or leaving it'.[85] In fig. 7 Gordon showed only one type of connection between the corpus dentatum and the brain-stem, what he called a pillar of the 'Vieussenian valve' (now termed the anterior

medullary velum) (fig. 7, 'a-b'). So the only fibrous link between cerebellum and brain stem was upwards rather than downwards.

(2) The corpus dentatum of the cerebellum was not in fact a mass of grey matter as Gall and Spurzheim claimed. In his 1815 text Gordon had described it as 'a nucleus of Orange-White Matter, contained in a capsule of Wood-Brown Matter, not more than a fiftieth part of an inch in thickness', although he acknowledged that the presence within the nucleus of venous structures 'has led some Anatomists, to describe the nucleus as being intermixed with Brown Matter'.[86] In fig. 7 the corpus dentatum ('c') is shown as white matter, encapsulated by a very thin 'grey' shell.

(3) The corpus dentatum is shown, as in the phrenologists' account, to be serrated, but these serrations are insisted to be composed of white matter and not of 'grey'. No fibres are shown leaving the serrations, and in the accompanying gloss, it is asserted that no fibres can be observed to leave them.

(4) In fig. 7 the corpus olivare is sliced open to show the 'real' structure of its dentate nucleus ('f'). It may be seen that it is displayed in the same 'syntax' as that used to show the cerebellar dentate nucleus, just as Gall and Spurzheim's representation uses the same 'syntax' to display the dentate nuclei of cerebellum and corpus olivare (fig. 6, 'c' and 'i'). Although, curiously, Gordon did not elect in his picture to show the interior structure of the pons (fig. 7, 'd'), he asserted that Gall and Spurzheim's representation was seriously in error. And, further, he showed a structure (the posterior medullary velum) (fig. 7, 'e') which Gordon claimed existed, but which Gall and Spurzheim's representation omitted altogether.

Not having provided a single illustration in his 1815 text, Gordon clearly expected that his juxtaposition of cerebellar 'reality' with the obvious 'distortions,' 'omissions' and 'misrepresentations' of the phrenologists' picture would have the effect of rendering them speechless and destroying their credibility. But Spurzheim, then in Edinburgh, preferred his own representation and argued that Gordon's was the one which was in error. In his lengthy reply to Gordon's attack, Spurzheim developed his case:

(1) The passage of fibres from the corpus restiforme to the corpus dentatum is 'easily shown'; one merely has to scrape away some obscuring nerves in order to observe it. Spurzheim, having

already shown this feature in Barclay's dissecting room, offered to display it again 'to every one who produces a fresh brain'.[87]

(2) The corpus dentatum of the cerebellum (as that of the corpus olivare) was indeed 'greyish matter', as previously stated. However, Spurzheim complained, with good reason, that the portion of the original engraving which Gordon had copied (Plate XII of the 1810 *Atlas*) showed a corpus dentatum containing 'more white matter than he has represented in the copy which he has taken from our plate'. (Compare the corpora dentata shown in accompanying figs. 2 and 5, 's'.) 'Is this whole proceeding', Spurzheim asked, 'consistent with candour?'[88]

(3) On the form of the corpora dentata of cerebellum and corpus olivare, Spurzheim declined to defend his representation as the only accurate one, nor did he contend that Gordon's was necessarily faulty. These structures appear in different lights depending upon how one views them, and from what perspective the view is taken. So the two engravings, which Gordon claimed to be comparable in these respects, are not necessarily so. 'How then could he', Spurzheim inquired,

> compare his figure of the corpus dentatum with one of ours, while both cerebella were different in size and form, and the corpora dentata are not cut in the same direction? . . . We have cut more towards the medial line; he more externally.[89]

Similarly, the representations of the dentate nucleus of the corpus olivare are not fit to be juxtaposed:

> [Gordon] has not yet learned that it varies, like the corpus dentatum [of the cerebellum], in size and form, in different individuals, and that the form appears different according to the section. His is horizontal, and ours vertical; hence the appearance must be different.[90]

Knowledge of the structures in their totality was thus said to be generated from a number of partial views. Arguably, knowledge of these esoteric structures *was* so generated during the course of the Edinburgh disputes.

As a matter of interest (but not central to the argument of this paper) we can turn to the modern anatomy text as a highly developed, stable account of the structures disputed in early nineteenth-century Edinburgh. Fig. 8, and the accompanying text, indicates that 'honours' must be considered shared. The dentate nuclei of cerebellum and corpus olivare both appear much as Gordon contended—white with a thin grey capsule—although the text confirms that the

nuclei appear more as a greyish mass when sections are taken towards the lateral edges.[91] The interior of the pons is shown much as Gall and Spurzheim represented it. When Gordon and Spurzheim discussed fibres entering the cerebellum, modern knowledge would lead us to suspect that they were 'actually' dealing with what are now referred to as the three cerebellar peduncles. The superior cerebellar peduncle, shown as the 'brachium conjunctivum' of fig. 8 is very probably what Gordon showed in fig. 7, 'a-b', connecting, as he argued, the corpus dentatum upwards to the hemispheres by way of the brain-stem. On the other hand, the inferior cerebellar peduncle (not shown in fig. 8) is in fact part of the corpus restiforme, and, thus, may correspond to 'a-b' in fig. 6. It does, as Spurzheim averred and as Gordon denied, enter the cerebellum and constitutes a group of fibres radiating out to various parts of its surface, but only a few of its fibres enter the corpus dentatum. The middle cerebellar peduncle connects pons to cerebellar convolutions, but does not enter the corpus dentatum. The implication, although nothing in this paper hinges thereon, is that no party to this dispute 'conjured up' any structure in his representations; there is an agreed-upon modern basis for all that was seen, although much was left 'unseen' and the connections between 'real' structures were made differently from the way they would be today.

Surely, representations of structures as esoteric as these could not have been influenced by considerations of social interest. Certainly, neither Gordon nor Spurzheim provide us with evidence that they detected the workings of social interests in the other's representations of the internal structure of the cerebellum and its fibrous connections. Indeed, partly because we cannot employ actors' own detections of the link between social interests and these representations, such a link is exceedingly difficult to discern and to make historically plausible. Yet the following is a hypothesis about such a connection:

(1) In the phrenological system the cerebellum, in its entirety, is a single 'organ', that of 'amativeness'.

(2) The cerebellum is the only 'organ' which was undeniably morphologically distinct from all other areas of the brain. Were it excised from the rest, there would have been no problem for phrenologists in identifying it as the organ of amativeness. The cerebellum was therefore generally appealing to phrenologist-anatomists as a subject relating function to structure.

(3) The material basis for a functional 'organ' would therefore be worked out in detail in the particular case of the cerebellum.

(4) The interest phrenologists had in the display of the cerebral fibres would be reflected in the cerebellum. If the fibres entering the cerebellum from the brain-stem entered it from *above* (as Gordon asserted), the cerebellum would be an anomaly in the general anatomical scheme. If, as Gall and Spurzheim claimed, the fibrous connection was from *below* (linking the organ to motor mechanisms), then desired consistency in this most visible of organs would be preserved, and the plan as a whole would be supported.

Social Interests and Esoteric Knowledge: Some Speculations

In the series of increasingly esoteric anatomical issues discussed above, the influence of social interests becomes more and more difficult for both actors and historians to discern. One possible conclusion from this impression would be that social interests affected representations of some anatomical structures and not others; for example, those structures on or near the cranial surface were liable to be infected by social interests, while representations of those more interior, more esoteric structures were manifestations of pure contemplation. The sociology of scientific knowledge, in this case at least, would have a limited role to play, literally and figuratively a superficial one.

However, such a conclusion would neither be a necessary nor an accurate inference from the episodes discussed. Indeed, these materials provide support for a rather different conception of the relationship between social interests and the development of esoteric bodies of knowledge.

Let us first examine the predicament of the phrenologists. Various phrenologists were committed to different moral and social policies, but all were committed to securing credibility for some such policy. In Gall's work one finds an apparent interest in the debunking of idealism, *Naturphilosophie,* Enlightenment optimism, and, presumably, Catholic theology. His expressions of these interests pre-date his anatomical work (see note 27). Spurzheim broke with Gall to develop phrenology into the legitimation of meliorist social policies, and the Edinburgh phrenologists were almost uniform in their

adherence to the Whig-to-Owenite social programme previously outlined. All had social commitments to further and all were deviant iconoclasts in their contexts.

While it is one thing to argue social policies on the basis of their inherent justness or 'rationality', it has often seemed a more persuasive strategy to argue them upon the basis of 'nature' and 'how things really are' in the natural order. Philosophical flaws in the 'naturalistic fallacy' do not diminish its obvious appeal as a social strategy.

The argument is that phrenologists did anatomy, defended and developed the anatomy of their canon, in an attempt to secure social credibility and to conceal the role of their social interests. The phrenologists' social interests may therefore be conceived as a sort of motor, driving them to produce and develop knowledge in which ideally it would become impossible for their opponents to discern the action of these interests. Such a motor might operate on a diachronic sequence, as the result of criticism from opponents, or it might equally operate by the imaginative rehearsal of *possible* criticisms prior to the enunciation of 'findings'. In our material, we see both modes of operation.

Credibility may be secured by the production of apparently naturalistic knowledge, in which it is impossible for opponents (or historians) to discern social interest, but not *any* naturalistic account will best further a particular social interest. Certain natural realities are better for some purposes than for others. Your enemies will, for example, be delighted to believe you if you prove them right, but that does you little good.

Hence, the naturalistic anatomical knowledge the phrenologists produced may be seen as the resultant of the forces of these two social motors. The first is the felt necessity to secure a naturalistic basis for one's policies, and, thereby, credibility in society. This encourages one to make a 'bet' about reality as it may be and as others, in a concrete social context, may perceive it to be. The 'bettor' may then produce a perceptual account which, considering all the contingencies of the setting, will maximise the probability that specified others will 'match' the account and the object portrayed; in other words, that some other person or persons will see (or be encouraged to see) the account as a reliable rendering of perceived reality. The push this social motor exerts towards naturalism, as actors in the setting recognise it, is obvious.

The second social motor reflects the *particular* legitimating requirement actors feel they have, as contrasted to the general desire to secure credibility for their perceptual accounts. This social motor pushes the perceptual accounts in the direction where they are best suited to the legitimating tasks at hand. Hence, Gall was concerned to display a brain with no common origin of the nerves and fibres, in order to argue against the idea of a 'common seat' of an immaterial soul. The skull with frontal sinuses 'little' was better for the phrenologists' social purposes than the skull with frontal sinuses 'large'. Each account offered reflects both these social motors.

What of the phrenologists' Edinburgh opponents? They too had their interests to defend. As custodians and practitioners of an institutionalised body of anatomical knowledge, they were concerned to defend the existing model of the brain as a reliable account of reality, and at the same time to expose the new, deviant account as deficient. Inasmuch as their enemies' brain-model stressed its differentiation, they had an interest in displaying lack of differentiation. In defending the existing model of the brain, they were defending their social situation as expert anatomists in that setting.

And what of the intellectual strategies professional anatomists employed to defend and further their interests? Are they symmetrical with the strategies employed by phrenologists? Arguably, they are. Barclay and Gordon responded to the phrenologists' threat by articulating more naturalistic-appearing, more esoteric bodies of knowledge. Greater refinement of focus was developed and more rigorous perceptual accounts were offered of structures hitherto of little interest to them. John Gordon produced a *picture* of the internal structure of the cerebellum, where before he devoted few *words* to its elucidation. These accounts were, like those of the phrenologists, manifestations of a 'bet' that they would be accredited as reliable accounts by specified others in a particular social setting, and they therefore reflect a push towards that setting's sense of naturalism. But, again, not any naturalistic account will serve the particular interest. Cerebral reality ideally had to be such as would preserve the greatest stock of institutionalised knowledge while discrediting as much as possible of the phrenologists' central claims to naturalism. Gordon and Barclay's behaviour manifests both these social interests.

But here many historians will object that, while the point relating social interests to knowledge may be granted for the phrenologists,

the evidence for a symmetrical treatment of their opponents seems weak. Perhaps one can make such a case for Sir William Hamilton, but surely not for Barclay and Gordon. Hamilton, who deviated from his normal ambit by learning cerebral anatomy precisely for the purpose of discrediting phrenology and upholding the validity of the Scottish Common-Sense philosophy of which he was such a leading exponent, provides historians with 'good' evidence of his social interests; he had little to gain by tolerating a psycho-philosophical system whose local leaders advocated the overthrow of the existing educational order, at both university and popular levels.

What historians take to be 'good' evidence for sustaining such an imputation is usually evidence of an individual's *motives* or *intentions,* in any case, evidence of that person's subjective state of mind. The phrenologists supply us with such information, relating the knowledge they produced to their intentions; Hamilton perhaps does as well; but Barclay and Gordon surely do not. There is not a shred of evidence which would support an interpretation which claimed to discern in their writings a special desire, for example, to thwart the social ambitions of the rising petty-bourgeoisie. The interpretation developed in this paper does not depend on a diagnosis of any given individual's subjective motives; it does, however, depend upon a notion of what his social interests may be.

The historiographic problems of distinguishing between motives and interests seem especially important when one is dealing with a comparative analysis of institutionalised and 'new' or deviant bodies of knowledge. In a new or deviant body of knowledge, we will typically see the social interests of those who produced it being closely 'coupled' to the actual form of their production. Typically also, we will have rather 'good' evidence as to their motives, and these will be uniformly expressed in the producing group. When, however, we come to look at 'old' or institutionalised bodies of knowledge, a different situation seems to obtain. Apart from their interest in defending the institutionalised body of knowledge and attacking its enemies, the social interests of its practitioners *may be* effectively 'de-coupled' from the actual content of the knowledge, and their motives in practising that body of knowledge may be very various.

Perhaps a concrete example will help to get this notion across. When the Romans occupied Britain, they built a road from what is now Cambridge to what is is now Godmanchester, passing on the way

the site of what is now Girton College. They built this road, like most of their British highways, with the intention of ferrying armies and military supplies as rapidly as possible between two, rather distant, points, and, because of their intention, the road, straight as a die, directly reflects their interest in making the Imperial occupation as effective as possible. That Roman road is now the A604, and it is used by many individuals, for very various purposes. Anyone who, observing a King's man cycling at evening towards Girton, decided that the scholar was intending to further Roman imperialism, might be guilty of an error of imputation. It would, of course, be equally incorrect, although less bizarre, to claim that the scholar's behaviour that evening, whatever his state of mind, owed nothing to Roman Imperial social interests.

There may be an interesting consequence of historians' preference for evidence linking actors' intentions to their knowledge when making social imputations. Such information, we have suggested, will tend preferentially to be available for new and, especially, for deviant bodies of knowledge, and will tend, correspondingly, to be unavailable for institutionalised or old bodies of knowledge. The consequence may therefore be that the usual canons of historical procedure will sustain a sociological approach to deviant bodies of knowledge, but not to institutionalised ones. Indeed, there is some evidence that this is what is developing in the social history of science: a sociology of error, of deviance and of rejected knowledge but not, as yet, much in the way of a sociology of 'truth'. Social interests may be *discerned* in the former, but not in the latter.

Yet the major concern of this paper has been to prise apart the notion of social interest in knowledge from the notion of error and distortion. Science does not guarantee its growth towards esoteric naturalism by systematically immunising itself from the action of social interests. Rather, it may be the action of conflicting social interests, and actors' ability to assign ideological concerns to knowledge claims, which provide a significant push towards the development of increasingly naturalistic forms. It is when the 'pressure is on' that knowledge develops most intensely in these directions. Hence, social conflict and ideological considerations may be seen as an important element in the development of bodies of knowledge valued as 'interest-free', rather than as a feature of the environment which retards such development.

We should, however, make it very clear that this thesis is not the same as the proposition that no interests other than social bear upon the development of naturalistic bodies of knowledge. This would be obviously incorrect. Practical interests of all kinds, the use of knowledge as an instrument for prediction and control of natural and technical processes, clearly act upon and influence the development of knowledge. The general argument has not been that such interests are unimportant; far from it. But I have not been able to see how such manipulative interests may have borne upon the material just discussed. No surgical procedures, for example, in the early nineteenth century, depended upon the elaboration of knowledge about the convolutions, the cerebral fibres, the sinuses or the corpus dentatum and its peduncles. Likewise, I have found it very difficult to see how these episodes may be dealt with by an analysis which stresses contemplation and the disinterested desire to know as the motors of knowledge. The fundamental argument has been that social interests act upon knowledge in ways rather different from those usually assumed; that it is the effect of such interests to conceal their action; and that, because of this, it may well be that social interests influence knowledge more pervasively than the usual canons of historical procedure can persuasively demonstrate.

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[1] For example, Ruth S. Cowan: 'Francis Galton's Statistical Ideas: The Influence of Eugenics', *Isis*, Vol. 63, 1972, pp. 509-528; P. Forman: 'Weimar Culture, Causality and Quantum Theory, 1918-1927: Adaptation by German Physicists and Mathematicians to a Hostile Intellectual Environment', *Historical Studies in the Physical Sciences*, Vol. 3, 1971, pp. 1-115; R. M. Young: 'Malthus and the Evolutionists', *Past and Present*, no. 43, 1969, pp. 109-145 and, 'Darwin's Metaphor: Does Nature Select?', *The Monist*, Vol. 55, 1971, pp. 442-503.

[2] For example, Donald Mackenzie: 'Statistical Theory and Social Interests: A Case Study', *Social Studies of Science*. Vol. 8, 1978, pp. 35-83.

[3] Karl Popper espouses the view that error will be systematically eliminated by the operation of critical debate in science, and that, provided a liberal and competitive 'open-market' obtains, those interests which produce error will be vanquished by those which produce truth or the progress of knowledge. In certain respects the present model is similar to Popper's, but there is no concern here with epistemological evaluation. What is at issue (to use the jargon of the ethnomethodologists) is the process whereby disinterested *appearances* are 'practically accomplished' in particular settings and contexts and against a particular background, not whether that 'accomplishment' is correct or not.

The present conception of the role of social interests in the production of knowledge owes much to the work of my colleague Barry Barnes (e.g. B. Barnes: *Interests and the Growth of Knowledge*, Routledge & Kegan Paul, London, 1977, expecially his discussion of Habermas (J. Habermas: *Knowledge and Human Interests*, Beacon, Boston, 1971) in chapter i of Barnes: op. cit. The idea of 'experiments in social control' invoking a nature which, over time, becomes increasingly naturalistic, is introduced in S. Shapin and B. Barnes: 'Science, Nature and Control: Interpreting Mechanics' Institutes', *Social Studies of Science*, Vol. 7, 1977, pp. 31-74.

[4] Owsei Temkin: 'Gall and the Phrenological Movement', *Bulletin of the History of Medicine*, Vol. 21, 1947, pp. 275-321.

[5] John D. Davies: *Phrenology, Fad and Science: A Nineteenth Century American Crusade*, Yale University Press, New Haven, Conn. 1955; David A. De Giustino: *Conquest of Mind: Phrenology and Victorian Social Thought*, Croom Helm, London, 1975.

[6] [Thomas Brown]: 'Villers *Sur une Nouvelle Theorie du Cerveau*', *Edinburgh Review*, Vol. 2, 1803, p. 147.

[7] 'Review of "Account of Dr. Gall's Discoveries regarding the Structure of the Brain." By T. C. Rosenmuller . . .', *Edinburgh Medical and Surgical Journal*, Vol. 2, 1806, pp. 320-324.

[8] 'Report on a Memoir of Drs. Gall and Spurzheim, relative to the Anatomy of the Brain . . .', *Edinburgh Medical and Surgical Journal*, Vol. 5, 1809, pp. 36-66.

[9] F. J. Gall: *On the Functions of the Brain and of Each of Its Parts*, Boston, 1835, 6 vols. (translation of *Sur les Fonctions du Cerveau*, Paris 1822-25).

[10] J. G. Spurzheim: *The Physiognomical System of Drs. Gall and Spurzheim*, London, 1815.

[11] Temkin: op. cit., 1947; E. Ackerknecht and H. V. Vallois: *Franz Joseph Gall, Inventor of Phrenology and His Collection* (Wisconsin Studies in Medical History, No.1), University of Wisconsin Medical School, Madison, 1956; Robert M. Young: *Mind, Brain and Adaptation in the Nineteenth Century*, Clarendon Press, Oxford, 1970; Roger Cooter: 'Phrenology: The Provocation of Progress', *History of Science*, Vol. 15, 1976, pp. 211-234.

[12] For example, see the engraving of such 'bumps' and depressions on the skull in F. J. Gall and J. G. Spurzheim: *Anatomie et Physiologie au Systéme Nerveux en General et du Cerveau en Particulier, Atlas*, Paris, 1810, Plate XCIX, reproduced in E. Clarke and K. Dewhurst: *An Illustrated History of Brain Function*, Sandford, Oxford, 1972, p. 92.

[13] Occasionally, phrenologists used evidence derived from instances of the destruction of parts of the brain, although they expressed reservations about the value of this sort of data; see Spurzheim: op. cit., 1815, pp. 239-241.

[14] Temkin: op. cit., 1947, pp. 278-279.

[15] [G. Combe]: 'Explanation of the Physiognomical System of Drs. Gall and Spurzheim', *Scots Magazine*, Vol. 79, 1817, pp. 243-250 and his *Essays on Phrenology*, Edinburgh, 1819; J. G. Spurzheim: *A View of the Elementary Principles of Education . . .*, Edinburgh, 1821.

[16] A quite useful, although biassed, contemporary account of most of the Edinburgh controversies is R. Chenevix: *Phrenology. Article of the 'Foreign Quarterly Review', with notes from G. Spurzheim*, London, 1830. (Original publication in *Foreign Quarterly Review*, Vol. 2, 1828, pp. 1-59.)

[17] G. N. Cantor: 'The Edinburgh Phrenology Debate: 1803-1828', *Annals of Science*, Vol. 32, 1975, pp. 195-218.

[18] S. Shapin: 'Phrenological Knowledge and the Social Structure of Early Nineteenth-Century Edinburgh', *Annals of Science*, Vol. 32, 1975, pp. 219-243. Also see S. Shapin: 'Homo Phrenologicus: Anthropological Perspectives on an Historical Problem', in B. Barnes and S. Shapin (eds.): *Natural Order: Historical Studies of Scientific Culture*, Sage, London, 1979.

[19] G. E. Davie: *The Social Significance of the Scottish Philosophy of Common Sense*, Dundee, 1972.

[20] De Giustino: op. cit.; Roger Cooter: 'Phrenology and British Alienists, c. 1825-1845', *Medical History*, Vol. 20, 1976b, pp. 1-21, 135-151.

[21] Young: op. cit., 1970; Clarke and Dewhurst: op. cit., pp.91, 101-102.

[22] Clarke and Dewhurst: op. cit., p. 91.

[23] E. Ackerknecht: 'Contributions of Gall and the Phrenologists to Knowledge of Brain Function' in F. N. L. Poynter (ed.): *The History and Philosophy of Knowledge of the Brain and Its Functions*, Blackwell, Oxford, 1958; cf. Owsei Temkin: 'Remarks on the Neurology of Gall and Spurzheim', in E. A. Underwood (ed.): *Science, Medicine and History*, Oxford University Press, London 1953, Vol. 2, pp. 282-289; McD. Critchley: 'Neurology's Debt to F. J. Gall (1758-1828)', *British Medical Journal*, Vol. 2, 1965, pp. 775-781; Erna Lesky: 'Structure and Function in Gall', *Bulletin of the History of Medicine*, Vol. 44, 1970, pp. 297-314.

[24] D. Ellis: *Memoir of the Life and Writings of John Gordon, M.D., F.R.S.E.*, Edinburgh, 1823, pp. 41-42.

[25] 'Report on a Memoir': op. cit., p. 65.

[26] Andrew Combe: 'Dr. Prichard and Phrenology', *Phrenological Journal*, Vol. 8, 1834, p. 650.

[27] Biographical information on Gall and his motives is scarce and mostly unreliable. The crucial evidence is his 1791 *Philosophisch—medicinische Untersuchungen* . . . which, prior to his anatomical investigations, set out his views on the relationship of body and soul; see Temkin: op. cit., 1947, pp. 276-278, 313-314. Gall's intention to debunk idealist philosophies is evident in this text.

[28] Spurzheim: op. cit., 1815, pp. 2, 543-551.

[29] George Combe: *The Life and Correspondence of Andrew Combe, M.D.*, Edinburgh, 1850, p. 44; cf. G. Combe: op. cit., 1819, pp. 304-342.

[30] Shapin: op. cit., 1975, pp. 234-235.

[31] Alexander Monro: *Observations on the Structure and Functions of the Nervous System*, Edinburgh, 1783, Table II, p. 106.

[32] For example, Sir George S. Mackenzie: *Illustrations of Phrenology*, Edinburgh, 1820, pp. 227-230.

[33] Shapin: op. cit., 1975, pp. 239-240.

[34] [John Gordon]: 'The Doctrines of Gall and Spurzheim', *Edinburgh Review*, Vol. 25, 1815a, pp. 227-268.

[35] ibid., p. 252.

[36] ibid., p. 249; cf. John Barclay: *An Inquiry into the Opinions, Ancient and Modern, Concerning Life and Organization*, Edinburgh, 1822, pp. 375-379; A. Combe: 'Observations on Dr. Barclay's Objections to Phrenology', *Transactions of the Edinburgh Phrenological* Society, Vol. 1, 1824, pp. 406-407.

[37] P. M. Roget: 'Cranioscopy', *Encyclopedia Britanica Supplement to 4th, 5th and 6th edns., Edinburgh*, Vol. 3, 1824, pp. 419-437.

[37a] ibid., p. 428.

[38] 'Controversy with Sir William Hamilton', *Phrenological Journal*, Vol. 4, 1827, pp. 377-407; 'Sir William Hamilton, Bart., and Phrenology', *Phrenological Journal*, Vol. 4, 1829, pp. 1-69; Thomas Stone: *Evidence against the system of phrenology . . .*, Edinburgh; 1828, *Observations on the phrenological development of Burke, Hare . . .*, Edinburgh, 1829, and 'On the Frontal Sinus', *Edinburgh New Philosophical Journal*, Vol. 14, 1833, pp. 82-89; Alexander Monro: *The Anatomy of the Brain* (with an account of experiments conducted by Sir William Hamilton), Edinburgh, 1831.

[39] 'Controversy with Hamilton': op. cit. pp. 390-391; Stone: op. cit., 1828, p. 54.

[40] 'Controversy with Hamilton': op. cit., p. 395.

[41] ibid., pp. 392, 401.

[42] ibid., pp. 386-387; 'Sir William Hamilton . . .': op. cit., p. 9.

[43] 'Controversy with Hamilton': op. cit., pp. 388-389n.

[44] 'Sir William Hamilton . . .': op. cit., pp. 11-12.

[45] Henry Gray: *Gray's Anatomy*, London, 1913, 18th edn, pp. 190, 221.

[46] Francis Schiller: 'The Rise of the "Enteroid Processes" in the 19th Century: Some Landmarks in Cerebral Nomenclature', *Bulletin of the History of Medicine*, Vol. 37, 1965, pp. 326-338; Clarke and Dewhurst: op. cit., pp. 60-67.

[47] It is important here to stress the ambiguity inherent in the notion of what structures were 'known' at any given time. The fissure of Rolando, for example, was 'shown' in various anatomists' representations prior to 1810 (or at least it has been 'shown' by historians to have been 'shown'). But it was not 'named' and assimilated to modern conceptions of pattern until much later. On this particular subject, and for an emphasis on the importance of 'naming', see Schiller: op. cit.

[48] John Gordon: *A System of Anatomy*, Vol. 1, Edinburgh, 1815b, p. 81.

[49] Gordon: op. cit., 1815a.

[50] John Gordon: *Observations on the Structure of the Brain, comprising an estimate of the claims of Drs. Gall and Spurzheim to discovery in the the anatomy of that organ*, Edinburgh, 1817.

[51] Barclay: op. cit.

[52] ibid., pp. 375-377.

[53] cf. Stone: op. cit., 1828, pp. 15-17.

[54] Gall: op. cit., ii, p. 249.

[55] Clarke and Dewhurst: op. cit., pp. 94, 101-102; E. Clarke and C. D. O'Malley: *The Human Brain and Spinal Cord: A Historical Study Illustrated by Writings from Antiquity to the Twentieth Century*, University of California, London, 1968, pp. 391-395; J. G. Spurzheim: *Examinations of the Objections made in Britain against the Doctrines of Gall and Spurzheim*, Edinburgh, 1817, p. 43.

[56] A. Combe: op. cit., 1824, p. 399; J. G. Spurzheim: *The Anatomy of the Brain, with a General View of the Nervous System*, London, 1826, pp. 110-111.

[57] A. Combe: op. cit., 1824, p. 403.

[58] Spurzheim: op. cit., 1826, p. 112; Stone: op. cit., 1828, p. 17.

[59] Clarke and O'Malley: op. cit., pp. 415-457.

[60] Clarke and Dewhurst: op. cit., p. 91.

[61] Spurzheim: op. cit., 1826, p. 111.

[62] Clarke and O'Malley: op. cit., pp. 566-567.

[63] ibid., pp. 598-599.

[64] 'Report on a Memoir': op. cit., pp. 64-66.

[65] Ackerknecht: op. cit., p. 151.

[66] Spurzheim: op. cit., 1815, pp. 36-43 and 1817, pp. 32-42.

[67] Gordon: op. cit., 1815b, p. 121.

[68] ibid., p. 123.

[69] ibid., pp. 123-124.

[70] Gordon: op. cit., 1815a, pp. 255-256.

[71] ibid., p. 256. It is interesting to note that Gordon expressed two, rather different, views of the value of direct sensory evidence. In this context he asserted that 'mere' appearances may be bad indicators of structural reality; elsewhere, as we have seen, he chided his opponents for doing other than describing 'mere' appearances.

[72] Gordon: op. cit., 1817, pp. 11-16.

[73] Spurzheim: op. cit., 1817, p. 20; cf., Spurzheim: op. cit., 1815, pp. 13-14.

[74] Spurzheim: op. cit., 1817, p. 21.

[75] ibid., p. 25.

[76] A. Combe: op. cit., 1824, p. 408.

[77] This is not to say that the fibres had a common origin or that the nerves were 'prolongations' of the brain. Phrenologists, especially Gall, were keen to deny these notions; for example, Spurzheim: op. cit., 1815, pp. 15-18.

[78] Gall: op. cit., ii, pp. 248-249.

[79] ibid., ii, pp. 247, 250.

[80] George Combe: *On the Functions of the Cerebellum*, Edinburgh, 1838.

[81] The subject matter of this section might easily have been addressed from a rather different perspective, that of the cognitive aspects of visual communication. Indeed, my attention was originally drawn to these issues by a reading of William Ivins: *Prints and Visual Communication*, M.I.T. Press, Cambridge Mass., 1953; and H. E. Gombrich: *Art and Illusion*, Phaidon, London, 1959. Ivins stresses the difficulty of relating a published engraving to what the anatomist may actually have 'seen', whereas Gombrich emphasises the relationship between 'schema' of artistic production and 'schema' for seeing. In any case, it is important to know that a number of people were involved in the production of these representations. The Gall and Spurzhiem plates were drawn by the artist Prêtre and engraved by Bouquet; the 'Gordon' cerebellum was in fact drawn by Syme and engraved by one W. Miller. Both artist and engraver impose their 'syntax' on the representation, which may result in the loss or distortion of those features of reality which most closely relate to the anatomists' concerns. However, the end-products become representations of 'reality' to which anatomists, and those they are able to persuade, give their assent as reliable accounts.

[82] Gordon: op. cit., 1817, figs. 1 and 2, pp. 209-215.

[83] Spurzheim: op. cit., 1815, pp. 34-35 and 1826, pp. 121-125; Gordon: op. cit., 1817, pp. 191-193, 198-199.

[84] Gordon: op. cit., 1817, pp. 39, 209-210.

[85] ibid., p. 38.

[86] Gordon: op. cit., 1815b, pp. 144-145.

[87] Spurzheim: op. cit., 1817, p. 15.

[88] ibid., p. 29.

[89] ibid., pp. 28-29.

[90] ibid., p. 39.

[91] Personal experience with dissection of these structures (aided by Dr. C. J. Lawrence) indicates that if one cuts the corpus dentatum towards its lateral edges it does appear to be a greyish mass, wheras slicing it medially produces a section which appears much as Gordon represented it. I should like to thank the Anatomy Department of the University of Edinburgh Medical School for providing us with the necessary material.

NOTES ON FIGURES

Figure 1: Sir George Stewart Mackenzie: *Illustrations of Phrenology*, Edinburgh, 1820, Plate IV, figure 1.

Figure 2: F. J. Gall and J. G. Spurzheim: *Anatomie et Physiologie du Systême Nerveux . . . Atlas*, Paris, 1810, Plate X.

Figure 3: Mackenzie: op. cit., Plate I, figure 3.

Figure 4: Gall and Spurzheim: op. cit., Plate VIII.

Figure 5: Gall and Spurzheim: op. cit., Plate V.

Figure 6: John Gordon: *Observations on the Structure of the Brain . . .*, Edinburgh, 1817, figure 1 (This is a reduced copy of Plate XII of Gall and Spurzheim: op. cit.)

Figure 7: John Gordon: op. cit., figure 2.

Figure 8: *Gray's Anatomy*, 18th edn., London, 1913, p. 771; cf. J. C. Brash (ed.): *Cunningham's Text-Book of Anatomy*, Oxford University Press, London, 1953, 9th edn., p. 910, fig. 797.

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IN THE BEGINNING: THE BATTLE OF CREATIONIST SCIENCE AGAINST EVOLUTIONISM*

Eileen Barker

WHETHER or not one agrees with the general theoretical position of Thomas Kuhn in *The Structure of Scientific Revolutions*[1] there can be little doubt that the theory of evolution does constitute an overwhelmingly pervasive paradigm not just for modern science but for almost the whole of modern thought. There are, however, those who operate outside the paradigm, rejecting evolution and all the assumptions and implications of that perspective, adhering instead to a fundamentalist view of the Bible and accepting as literal the account of Creation as it is presented in Genesis and elsewhere in the Scriptures.

The particular conflict between science and religion which was engendered by the publication of Darwin's *The Origin of Species*[2] has been faced in a variety of ways which basically involve either accommodation or rejection.[3] The accommodators believe that evolutionary theory and Christianity can be seen as compatible. The Bible is interpreted as partially allegorical or perhaps as only relating to things spiritual, and some kind of theistic evolution is adopted. In other words evolution is accepted as the Creator's way of doing things. The rejectors continue to argue that Christianity and Evolution are incompatible and as a consequence deny the truth either of religion or of evolutionary theory.

Those who reject evolution may do so unobtrusively, withdrawing from situations in which their beliefs will be questioned or threatened by the 'domain assumptions'[4] of the community at large. The division of labour, the general compartmentalisation and the heterogeneity of contemporary industrial society allow an individual Creationist to lead

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