

## **On splitting hairs:**

### **Hierarchy, knowledge and the school curriculum**

#### **Johan Muller**

‘To me, wherever there is pedagogy there is hierarchy. What is interesting, it’s the language of description that we use, because the language of description masks hierarchy, whereas the language of description should attempt to sharpen its possibility of appearance’ (Bernstein, in Morais et al [eds], 2001: 375).

‘In every hair there are an infinite number of lions, and in addition all the single hairs, together with their infinite number of lions, in turn enter into a single hair. In this way the progression is infinite, like the jewels in Celestial Lord Indra’s net’ (Fa-Tsang (T’ang Dynasty, quoted in Collins, 1998: v).

#### A) The trouble with hierarchy

The set of papers in this volume can loosely be said to be about hierarchy in discourse – in language, knowledge, and pedagogy. The two disciplinary communities represented in this volume do not deal with hierarchy in the same way, but they are at least endeavouring to find common ground for representing it in the same discursive space. This is a large step forward. In fact, hierarchy is a word we generally shun in our lexicons, infused as they are with one or other kind of egalitarianism, which is generally speaking a good thing. Deeply embedded in our egalitarian zeitgeist is the unassailable assumption that hierarchy in discourse and hierarchy in society are connected, together with a corollary assumption that one inoculates

oneself from the latter by avoiding talk about the former. Alas, sympathetic magic of this sort works about as well in social science as it does in folk medicine.

Our two communities are on the face of it engaged in nicely complementary projects. The linguists are engaged in establishing what the building blocks of hierarchy are, while the sociologists of education are engaged in establishing how hierarchy is distributed. Both communities have made some progress, but neither community has settled the issue of what exactly discursive hierarchy derives from, or what knowledge hierarchy *is*. There are at least three obstacles that I can see. The first is that we are locked into an early (lexical) metaphorical stage of discussion, where the terms are more suggestive than they are explanatory, and where use of the same term does not guarantee equivalent meaning. Secondly, the egalitarian ethos seems to drive us to use terms that obdurately suggest variety without hierarchy – discovery, variation, and the like. Thirdly, a currently influential trend in social science that I call the ‘New Cynicism’ below, denies the very existence of discursive hierarchy, making all talk about it sacrilegious. Fortunately, the two communities gathered together in this volume seem united in the view that the devil you know is better than the one you don’t, and that understanding hierarchy in discourse is a necessary prelude to combating it in society. That is promising indeed.

Though we routinely avoid addressing it directly, we willy nilly imply hierarchy: to take an example almost at random, Hasan (2001) refers to ‘higher mental functions’, after Vygotsky. One infers that ‘higher’ functions enable greater abstraction, hence greater combinatorial power. But what about the levels in the parent discourse within which this higher abstraction is embedded? From a constructivist ‘knower’ perspective, it is almost as if each neophyte knower invents the levels *ab initio*. From a ‘knowledge’ perspective, where it is the

distributive potential of different kinds of knowledge that is at stake, it is precisely knowledge hierarchy that conditions distributive potential. So there is no avoiding it.

Martin (this volume) tackles it head on. Starting with Bernstein's common sense – uncommon sense cline, Martin produces a branching diagram that, despite proceeding in the opposite direction to Bernstein's (2000: 168) own branching diagram, anticipates its principal features in a quite remarkable way<sup>1</sup>. The principal similarity is that both Martin and Bernstein use the branching tree device to complicate and fill in the continuum between the two ends of the spectrum. With this, the explanatory implication of the tree shifts from dichotomy to continuity. The question then becomes: how far do we want to push the implication? Do we want to imply that there is a complete continuum, or are there categorical differences between some of the symbolic ensembles unbranched by the tree?

The answer depends upon whether one is primarily interested in knowledge as meaning or knowledge as distributed social goods. If one is interested in knowledge as meaning, then one is primarily interested in describing the universal semantic building blocks that enable transition from one form to the other. Martin goes on exemplarily to show how grammatical metaphor 'engenders' the 'drift' from spoken to written discourse, from horizontal to vertical discourse (Martin, this volume: 18). If one is primarily interested in knowledge as distributed social goods, then one is interested in describing the way both forms have distributive rules which are in turn conditioned by discontinuities in semiotic structure that mirror, sustain and reproduce inequalities in society. For the first, the explanatory task is to uncover the most basic universal processes and hence to reveal the ideal underlying unity of semiosis; for the second project, the task is to delineate the social limits to distributive equality. The first is, if

you like, a classical, ultimately optimistic enterprise; the second is a fundamentally tragic enterprise, no matter how optimistically driven.

My intention is not to separate the enterprises. Quite the opposite. I hope to sharpen the difference in the projects and starting points the better to make visible where the projects at present overlap and where bridge building should concentrate. Both Bernstein and Martin distinguish between discourse forms tied to empirical particulars (to 'context'), and those which do not depend upon the world in order to make sense, which in fact float free from it. For Bernstein, a fundamental distinction between what he called horizontal and vertical discourse is that the latter is integrated at the level of meanings allowing de-contextualisation, the former at the level of (culturally specialised) segments binding the language to context. In his contrast between 'everyday' and 'scientific' taxonomies, Martin makes the same point (pg 5). A key characteristic of everyday categories is that they are largely learnt ostensively or by modelling, that is, by modes of discursive action that require the coincidence of time and space, for Bernstein placing a constraint on their distribution. In middle class homes, as Painter (1999) shows, the transition from ostensive definition to decontextualised definition (to technical lexis), 'allowing the speaker to attend to the meaning rather than the referent' (Painter, 1999: 82), is pretty well seamless, at least for young Stephen busy acquiring his semantic style (see also Painter, this volume). Bernstein would be in full agreement, but would want to make something more of the social gulf between the two forms of discourse. To see this, it is useful to take a small detour via Durkheim.

In The Elementary Forms of the Religious Life Durkheim (1995) famously draws a distinction between two orders of existence which relate thought and practice in two

fundamentally different ways. The first order is the profane world, the everyday world of ‘sensual representations’, the world of matter and sense, where meaning arises directly out of bodily encounters with the world, with other people, with reality. It is a world of flux and of particulars, and it is driven by the most practical and direct wisdom: proverbs, prudence, street lore, on-the-job knowledge, the rhythmic language and wisdom of the domestic community.

The second order is the sacred (originally religious) world, one of prescriptions and interdicts that are not pragmatically modifiable but are ‘fixed and crystallised’ (Durkheim, 1915: 433). This sacred world is an order of verities not originating in bodily hexis, and therefore arbitrary, in Pierce’s sense of unmotivated: taboos, for example, can be attached to any object. The religious world is thus a world of arbitrary conceptual relations, a symbolic order constructed by an accretion of ‘collective representations’ (op.cit: 434) that are a collective accomplishment, the ‘work of the community’, in contrast to the ‘sensual representations’ of the everyday world that are the work of continually changing experiential particulars shared traditionally in face to face encounters (see Muller, 2000).

Religion is for Durkheim the primary cognitive classificatory scheme of the sacred, the primary form of ordering social representations in non-empirical, formal ways. The force of the ordering comes from ‘outside of the object in which it resides’ (quoted in Thompson, 1994: 125), not from the object itself. It is the result of a process of ‘examination and elaboration’ (op.cit: 126): it is the result of a cognitive process of idealisation, or ‘schematic idealisation’ in Martin’s terms (pg 8).

Durkheim means at least two things with this faculty of idealisation. The first is the purely cognitive or speculative sense of being able ‘to connect things with each other, to establish internal relations between them, to classify them and to systematize them’ (op.cit: 133). The second is that of forward projection towards an order and a world more desirable, more felicitous, more powerful - in a word, better - than the one we have in hand at any specific point in history.

Durkheim plays upon the double sense of ideal: ideal first as the facility to manipulate objects and relations in non-empirical virtual space; ideal secondly as the projection into and towards that which is more desirable. Both together allow us to break with empirical facticity and to imagine an ordering of objects that is ‘logical’ and ‘hierarchical’ (op.cit: 137). This is a key feature of virtual connections that allows, as Foucault (1981: 59) says in a related idiom when discussing disciplinarity, ‘the possibility of formulating new propositions, ad infinitum’, or as Hacking (1985: 156) says when discussing styles of reasoning, to ‘generate new classes of possibilities’. No surprise then that the exemplary form that the sacred takes in societies with a complex division of labour is *science*.

The sacred and the profane are thus two fundamental orders present in all forms of society. The principal purpose of the strong classification between the two is to sustain the fundamental social cleavage between mental and manual labour, and to reproduce it. As easy as it is for Stephen with the help of Stephen’s mother to traverse the semiotic gap (Painter, 1999), as difficult is it to close the social gap. For Bernstein, this is because of the bias in the distributive rules that regulate access to powerful discourses, to highly specialised forms of consciousness. The more differentiated the division of labour, the more differentiated will be the distribution of these sacred goods.

This may seem to damn both Bernstein and Durkheim as incorrigible pessimists, yet, though they were both frequently derided as functionalists, they were both anything but pessimists. To say that power arising from the social base is not to say that power is monolithically and automatically reproduced. It is simply to say that symbolic configurations and their distributive potential are allied to socio-economic conditions. To understand how the symbolic configurations are reproduced is to enquire into the way these symbolic ensembles are recontextualised, and how the recontextualised discourses are acquired. This is to enquire into the workings of symbolic control and its agencies, which is to say, the education system, which is, as we used to say, a site of struggle within which much can be done. David Rose has shown this at the level of the classroom (Rose, 2004), and Cuba has shown it at the level of the state, outperforming its fellow Latin neighbours for reasons that Durkheim and Bernstein (and Rose) would have applauded, namely, because the state has realised that reducing social inequality across the society was an important corollary to a large scale equalising of the distribution of educational competencies (Carnoy, Gove & Marshall, 2004).

Returning briefly to Martin's cline, it is worth observing that the initial categories of his cline are oral transmission and written transmission. Bernstein almost seems to shy away from this contentious area<sup>2</sup>, but it is noteworthy that his exemplification of the way everyday wisdom circulates has everything to do with its face to face (oral) nature (Bernstein, 2000: 158). In both Martin and Bernstein thus we find echoes of the dual advantages of writing, both cognitive and social. On the one hand, as Collins (1998: 27) reminds us after Goody, Ong and Havelock, sustained writing is a 'gateway to abstraction and generality', on the other, writing breaks the strictures of time/space coincidence that mark oral cultures: 'What is needed is a social arrangement for writing texts of some length and distributing them to

readers at a distance ...' (op cit). I have been making the claim in this introductory section that while both sociologists and linguists share this dual interest, linguists concentrate on the former – how texts are specialised – while sociologists concentrate on the latter – how texts are distributed.

Not all sociologists concentrate on distribution from the field of production to the fields of reproduction and acquisition, as Bernstein does. It may be interesting to examine briefly how an exemplary sociologist of science, Robert Merton, describes the distributional consequences of discursive structure for the discourse producers (rather than acquirers) – how disciplinary differences affect their practising scholars. Merton first establishes in a terse formulation his version of (a part of) the cline, the terms in which specialised disciplines differ: 'Codification refers to the consolidation of empirical knowledge into succinct and interdependent theoretical formulations. The various sciences and specialities within them differ in the extent to which they are codified' (Merton, 1973: 507; see also Foray & Hargreaves, 2003). Degree of codification has a series of consequences, three of which are the following<sup>3</sup>:

- There is a higher rate of obsolescence in C+ than in C- disciplines, because they display a greater tendency to subsume past work. One consequence is that there is a greater percentage of references to recent rather than older work in C+ than is the case in C- disciplines;
- In C+ disciplines innovative work by young scholars is more easily recognised than in C- disciplines, where it is easier to be overlooked, leading to what Merton calls the Matthew Effect (Merton, op.cit: 516), from St Matthew: to him who hath shall be given, etc. Young scholars find it difficult to break into C- disciplines. One



consequence is that there are age differences in discovery patterns, summed up famously by Caius Asinius Pollio in Robert Graves' I Claudius: 'Science is a young man's game' while 'history is an old man's game' (op.cit, fn. 39: 513), or Merton, with the irony for which he was famous: 'This sort of thing can thus foster the illusion that good mathematicians die young, but that, say, good sociologists linger on forever' (op cit).

- Induction into C+ entails grasping high level propositions; into C-, into learning masses of particulars. Induction opportunity costs consequently differ.

Merton's discussion of degrees of codification rings many bells in the popular as well as esoteric literature: recall Bertrand Russell's distinction between 'hard' and 'soft' disciplines, a distinction formalised by Tony Becher (Becher, 1989; see also Becher & Parry, 2005) using a version of Bernstein to aid him. It rings bells in the work of self-styled Bernsteinian heretic Paul Dowling (1999), who has coined the concept of discursive saturation to replace Bernstein's code and discourse cline. Dowling's objection to code/discourse involves an objection to the separation of the dimension of classification from that of framing. For Dowling, classification, the carrier of power and the distributive rules, is not to be separated from its semiotic enactments (framing), thus there is only high discursive saturation (DS+) and low discursive saturation (DS-); the former is specialised by generalising strategies, the latter by localising strategies. This is a stunningly original elaboration of the theory in its pedagogic dimension, that is, in establishing which pedagogic strategies belong with which kinds of DS mode, although the core distinctions are arguably latent in Bernstein's tacit and explicit transmission distinction. Yet in its predominant focus on texts and pedagogy, it takes us away, once again, from the field of production, from knowledge and how it grows, from hierarchy<sup>4</sup>.

The codification cline rings bells for Bernstein and Martin too, but I believe the affinity is greater with Martin than with Bernstein, the sociological congruence around distribution notwithstanding. This is because both Merton and Martin are pursuing a notion of textual specialisation within knowledge structure across a single graded continuum, while Bernstein, as I hope to make clearer below, seeks to find the heart of the discontinuity between the way the two ends of the codified spectrum grow, and progress. The rest of the paper is an inquiry into hierarchy from the point of view of the question of knowledge progress.

#### A) Knowledge and the dilemma of progress<sup>5</sup>

The reluctance to speak directly about hierarchy and its cognate, progress, referred to above, is an old one, and below I will trace its roots to the terms of a debate in the eighteenth century at the advent of the age of science, continuing to the present. This debate is about the idea of progress in general, and the idea of progress in knowledge in particular. We are, it would seem, exceedingly reluctant to speak about the social dimensions of knowledge hierarchy, not only in terms of relations between different knowledge forms, but particularly in terms of relations within knowledge forms. The idea of hierarchy haunts us, nowhere more so than in regard to the question of knowledge progression and growth.

Bernstein has intervened decisively in the discussion about the forms of symbolic systems, setting out to delineate the 'internal principles of their construction and their social base' (Bernstein, 2000: 155). As is by now well known, he distinguishes between two forms of discourse, horizontal and vertical, as the discussion above made clear. From here on, this paper will not discuss the question of discourses further and will concentrate on the question

of variation between knowledge structures within vertical discourse. Here Bernstein distinguishes between two kinds of knowledge structure, hierarchical and horizontal.

For Bernstein, knowledge structures differ in two ways. The first way is in terms of what I call verticality. Verticality has to do with how theory develops. In hierarchical knowledge structures, it develops through integration, towards ever more integrative or general propositions, the trajectory of development of which lends hierarchical knowledge structures a unitary convergent shape. Horizontal knowledge structures, on the other hand, are not unitary but plural, consisting of a series of parallel incommensurable languages. Progress in horizontal knowledge structures occurs not (or at least not primarily) through theory integration but rather through the introduction of a new language which constructs a ‘fresh perspective, a new set of questions, a new set of connections, and an apparently new problematic, and most importantly a new set of speakers’ (ibid: 162). Because these languages are incommensurable, they defy incorporation. The level of integration, and the possibility for knowledge progress in the sense of greater generality and hence explanatory reach, is thus strictly pegged.

Before I proceed to discuss the second form of knowledge form variation, it is worth making a few observations on verticality. The first observation is that it artfully incorporates and recapitulates the fierce dispute in the philosophy and sociology of science between the logical positivists and the non-realists, a dispute I selectively re-visit below. Bernstein is implicitly asserting that the logical positivists (or realists) were right, but only in respect of hierarchical knowledge structures; the non-realists (Kuhn and after) likewise right, but only in respect of horizontal knowledge structures. In other words, encoded into Bernstein’s principle of verticality are the terms of debate in the philosophy of science since the romantic

revolt of the eighteenth century. Secondly though, we should note that the category of horizontal knowledge structures span a very broad range, from mathematics to sociology and the humanities. Although there is more than one mathematical language, and mathematics is in this sense a ‘horizontal’ knowledge structure, this example makes clear that verticality is certainly possible within the discrete languages constituting horizontal knowledge structures, verticality of a kind approaching the triangular form obtained in hierarchical knowledge structures, as Wignell (this volume) argues. The germane question then becomes, not so much what constrains progression in horizontal knowledge structures, but rather, what internal characteristics fail to constrain it in those that proliferate languages compared to those where language proliferation is constrained. For Bernstein, this is the difference between ‘strong’ and ‘weak grammar’ horizontal knowledge structures. In this usage of the term ‘grammar’, Bernstein is referring to internal properties of the knowledge structure. This should not be confused with the external sense of grammaticality discussed below.

If verticality has to do with how theory develops internally, with what Bernstein later called the internal language of description, grammaticality (in the external sense) has to do with how theory deals with the world, or how theoretical statements deal with their empirical predicates, the external language of description (Bernstein, 2000). The stronger the (external) grammaticality of a language, the more stably it is able to generate empirical correlates and the more unambiguous because more restricted the field of referents; the weaker it is, the weaker is its capacity to stably identify empirical correlates and the more ambiguous because much broader is the field of referents, thus depriving such weak grammar knowledge structures of a principal means of generating progress, namely empirical disconfirmation: ‘Weak powers of empirical descriptions removes a crucial resource for either development or rejection of a particular language and so contribute to its stability as a frozen form’

(Bernstein, 2000: 167-168). In other words, grammaticality determines the capacity of a theory or a language to progress through worldly corroboration; verticality determines the capacity of a theory or language to progress integratively through explanatory sophistication. Together, we may say that these two criteria determine the capacity of a particular knowledge structure to progress.

The precise nature of the relation between verticality and grammaticality is unclear. A plausible surmise could be the following: that verticality is a categorical principal, consigning knowledge structures to either a theory-integrating or a theory-proliferating category. The latter can in turn be broken down into a constrained proliferation or an unconstrained proliferation category. Grammaticality on the other hand is an ordinal principal, constructing a continuum of grammaticality within each category of knowledge structure, or perhaps across the entire spectrum<sup>6</sup>. In what follows, I will concentrate mainly though not exclusively on verticality, on the internal characteristics of the internal language of description.

Why would one want to elaborate a theory of knowledge forms? After all, we seem to have got along reasonably well without one for a long time. Bernstein only turned to the issue towards the end of his work. The contention here is that this lacuna in the study of knowledge and education was not accidental. Rather, I suggest, it was produced by the failure of social thought to deal with the dilemma of progress and the distributive strictures of hierarchy. The failure to reckon with the material structural differences in knowledge forms has become something of an obstacle in educational thinking. This can briefly be illustrated in two domains of education practice, namely, curriculum planning, and research administration.

Curriculum planning has been thrust into the limelight by international learner performance comparisons, most vividly displayed by the Third International Mathematics and Science Study (TIMSS)<sup>7</sup>. A central tenet of assessment is that the instrument measuring performance is valid to the degree that it assesses what has been made available for acquisition. TIMSS has made visible the fact that not all children of the same age cohort across the globe learn the same things in the same order at the same level of cognitive demand. This has put a spotlight on the stipulation, sequence and progression requirements of curricula, and has begun to suggest that not all subjects in the curriculum have the same requirements. Could this be because their parent knowledge forms are different and take different distributional forms which in turn lead to different recontextualising requirements?

As for the question of research administration, research assessments of individuals and bodies of work have made possible comparisons between individuals, faculties, universities and countries. As more and more comes to depend on assessments of innovation and novelty ('Is this paper really a contribution to new knowledge, or a re-hash of the known?'), the question arises as to what exactly constitutes innovation in different areas of research endeavour, and whether they are at all comparable. This is only the tip of the iceberg: it soon becomes clear that there are different epistemic cultures, different kinds of collaboration, different publishing traditions, and so on. In short, the globally emergent audit culture compels us to reflect on our knowledge practices, at the centre of which sits the question of their likeness, their comparability, and their compatibility. Once again, we realise how little we really know about how they may be alike or different, and what difference this might make. At the centre of this conundrum lies the question of knowledge hierarchy and progression.

A) Progress: the very idea, and its sceptics

The foundation of the Cartesian revolution in the seventeenth century was an axiom that appeared to be radically new, namely, that ‘true’ knowledge was characterised by knowledge progression. As Berlin put it, that ‘which had once been established did not need to be proved again, that is to say, in which scientific progress, universally recognised as such by rational thinkers, was possible’ (Berlin, 2000a: 28). The conventional account depicts this as the decisive moment in the emergence from the closed tautological world of antiquity, and the birth of the modern (Shapin, 1996).

There are a number of entailments to this view. First, Descartes believed that only in a bona fide branch of knowledge can we find ‘clear and distinct ideas’ (Berlin, 2000a: op.cit).

‘The paradigm of true knowledge, according to the Cartesian school, consisted in beginning from truths so clear and distinct that they could be contradicted only on pain of falling into absurdities; and in proceeding thence, by strict deductive rules, to conclusions whose truth was guaranteed by the unbreakable rules of deduction...’

Ibid.

This was indeed a lofty aim for knowledge, and it meant that Descartes viewed the knowledge array then available in a particular way. For example, the human sciences might generate edification and improvement, but were otherwise of little enduring social value because they could not produce ‘strict deductive rules’. Here lies the foundation of the distinction between science and all other symbolic ensembles, and it rests on the notion of what may be called strong progression, that is, the stepwise accretion of certainties.

No-one today is a thorough-going Cartesian; no-one today believes in strong progression. Challenges to Cartesian rationalism have come from both within and outside of science. One challenge to this idea of strong progression from within science has culminated in the generally accepted position in science today of what may be called weak progression, or what Haack (2003) would call progress ‘within reason’, which I will return to below. This is a revision which accepts the postulate of progression (and hence of the division of the field of representations into ‘true’ or progressive knowledge, and belief or mere narrative), but recognising at the same time that the ‘true’ in true knowledge did not equal absolute knowledge, and that progress in knowledge, if based on the best certainty to hand at that time, could always and in principle be revised – hence, weak progression.

The dominant challenge to strong progression from outside science has sought to overturn the distinction between knowledge that progresses (‘science’) and knowledge that does not. The first brilliantly original formulation can be traced back to Giambattista Vico who, with his 7<sup>th</sup> Inaugural lecture in 1708, and later with the publication of the first edition of Scienza nuova/ New Science in 1725, rejected the fundamental premise of Cartesian rationalism, the distinction between the true (verum) and the artificial (factum). Vico begins by arguing their essential unity: ‘We demonstrate geometry because we make it’ (Berlin, 2000a: 31). What he meant by this was that we can be said to fully know something, not only because we know what it is (i.e. through rational reconstruction) but because we know how it came to be (i.e. through historical or genetic reconstruction), which he called per causas. By this logic, we only know what we create. If we did not create it, we cannot know it, because it then has no human history. ‘The true (verum) and the made (factum) are convertible’ (ibid: 35), or, ‘The



criterion of truth is to have made it' (ibid: 36). In other words, with this argument, truth becomes a human artefact, and Vico becomes the first constructivist.

Thus, whereas Descartes with his criterion of 'clear and distinct ideas' fundamentally sundered verum from factum, Vico fundamentally subverts it by re-uniting them. The 'demarcation debate' in the philosophy of science, as to whether there is or is not a significant distinction between 'science' and other knowledge forms, begins here.

Vico's revolt has come to be a mere dress rehearsal for the more thorough-going romantic revolt of the nineteenth century, and the anti-realist one of our own time. The European romantics took up Vico's anti-demarcatory premise of the make-ability of truth and of the world: ... 'the common assumption of the romantics that runs counter to the philosophia perennis is that the answers to the great questions are not to be discovered so much as to be invented. They are not something found; they are something literally made' (Berlin, 2000b: 202,203). Amongst the romantics and their contemporary successors there are strong and weak traditions of make-ability. Common to all, however, is the following:

Hence that new emphasis on the subjective [the maker] and ideal rather than the objective and the real, on the process of creation rather than its effects, on motives rather than consequences; and, as a necessary corollary of this, on the quality of the vision, the state of mind or soul of the acting agent – purity of heart, innocence of intention, sincerity of purpose rather than getting the answer right, that is, accurate correspondence to the 'given' (ibid: 203).

It is this tradition of ‘make-ability’ that I will trace below, first as it snakes its way through the debates on knowledge and then, in a homologous way, through the debates on curriculum. As we will see below, the tradition of ‘make-ability’ translates into a ‘knower’ as opposed to a ‘knowledge’ perspective (Moore & Maton, 2001).

#### A) On the shoulders of giants

What the scientific revolution of the seventeenth century accomplished was a decisive challenge by the self-styled Moderns to the ‘human-centred universe’ (Shapin, 1996: 20) of the Ancients, as consecrated by Aristotelianism, which had become a hermetic dogma of a priori truth. The cultural shock should not be underestimated. By 1611, the clerical poet John Donne could write: ‘And New Philosophy calls all in doubt’, ending with:

‘Tis all in pieces, all coherence gone;

All just supply, and all Relation.

(ibid: 28).

A century before Vico, Donne was registering a commonly felt shock at the cultural displacement of a deeply cherished worldview. What was gone was the measure of man, man as the measure of nature, and with it, the dominance of the humanistic Trivium over the scientific Quadrivium was decisively broken (Durkheim, 1977; Bernstein, 2000). At the heart of it was the entirely novel notion of progression towards a not-yet-attained truth that was not determined by man, but could be discovered by him through rational methods and intellectual daring. With the future and man’s fate loosed from the comforting embrace of classical-Christian teleology, the classicists, Christians and humanists of every stripe discerned a

cultural abyss. The threat was felt to every form of social authority that depended on that worldview. The humanist counter-revolution would be only a matter of time.

In the meantime, the intoxication of the expanded temporal horizon that the idea of progress suddenly constituted can be graphically seen in drawings and sayings of the time. In the frontispiece to his 1620 Instauratio magna / The Great Instauration, an already provocative title, Francis Bacon depicted a ship boldly sailing out beyond the Pillars of Hercules, symbolising the traditional limits of knowledge, below which was written the biblical text from Daniel: 'Many shall pass to and fro, and science shall be increased' (cited Shapin, 1996: 21). But if the forward horizon was extended, so too was the horizon backwards into the past in like manner re-constituted.

INSERT figure 1 about here

This expanded retrospect is given iconographical expression in Johannes Kepler's tower. At the front of the tower are two modern columns named for Copernicus and Tycho Brahe. Further back are more rough-hewn columns representing the earlier knowledge of Ptolemy and Agrippa; at the back are crude columns representing ancient astronomy. Right at the front, seated, is Kepler himself: the more recent, hence, the more sophisticated. The Moderns are separated from the Ancients by two dimensions, thus. The first is time. But in order to express progress across time, a second dimension is crucial to the first, namely, greater differentiation. In order to express this, then, the further towers are less differentiated, the nearer ones more so. What evolves, or progresses, is differentiation. The condition of that progression is a progressive capitulation and building on previous knowledge, a greater differentiation of knowledge. This quintessentially 'modern' idea, progressive differentiation

and dual temporality, is embodied in Newton's famous aphorism, 'if I have seen farther, it is by standing on the shoulders of giants' (Merton, 1993: 1).

In one of the richest ironies in the history of science, it turns out that the aphorism, everywhere attributed to Newton and hence taken as emblematic of the modern view of progress, does not originate with him at all. Indeed, it appears to have been common currency in knowledge circles since at least Bernard of Chartres in 1126, who probably got it from his Priscian predecessors, and was used in various forms, at regular intervals. Merton (1993: 268,269) records at least 27 usages in print before Newton. The aphorism continues to be used today in a wide variety of more or less appropriate contexts<sup>8</sup>. The original point of the aphorism was to highlight inter-generational cooperation as the ground for scientific progress, usually expressed in humble or mock-humble terms: 'A dwarf standing on the shoulders of a giant may see farther than a giant himself' (ibid: 4).

As Merton himself puts it:

When you come right down to it, the essential point is that the dwarfs-on-the-shoulders-of-giants Aphorism is a rough equivalent to the twentieth-century sociological conception that scientific discoveries emerge from the existing social base and consequently become, under conditions that can be reasonably well defined, practically inevitable'.

Ibid: 267.

What we learn from this pithy story is that scientists probably had a pragmatic view of themselves and the process of science from relatively early on – they certainly didn't have to

wait for social studies of science to discover messiness and serendipity in the twentieth century - but it was only in the seventeenth century that the threat to social order, up until then clearly contained by the hegemonic view, provoked the first in a series of backlashes that have continued with greater and greater sophistication to this day. The debate is variously figured, but it is probably fair to say that it has been between various kinds of realism and irrealism, those for a more or less strong view of progress in science (called by Haack, 2003, the 'Old Deferentialists'), and those against, (the 'New Cynics'). Before being sucked into the complexities of contemporary philosophy of science, I should immediately declare that my aim in what follows is solely to get a grip on the way that knowledge systems are internally differentiated, or are said to progress, and to answer the question 'what is it that progresses when they do progress? And is it only science that progresses? Has only science got hierarchy?' The philosophy of science debate detracts from asking the question about the non-science disciplines. Yet the point must hold for the non-science disciplines too, at least in one form or another, if these disciplines are not to surrender all claims to progress and relevance in an information or knowledge age (Foray & Hargreaves, 2003).

#### A) Kinds of verticality

In answer to the question, 'what is it that accumulates when knowledge progresses?' the logical positivists gave an unequivocal answer: it was the piled up structure of laws related to one another by strict definition, in strict order of explanatory integratedness, that is, in strict

order of their approximation to the truth. Here is to be found the definition of Basil Bernstein's verticality, namely, the degree of integratedness and 'subsume-ability' of theory.

The logical positivist idea of progression has come under universal attack. The debate has been intricate and technical, a far cry from the 'village or tabloid' scapegoat of positivism (Matthews, 2004: 2) that has taken centre stage in the social sciences. The principal objection has been to the founding idea of progression, to the idea of a single convergent system of knowledge. There was no single progression path, went one criticism, not least because the explanatory reach and range of application of most covering laws was much more modest, leading to a notion of a cluster of 'languages' rather than a single converged-upon structure, an idea conceded already by leading logical positivist Otto Neurath, he of the modest title of 'Director of the Agency for Full Social Planning' in ante bellum socialist Vienna (Cartwright, 2001). Nor is it a matter simply of 'inductive scepticism', of asserting the messiness of discovery against the seeming imperialism of the subsumptive structure: after all, the 'Old Differentialists', following Reichenbach in the early twentieth century, maintained a distinction between the 'context of discovery' as distinct from the 'context of justification' to deal with just this objection (Phillips, 2004), though the distinction proved difficult to sustain. The contemporary disavowal of progress by the 'New Cynics' cuts far deeper, against the heart of the impersonality of this vision of progress (Popper's 'epistemology without a knowing subject'), against the notion of a knowledge about the world that exists without man at its centre, in its most extreme reduction, against the idea that there is a real independent world to be known at all, a disavowal that eliminates progress by disavowing the world and the possibility of real knowledge about it (Moore and Muller, 1999).

Just as all forms of realism have built into them some or other form of progress, thus, all forms of the 'New Cynicism' have built into them the idea that knowledge progress is incoherent. While there are many alternative accounts (meaning holism and constructive empiricism to name but two), the landmark account belongs to Thomas Kuhn and his account of innovation by 'revolution' or paradigm change (Kuhn, 1962). This can be grasped by seeing that Kuhn turns the tables on the imperialism of the 'Old Deferentialists' who depicted all knowledge in the image of science, by depicting all knowledge, science included, as behaving like Basil Bernstein's horizontal knowledge structures, advancing up to a point, only to break off into an alternative theoretical language or paradigm. For Kuhn, as for Bernstein, the crucial point was that the languages were incommensurable.

One of Bernstein's great contributions, as I suggested above, is to have recapitulated realism's loss of innocence, as staged in the literature of the philosophy of science, and recast the terms of debate into a taxonomy of knowledge forms, with verticality, or 'subsumability', as one principal criterion. Earlier I suggested that verticality was a categorical principal. In the discussion above it is apparent that though this criterion has been considerably weakened, that though it is now conceded that knowledge grows by virtue of different kinds and paths of conceptual change, that these are still categorically distinguished as to whether they are commensurable or not. Or are there degrees of commensurability? Does incommensurability of a more absolute sort characterise what Bernstein called languages with weak internal grammars, (and I called with 'unconstrained proliferation')? Is incommensurability less absolute among 'constrained proliferation' languages? We could put this to the following test: can SFL - a language by all accounts (including those of Bernstein, Dowling and Martin) that has a strong internal grammar, is theory-integrating, and is discursively saturated – commune with, say, other forms of sociolinguistics? Or is that

conversation of the deaf as absolute as anything in the social sciences? I suspect that, in comparison with the hapless sociology, there is greater seepage between languages in linguistics than in sociology.

The discussion may be summed up as follows. As far as the internal structure of internal languages of description is concerned, that is, as regards their verticality, languages vary as to their:

- capacity to subsume statements into logical types (syntactic/semantic axis);
- therefore their relative expressibility in terms of general and particular statements (general/particular axis);
- and therefore their relative expressibility in terms of propositional content and stylistic content (content/form axis)

One could go on. The question now for this paper is: how are different powers of subsumption, of verticality, expressed by pedagogy? Does hierarchy specify pedagogy, and if so how?

#### A) The knowledge structure/pedagogic structure link

Does knowledge structure constrain pedagogic structure, does it place any onus on the way that the 'what is to be learnt' is recontextualised? Do these internal characteristics of knowledge structures place limits on the form their curricular offspring optimally could and should take? We know that pedagogic structure has distributive potential, but does knowledge structure come with an already encoded distributive potential, placing structural limits on pedagogic form? We know that it takes a specialised language to specialise consciousness: but can we determine what kind of specialisation a pedagogy must encode to



effectively realise a specialised consciousness in a specialised language? All these different ways of posing the question presuppose answering the question one way or another.

One affirmative response to these questions is given in the Review Committee's (2000) report on a review of the South African grade 1 to 9 national curriculum, known as Curriculum 2005 (C 2005). The Review found that the curricular form of C2005 was understipulated, under-sequenced and its pacing requirements under-signalled. It was a form of invisible or competence pedagogy (Bernstein, 2000) which provided minimal markers as to what should be learnt or evaluated at what level. Unsurprisingly, the Review found that poorly-trained teachers, teaching largely disadvantaged children, fared worst with this pedagogy: they had not covered what the curriculum expected them to have covered by the end of each grade. Consequently children entered the next grade with knowledge gaps, elements of knowledge presupposed by the curriculum of the next grade. These knowledge gaps had more serious consequences in what the Review called 'content-rich' subjects (maths, science and language) than in more skills based subjects like life skills, because the former had content, sequence and progression requirements deriving from their parent disciplines.

How does Bernstein answer the question? Equivocally, it turns out. In the paper on the pedagogic device, the answer is negative:

As physics is appropriated by the recontextualising agents, the results cannot formally be derived from the logic of that discourse. Irrespective of the intrinsic logic which constitutes the specialised discourse and activities called physics, the recontextualising agents will select form the totality of practices which is called

physics...But these selections cannot be derived from the logic of the discourse of physics... (emphasis added).

Bernstein, 2000: 34.

Here Bernstein appears to contradict the Review, but we should note the context, where Bernstein is asserting the theoretical priority of the regulative over the instructional, meaning that the internal order of school physics is wholly derived from normative social order. In one sense this is undoubtedly correct. Any state can, on the basis of its ideology, decide what pedagogic modality to impose. It can even appear to choose a de-specialising pedagogy in defiance or denial of the requirements of its specialised division of labour, at least for a while. This is indeed what happened in South Africa with C2005 in the 1990s as it had in the UK with the Plowden Report in the late 1960s (Fitz, Davies & Evans, 2006). But in another sense, this is quite misleading. Indeed, the argument can be made that Bernstein came to the view, late in his career, that the instructional domain – or knowledge – has an internal determinative logic of its own, one which cannot simply be reduced to subordination to the regulative order. Although the sea change was presaged in the ‘pedagogic device’ paper, the strongest evidence for this view can be found in Bernstein’s ‘vertical and horizontal discourse’ paper (Bernstein, 2000).

The principal reason Bernstein opposed the idea of a link in his early work is because he maintained that the recontextualised discourse (eg school physics) was a wholly separate discourse to that of research-based physics. It was necessary to maintain this position in order to stay true to the postulate that all symbolic formations were specific to a context with its specialising practices. That context is conditioned by a society’s regulative or moral order. But if recontextualisation totally severs any relation, then how are specialised knowledges

ever reproduced? After all, school maths performance predicts (imperfectly to be sure) university maths performance; and that predicts in turn proper maths adeptness. The only way this can be intelligible is by conceiving that school maths competence ‘precurses’ (Gee, 2001) university maths competence, which ‘precurses’ real maths adeptness. There has to be some form of specialisation of consciousness continuum in play; this could be called a founding assumption of modern education, and it is strongly suggested by Bernstein’s view that the symbolic device is ‘condensed’ in the evaluative rules which binds the logic of the parent discipline to the attainment requirements for acquirers (Bernstein, 2000). After all, this idea of the interpenetration of symbolic competence is built into Bernstein’s explanation of how the middle class home code precurses its young into the school code better than does the working class home code. So, a relation there must be. One might pursue the exact nature of the relation. A preliminary question for this chapter is: what *effects* the relation? What activates it?

There are two typical answers: let us call them a *knowledge* answer, and a *knower* answer. A knowledge approach is epitomised by TIMSS and their principal intellectual construct, ‘opportunity to learn’ (OTL). OTL in its simplest form is defined as coverage of the curriculum, and the original TIMSS project defined coverage in terms of a serial list of topics only (Porter, 2002). But is that sufficient to map coverage in a vertical curriculum? It certainly wasn’t adequate in TIMSS. A syntactical view will say: list the principal propositional steps in the knowledge hierarchy. Each propositional step will function like a rule with rules of combination, each cluster of which can generate an indefinite number of possibilities; for example, ‘odd numbers’ in arithmetic (see Pinker, 1999: 318). A complete list will describe the internal grammar of the internal language of the subject. Here is one way of representing this, drawn from Reeves and Muller (2005):

INSERT Table 1 about here

This table displays an extract from a finite list of maths content presumed to be learnt in grade 6, listed in order of cognitive complexity. The information in brackets (g4, g5, g6) indicates that these knowledge elements are considered essential at the grade 4, 5 or 6 levels – in other words, they reflect work that learners are, at a minimum, expected to cover at this level. However, although certain elements of topics or subtopics are considered essential for a particular grade level, there are other elements of topics or subtopics that are considered essential at all or more than one grade level.

But here a pedagogical question arises. Does a list of topics in order of complexity, in other words in order of disciplinary progression, constitute an optimal learning path? The reconstituted logic of a discipline and the optimal pedagogical learning sequence might overlap only by default. The reason for this lies with the way subsumption works: the same semantic topics (the same particulars) play different roles in different generals. The upshot is that particular topics, even for the most hierarchical of subjects, are repeated across learning levels, but differently. In short, imperfect subsumption has so far stymied the linear representation of content in a curriculum, and the relation of curricular structure to disciplinary structure has remained an open, more usually an avoided, question. The same question may be posed to the linguists: does a curriculum following a genre-sequential logic constitute an optimal learning path? How are these different cognitive logics to be braided into the artifice called curriculum and pedagogy? This is the nub of pedagogy.

All in all, it is not too surprising that by far the most common way of representing verticality in the literature has been distilled from what teachers do or expect, in terms of an index of ‘cognitive demand’, usually depicted as a scale from ‘memorisation’, through ‘routine

procedures’, ‘communication of understanding’, ‘problem solving’, to ‘conjecture/generalise/prove’ (Porter, 2002: 4). Each listed topic is given a ‘cognitive demand’ rating. Proportion of coverage by degree of demand yields a proportion of instructional time spent. This temporal proportion becomes a proxy for ‘opportunity to learn verticality’. There are clearly other ways of compiling a demand index (see Morais, et al, 2004, for a good example). All of them, as far as I can see, shift the focus from the knowledge itself to the knower-actors, from a knowledge approach to a knower approach. They shift the focus from what knowledge is made available, to what levels of complexity teachers make available. Hierarchy moves back into the shadows.

In the wake of the demise of logical positivism, and the discrediting of the distinction between the contexts of discovery and justification, a new orthodoxy under the aegis of the ‘New Cynics’ and their pedagogical confreres the educational progressives, took hold, to the effect that sequence and progression in pedagogy simply didn’t matter, that there was no one royal road to learning, and that only the most minimal stipulations were necessary to signal the learning end points as measured by common assessment instruments (Muller, 2002; Labaree, 2004). This turned out to be wrong, in South Africa and elsewhere. Such radically invisible pedagogies can work, but only for middle class pupils and usually only in the lower grades, and exactly how they do that is still being unearthed. For the majority of poorer children, the evidence increasingly suggests, clear and explicit articulation of evaluation criteria is sine qua non (see the various papers in Muller et al [eds], 2004).

What are the evaluation criteria evaluations of? Of the knowledge steps to be traversed; it is hard to avoid this conclusion. To be sure, there is not only one set of steps per discipline, nor need we assume that these steps are always to be traversed in exactly the same order: in

practical situations they simply won't be. Nevertheless, insofar as the idea of theory integration means anything at all, it does, qua hierarchy, specify the formal, minimal steps to be acquired in order for sense to be made at all. So, making concessions to messiness and agreeing that we cannot stipulate a once-and-for-all-path, we would still have to concede, retrospectively considered, that there are a specifiable necessary minimum set of steps that must be pedagogically traversed. In a world of disadvantage, to lose sight of this is to lose sight of the target for the social equality of outcomes.

Does this argument do away with the necessity of the teacher? Not at all. What it does is to emphasise the knowledge dimension of what makes a teacher a teacher. The condition for a teacher being an authoritative pedagogical agent is, at the minimum, an internalised map of the conceptual structure of the subject, acquired through disciplinary training (this is perhaps why Morais et al 2004 dub the index of the what 'teacher competence' in their study). In other words, the condition for teachers to be able to induct pupils into strong internal grammar subjects is that they themselves already stand on the shoulders of giants, that they can speak with the disciplinary grammar. But if they can't? I am inclined to say; let us then train them so that they can. The difficulty is, it is often not clear what they don't know. Two things stand out in the global literature on effective learning. The first is that teacher competence is by far the most important factor in learner attainment; the second is that in-service teacher training has had almost no effect. I fear this will continue unless we pay as much attention in future to knowledge as we have up until now to knowers.

A) Conclusion

I have proceeded in this paper on the hunch that the contemporary avoidance of knowledge structure, in this paper principally of the question of hierarchy and progression, lies at the heart of many current pedagogical dilemmas, in particular those having to do with providing to poor children access to the tools of powerful knowledge. That this can be done has been incontrovertibly shown by Rose (2004) and Carnoy et al (2004). I have not kept that in the foreground of the discussion, but it nevertheless remains a principal motive force. It remains plausible, perhaps even likely, that knowledge structure has distributional implications, which interact with distributional alignments of pedagogy. It has proved easier discussing verticality in hierarchical disciplines than in those with horizontal knowledge structures. I have suggested, nudging Bernstein and Martin, that not all horizontal structures have languages that are equally incommensurable. I have suggested that some, like linguistics perhaps, have languages whose boundaries are more permeable than those, like sociology perhaps, that are inclined to proliferate languages without constraint. Constraint must at least in part be promoted by hierarchy. This remains a task to be continued, not least because it seems likely to me that the exceptionalism that the social sciences and humanities have claimed for so long will prove increasingly implausible in the global networks of the knowledge society. When that happens, I fear that the 'New Cynicism' and its pedagogical analogues will be about as effective a cloak against the cold winds of global comparability as fashionable decadence was for the artistic fringe in ante bellum Berlin.

#### A) References

Becher, T. (1989), Academic Tribes and Territories: Intellectual Enquiry and the Cultures of Disciplines. Buckinghamshire: SRHE & Open University Press.

Becher, T. & Parry, S. (2005), 'The endurance of the disciplines', in I. Bleiklie & M. Henkel (eds), Governing Knowledge. Dordrecht: Springer.

Berlin, I. (2000a), Three Critics of the Enlightenment: Vico, Hammann, Herder. Princeton: Princeton University Press.

Berlin, I. (2000b), 'The essence of European romanticism', in I. Berlin. The Power of Ideas. London, Pimlico.

Bernstein, B. (1994), 'Discourse, knowledge structure and fields: some arbitrary considerations'. Mimeo.

Bernstein, B. (1996), Pedagogy, Symbolic Control and Identity: Theory, Research, Critique. London: Taylor & Francis.

Bernstein, B. (2000), Pedagogy, Symbolic Control and Identity: Theory, Research, Critique. Oxford: Rowman & Littlefield Publishers.

Carnoy, M., Gove, A., & Marshall, T. (2004), Why do some Students Achieve More in some Countries than in Others? A Comparative Study of Brazil, Chile and Cuba, in press.

Cartwright, N. (2001), The Dappled World: A Study of the Boundaries of Science. Cambridge: Cambridge University Press.



Collins, R. (1998), The Sociology of Philosophies: A Global Theory of Intellectual Change. Cambridge, Mass.: The Bellknap Press of Harvard University Press.

Dowling, P. 1999. 'Basil Bernstein in frame: "Oh dear, is this a structuralist analysis?"'  
<http://www.ioe.ac.uk/ccs/dowling/kings1999/index.html>

Dowling, P. 'A timely utterance'.  
[http://homepage.mac.com/paulcdowling/ioe/publications/dowling2005/timely\\_utterance/index.htm](http://homepage.mac.com/paulcdowling/ioe/publications/dowling2005/timely_utterance/index.htm)

Durkheim, E. (1995: 1<sup>st</sup> pub. 1912), The Elementary Forms of Religious Life. Trans. K. Fields. New York: The Free Press.

Durkheim, E. (1977: 1<sup>st</sup> pub. 1938), The Evolution of Educational Thought: Lectures on the Formation and Development of Secondary Education in France. Trans. P. Collins. London: Routledge & Kegan Paul.

Fitz, J., Davies, B. & Evans, J. (2006), Educational Policy and Social Reproduction: Class Inscription and Symbolic Control. London: Routledge.

Foray, D. and Hargreaves, D. (2003), 'The production of knowledge in different sectors', London Review of Education, 1, (1), 7-19.

Foucault, M. (1981), 'The order of discourse', in R. Young (ed), Untying the Text. London: Routledge & Kegan Paul.

Gee, J. (2001), 'Learning in semiotic domains: a social and situated account', paper presented to the International Literacy Conference, Cape Town, 13-17 November, 2001.

Goldman, A. (1999), Knowledge in a Social World. Oxford: Oxford University Press.

Haack, S. (2003), Defending Science – Within Reason. New York: Prometheus Books.

Hacking, I. (1985), 'Styles of scientific reasoning', in J. Rajchman and C. West (eds), Post-Analytic Philosophy. New York: Columbia University Press.

Hasan, R. (2001), 'The ontogenesis of decontextualised language: some achievements of classification and framing', in A. Morais, I. Neves, B. Davies & H. Daniels (eds) Towards a Sociology of Pedagogy. New York: Peter Lang.

Kuhn, T. (1962), The Structure of Scientific Revolutions. Chicago: Chicago University Press.

Labaree, D. (2004), The Trouble with Ed Schools. New Haven: Yale University Press.

Matthews, M.R. (2004), 'Editorial', Science and Education, 13, 1-4.

Merton, R.K. (1973), The Sociology of Science: Theoretical and Empirical Investigations. Chicago: The University of Chicago Press.

Merton, R.K. (1993: 1<sup>st</sup> pub. 1965). On the Shoulders of Giants. Chicago: The University of Chicago Press.

Moore, R. & Maton, K. (2001), 'Founding the sociology of knowledge: Basil Bernstein, epistemic fields and the epistemic device', in A. Morais, I. Neves, B. Davies & H. Daniels (eds), Towards a Sociology of Pedagogy: The Contribution of Basil Bernstein to Research. New York: Peter Lang.

Moore, R. & Muller, J. (1999), 'The discourse of "voice" and the problem of knowledge and identity in the sociology of education', British Journal of Sociology of Education, 20, (2), 189-206.

Moore, R. & Muller, J. 2002. 'The growth of knowledge and the discursive gap', *British Journal of Sociology of Education*, 23, (4), 627-637.

Morais, A., Neves, I. & Pires, D. (2004), 'The what and the how of teaching and learning', in J. Muller, B. Davies & A. Morais (eds), Reading Bernstein, Researching Bernstein. London: RoutledgeFalmer.

Muller, J. (2000), Reclaiming Knowledge: Social Theory, Curriculum and Education Policy. London: RoutledgeFalmer.

Muller, J. (2002), 'Progressivism redux: ethos, policy, pathos', in A. Kraak & M. Young (eds), Education in Retrospect: Policy and Implementation Since 1990. Pretoria & London: HSRC Publishers & Institute of Education, University of London.

Muller, J., Davies, B., & Morais, A. (2004: eds) *Reading Bernstein, Researching Bernstein*.

London: RoutledgeFalmer.

Mullis, I., Martin, M., Gonzales, E., Gregory, K., Garden, R., O'Connor, K., Chrostowski, S., & Smith, T. (2000), TIMSS 1999 International Mathematics Report: Findings from IEA's

Repeat of the Third International Mathematics and Science Study at the Eighth Grade.

Chestnut Hill: Boston College.

Nagel, E. (1961), The Structure of Science: Problems in the Logic of Scientific Explanation.

London: Routledge & Kegan Paul.

Painter, C. (1999), 'Preparing for school: developing a semantic style for educational knowledge', in F. Christie (ed), Pedagogy and the Shaping of Consciousness. London:

Continuum.

Phillips, D.C. (2004), 'Two decades after "After the wake: postpositivistic educational thought', Science and Education, 13, 67-84.

Popper, K. (2002: 1<sup>st</sup> pub. 1963), Conjectures and Refutations: The Growth of Scientific Knowledge. London: Routledge Classics.

Porter, A. (2002), 'Measuring the content of instruction: uses in research and practice',

Educational Researcher, 31, (7), 3-14.

Pinker, S. (1999), Words and Rules: The Ingredients of Language. Cambridge: Cambridge University Press.

Reeves, C. and Muller, J. (2005), 'Picking up the pace: variation in the structure and organisation of learning school mathematics', Journal of Education, 37: 97 – 125.

Rose, D. (2004), 'Sequencing and pacing of the hidden curriculum: how Indigenous learners are left out of the chain', in J. Muller, B. Davies & A. Morais (eds), Reading Bernstein, Researching Bernstein. London: RoutledgeFalmer.

Shapin, S. (1996), The Scientific Revolution. Chicago: The University of Chicago Press.

Thompson, K. (1994: ed), Readings from Emile Durkheim. London: Routledge & Kegan Paul.

Weinberg, S. (1993: 1<sup>st</sup> pub. 1992), Dreams of a Final Theory. New York: Vintage.

Figure 1: The Astro-poecilo-pyrgium (the variegated star tower) from the title page of Johannes Kepler's Tabulae Rudolphinae, 1627.  
(Shapin, 1996: 77).

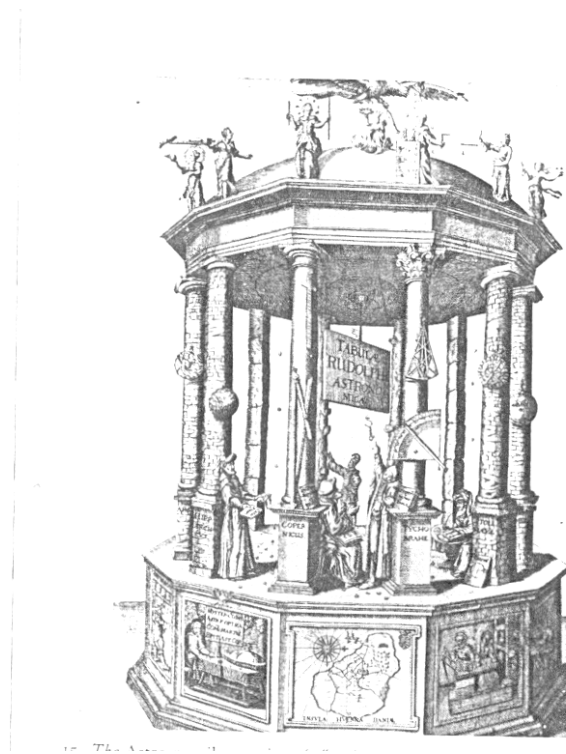


Table 2: Extract of hierarchy of maths content for grade 6:

Representing and comparing whole numbers including zero and fractions including:
Whole numbers to
• 4-digit numbers (g4)
• 6-digit numbers (g5)
• 9-digit numbers (g6)
Odd and even number to 1 000 (g4)
Common fractions in diagrammatic form (g4)
Common fractions with different denominators including
• halves (g4)
• thirds (g4)
• quarters (g4)
• fifths (g4)
• sixths (g4)
• sevenths (g4)
• eighths (g4)
• tenths (g6)
• twelfths (g5, 6)
• hundreds (g6)

---

<sup>1</sup> The first record in print of Bernstein's tree is in a mimeo from March 1994. If Martin published his in 1992, as the text referred to above implies, then he is indeed responsible for a critical breakthrough.

<sup>2</sup> Wariness of the written-oral cline is explicit in the early forms of the 'discourses' paper (see Bernstein, 1994), implicit in the later ones (see the version in Bernstein, 2000).

<sup>3</sup> Highly codified disciplines are labelled C<sup>+</sup>; weakly codified disciplines C<sup>-</sup>

<sup>4</sup> This does not stop him from commenting on disciplines, and although he professes relative ignorance, Dowling (2005: 6) is unusually generous about SFL: 'Systemic Functional Linguistics, by contrast (again with the hapless sociology), is now well established, which is to say, strongly institutionalised, internationally and is clearly DS+ as is readily apparent

---

from even an amateur's perusal of Halliday and Mathiessen (2004). We may legitimately refer to SFL as a discourse in its own right...'

Oddly enough he seems unaware of Kay O'Halloran's work (see this volume), a SF linguist not only working in his own area, maths education, but who uses a term, symbolic saturation, close in spirit to his own.

<sup>5</sup> Sections of what follows will be published as 'On the shoulders of giants: verticality of knowledge and the school curriculum', in R. Moore, M. Arnot, J. Beck & H. Daniels (eds), Knowledge, Power and Educational Reform: Applying the Sociology of Basil Bernstein. London: RoutledgeFalmer, 2006, forthcoming.

<sup>6</sup> Though Bernstein depicts grammaticality as a feature only of horizontal knowledge structures in the diagram on pg 168, he refers to physics as having a 'strong grammar' on pg 163. He is probably using it here in its internal sense of 'explicit conceptual syntax'.

<sup>7</sup> TIMSS and the TIMSS Repeat studies are synonymous with international learner attainment comparisons, having generated comparable data from 38 countries for Maths and Science, and leading to the first international league tables (see Mullis, et al, 2000).

<sup>8</sup> The cheekiest is its use as the heading on the opening page of the Google Scholar search engine.