[Gilbert, J. (1999). Gender Equity Statements in the New Zealand National Curriculum Documents: Their Genealogy and Likely Effects. *New Zealand Annual Review of Education, 8,* 97-117]

Gender Equity Statements in the New Zealand National Curriculum Documents: Their Genealogy and Likely Effects

JANE GILBERT

Abstract:

This article examines the "equity" statements which have appeared in the New Zealand national curriculum documents published over the last 5-10 years. Focussing in particular on the statements on girls and science, it examines the origins of these statements, and points out some of the issues and problems which arise when equity issues are thought about in this way.

During the 1990s there was a major review of the New Zealand national school curriculum, culminating in the publication of *The New Zealand Curriculum Framework* (Ministry of Education, 1993a) as well as a series of other closely related documents providing details of the different curriculum areas. Most of these documents contain statements on the equity issues seen as being important to that particular curriculum area. For example, under the heading "The New Zealand Curriculum Framework provides all students with equal educational opportunities", it is stated that:

> The school curriculum will recognise, respect, and respond to the educational needs, experiences, interests, and values of all students: both female and male students; students of all ethnic groups; students with different abilities and disabilities; and students of different social and religious backgrounds. Inequalities will be recognised and addressed. All programmes will be gender-inclusive, non-racist, and non-discriminatory, to help ensure that learning opportunities are not restricted. (Ministry of Education, 1993a, p. 7)

In the foreword to this document, a "gender-inclusive curriculum" is defined as being one which:

> acknowledges and includes the educational experiences of girls equally with those of boys, both in its content, and in its language, methods, approaches, and practices of teaching.
> (Ministry of Education, 1993a, p. 1)

In *Technology in the New Zealand Curriculum* (Ministry of Education, 1995), this statement is simply repeated (p. 15). However, in the Mathematics and Science documents, there are long sections, headed "Catering for Individual Needs", and "Science For All" (followed by "Girls and Science"), respectively. These statements give information on equity issues, as they relate to mathematics or science, and offer advice to teachers as to how they might create an "inclusive curriculum" in their classrooms. The wording of the statements is as follows:

> **Girls and Science**
>
> Girls can, and do, achieve in science but once they have the choice, many decide not to participate in science courses or seek science-related careers. Many girls view much of school science as outside their life experience, and see little use for scientific knowledge and understanding in their future lives.
>
> ....
>
> Science education often under-values the contribution of girls, provides unfamiliar contexts for their learning, and fails to develop their confidence in pursuing studies in this area.
>
> ...
>
> An inclusive curriculum in science provides opportunities for girls to:
>
> - learn science that they value;
> - develop a range of skills required for successful learning in science;
> - use their language strengths and co-operative learning skills;
> - express their experiences, concerns, interests and opinions;
> - examine the historical and philosophical construction of science;
> - view science from a range of perspectives;
> - interact in an environment where the language and resource materials are non-sexist;
> - share the teacher's time and attention equitably with boys.
>
> (Ministry of Education, 1993b, pp. 11-12)

Catering For Individual Needs

In many cases in the past, students have failed to reach their potential because they have not seen the applicability of mathematics to their lives and because they were not encouraged to connect new mathematical concepts and skills to experiences, knowledge, and skills which they already had. This has been particularly true for many girls, and for many Maori students, for whom the contexts within which mathematics was presented were irrelevant and inappropriate. These students have developed deeply entrenched negative attitudes towards mathematics as a result.

An awareness of these issues has led to improved access for girls to mathematics, but the participation rate of female students in mathematics continues to be lower than that of male students at senior school level and beyond. This limits later opportunities for girls and women.

The suggested learning experiences in this document include strategies that utilise the strengths and interests that girls bring to mathematics. Techniques that help to involve girls actively in the subject include setting mathematics in relevant social contexts, assigning co-operative learning tasks, and providing opportunities for extended investigations.

The suggestions also describe experiences which will help girls develop greater confidence in their mathematical ability. Girls' early success in routine mathematical operations needs to be accompanied by experiences which will help them develop confidence in the skills that are essential in other areas of mathematics. Girls need to be encouraged to participate in mathematical activities involving, for example, estimation, construction, and problems where there are any number of methods and where there is no obvious "right answer".

(Ministry of Education, 1992, p. 12)

Each of these statements embodies, in a reasonably accurate way, key elements from the significant volume of research on gender and science/mathematics education published in the 10-15 years preceding their appearance. In this paper I review the development of certain key ideas in this research literature, looking in particular at science education. I examine the assumptions on which the literature is based, the research methodologies that it uses, and the explanations for – and solutions to – the problem that are proposed in it. My aim in doing this is to show that, largely as a result of some of its initial assumptions, this work contains some important contradictions, and that these

contradictions work to reproduce – not to solve – the problem of gender and science/mathematics education.

Equal Opportunity for Girls in Science Education?

New Zealand education, in the period immediately following the implementation of what became known as the "Thomas Report" (Department of Education, 1944) was, to a large extent structured by what Beeby was to later term the "myth" of equal opportunity (Beeby, 1986).[1] While, at least officially, girls and boys had equal access to education in general, the forms that this education took were, in fact, very different (Fry, 1985; Middleton, 1990). One result of this was that girls' participation in subject areas such as mathematics and science were, until recently, considerably lower than those of boys. These differences were not widely discussed, nor were they the focus of interventions, until after the influence of "second wave" feminist activity began to permeate education in the 1970s and 80s. One of the outcomes of the International Women's Year (1975) conference on women and education (Department of Education, 1976) was the official identification of the presence of sex stereotyping in education and male bias in the curriculum as a problem. After this conference, a number of research reports were commissioned by the (then) Department of Education, some of which were designed to document the extent of the problem (for example, Department of Education, 1980), while others were designed to explain it and/or offer solutions.

One of these reports (Norman, 1983) reviewed research on the problem of girls' under-participation in science education. It summarised the arguments made in support of increasing girls' participation as being largely based on one or other of two arguments – *either* that, for reasons of democracy and/or social justice, it is important for girls to study science so that they are capable of functioning independently in the world, both as "consumers" (in the modern technological world), and as active, informed participants in public debates that have a scientific component to them; *or* on the argument that girls need to study science at school so that they do not "limit their future career options" through not having the requisite qualifications. Both these arguments rest on the assumption that girls, if they are to be economically and intellectually independent citizens, need an education in science. They are taken largely from work being done in the UK at that time (see, for example, Kelly, 1981; Kelly & Weinriche-Haste, 1979), which in turn arose out of certain of the

assumptions of the liberal feminist theory of the time: in particular, the assumption of girls as being fundamentally and originally equal to boys, as "naturally" having the potential for citizenship and for active participation in the public sphere, but, like boys, requiring a liberal education (to develop their capacity for reason) before this potential can be realised. In the early work on girls and science education, girls' under-participation in science subjects was explained via the argument that girls' "natural" equality with boys is disrupted as a result of the different forms of socialisation that they receive. According to this argument, girls are socialised in ways that represent them as:

- passive (rather than active and adventurous);
- having a focus on people and relationships (rather than on objects and achievement in the world);
- having a preference for working in cooperative (rather than competitive) ways.

In other words, they were seen as having qualities which do not pre-dispose them to an interest in – or a likely enjoyment of – subjects such as science and mathematics (see, for example, Burns, 1984; Harding, 1985; Kelly, 1985; Parker, 1991; Parker, Rennie & Hutchinson, 1985). This argument is in turn based on an understanding of socialisation as being a relatively straightforward process of overlaying, or "dressing up", an individual's core "self" with various socially accepted attributes which, because they are relatively superficial (and socially constructed), are seen as being reasonably easily altered.

On the basis of this explanation of the reasons for girls' under-participation in science, interventions were developed which were designed to counter the effects of this socialisation, mainly via programmes that provided support for young women to change in ways that would allow them to more closely resemble the male norm. Typically, these encouraged them to become more individualistic, more competitive, more object-focussed (and interested in the manipulation of objects), and more career-focussed. Some examples are the *Girls Into Science and Technology* (GIST) project in the UK (Smail, 1985a; 1985b; 1985c; Whyte, 1985; 1986); the *Skills and Opportunities in Science* (SOS) projects in New Zealand (Farmer & McCowan, 1991); and there are many others.

In the approaches described above, girls are assumed to be a relatively homogenous group – to be individuals who have a similar core identity, who are socialised in similar ways, and who, as a result of

this, are characterised by a set of reasonably similar features, interests, and aspirations. The research work that was (and continues to be) associated with this set of assumptions focuses largely on the documentation and reporting of differences between boys' and girls' participation and achievement rates in school science and their attitudes towards science and scientific careers. It is very common, in this work, via its assumption of girls as a homogenous group, for gender to be treated as if it were an independent variable. There is a focus on the search for quantifiable effects that can be correlated with gender. These effects are later described in ways that imply that they have been "caused" by gender. Such arguments, the assumptions which underpin them, and the explanations and interventions that arise out of them, are derived from feminist theory developed in the 1970s and 80s. However, they continue to have a strong influence on much of current work in the area of gender and science. Many recently published research papers, for example, describe projects which continue to document differences, to develop interventions which attempt to re-socialise girls in the ways described above, and which continue to argue for girls' increased participation in science education solely on the grounds of gender equity (see, for example, Baker & Leary, 1995; Greenfield, 1995; Parker, Rennie & Fraser, 1996; Seymour, 1995; Weinburgh, 1995).

Valuing Difference

For many of those working during the 1980s in this field, however, this early focus – on attempting to change girls, on helping girls to "measure up" to male norms, and to compensate for what were seen as their deficiencies – was largely replaced by approaches which emphasised and attempted to value or celebrate girls' *differences* from boys. This emphasis, which was derived from the radical feminist theory of the time, is based on the argument that the "problem" of girls and science originates, not in girls, but in the masculine construction of science and scientific knowledge, and in the consequences this has for the ways in which science is taught in schools (see, for example, Baker, 1990; Baker & Leahy, 1992; Burns, 1988). From the mid-1980s onwards, it became common to argue that the problem originated in the lack of recognition given to differences in the background experiences' of boys and girls, and that, in science education in particular, girls would be likely to bring very different background knowledge and experiences from those brought by boys. Many of those working in the field went on to make the case that, if girls are to be successful in science education, these

differences must be acknowledged and actively taken into account in designing programmes for the teaching and learning of science (see, for example, Bell, 1988; Department of Education, 1986; Ministry of Education, 1991; Weatherburn, 1985). The problem of girls and science education, many argued, would be solved through the re-designing of the school science curriculum in ways that would make it appear to girls as being more "human", and more relevant to their lives; in ways that would make it more accessible to girls, and more "girl-friendly" (Baker, 1990; Bell, 1988). In the early 1990s, the argument that girls "naturally" have skills, abilities, and background knowledges that are different from those of boys; that they, as a result, learn differently from boys; and that these differences should be recognised, valued, and used in ways that advantage girls, began to appear. Later, it became more common to argue for the development of approaches to teaching which recognise, support, and value girls' "preferred learning styles" (see, for example, Baker & Leahy, 1992). This emphasis – on girl-friendly teaching styles, and on affective factors – remains as the dominant approach in more recent work in the area of gender issues and science education (see for example, Baker & Leary, 1995; Roychoudhury, Tippins & Nichols, 1995; Seymour, 1995; Weinburgh, 1995).

A number of interventions into science education – in New Zealand and Australia as well as in other countries – were developed and implemented, drawing on arguments such as those outlined above for the presentation of science in more "female-friendly" ways, and on arguments for the recognition of differences in the learning styles and methods of assessment that, it was argued, are preferred by girls and women (for example, Weatherburn, 1985; Burns, 1988; Gilbert, 1990; Gilbert & McComish, 1990; Hildebrand & Allard, 1993; Lewis, 1993; McClintock Collective, 1993a; Ministry of Education, 1991; Rosser, 1990). In addition, drawing on research which showed that large numbers of primary school teachers (mostly female) lacked confidence in their teaching of science (thus, it was argued, perpetuating the myth of science as a masculine pursuit), a number of intervention programmes were initiated by teacher educators (see, for example, Allard & Hildebrand, 1993; Bearlin, 1993; Kirkwood, 1995; Kirkwood et al, 1990; McClintock Collective, 1993b; Segal & Cosgrove, 1993). These programmes were characterised by their attempt to use a concept of feminist pedagogy to produce, in pre-service and in-service teachers, less negative perceptions, both of the nature of science, and of their ability to understand it. Attempts were also made to recover and make

visible the work of earlier women scientists (for example, Burns et al, 1989). There was thus a shift, in these later approaches, from a focus on changing girls, to one in which the goal was to change the science curriculum and/or the learning environment in science classrooms in ways that would make them more girl-friendly, gender inclusive, "gender fair", or even, in some approaches, "gender free".

The second of these two approaches clearly had a major influence on the writers of the statements on girls and science/mathematics in the current national curriculum documents. However, elements from the first approach remain – girls are still seen as needing to "develop a range of [the] skills required for successful learning in science" (Ministry of Education, 1993b, p. 11), and as needing to develop "greater confidence in their mathematical ability," especially once they progress past the early stages of mathematical learning and beyond the more "routine" aspects of mathematics (Ministry of Education, 1992, p. 12).

Girls and Science: Is There Still a Problem?

During the period in which the research outlined above took place (1975-1993), girls' rates of participation in science and mathematics subjects at the senior secondary and university undergraduate level increased steadily, as did the levels of their achievement. Girls are, on average, now achieving in these subjects at a level which is either equal to or better than that of boys (Blithe et al, 1990; Keef, 1990; McDonald, 1992; Ministry of Women's Affairs, 1992; Sturrock, 1993). Given this, it would appear that girls' under-participation and under-achievement in school science and mathematics is no longer an issue. However, in the science and mathematics documents (and in other statements in a whole host of other, more recently published, official policy documents), there is a clear message that girls are disadvantaged – that there ***is*** still an issue (Jones & Jacka, 1995).

It seems that we may have come full circle, in the sense that the early concern with girls' under-participation and achievement in science subjects – with its emphasis on changing girls' attitudes so that they would choose to study science, later replaced by a focus on the development of a more gender-inclusive science curriculum – has not abated. We are now in a period in which girls, if they choose to study science and mathematics to senior levels, are performing very well in them. It is also a period in which many more girls are choosing these subjects than was the case in the past. Girls, nevertheless, continue to be constructed as "disadvantaged". Why should this be? This apparent

disadvantage can no longer be linked to a lack of achievement, so, because it appears that girls *must* be disadvantaged, the disadvantage is seen as being the result of the choices girls make – choices which will limit their future career options. According to *Science in the New Zealand Curriculum*, for example, girls, "once they have the choice ... decide not to participate in science courses or seek science based careers" (Ministry of Education, 1993b, p. 11). According to *Mathematics in the New Zealand Curriculum*, in the past, girls have "failed to reach their potential because they have not seen the applicability of mathematics to their lives", a situation which "limits [their] later opportunities" (Ministry of Education, 1992, p. 12). These statements assume, as if it was a straightforward matter, that participation and achievement in mathematics and science *does* increase the number and range of career opportunities that are available to girls, and that doing what boys do must always be the best thing for girls to do. They gloss over the many very good reasons why girls might choose *not* to take these subjects (Kenway, 1993). They over-value masculinist knowledge systems such as science and mathematics, and they ignore the extensive feminist research on women and the labour market. This research clearly shows that achieving the formal qualifications required to enter non-traditional fields is *not* necessarily, for women, followed by access to the economic and other benefits supposedly offered by those fields. If they *do* enter these fields, young women are likely to find it necessary to take on the strongly masculinist cultures they find there in order to survive (see, for example, Kenway & Willis, 1995). This assumption, that science and mathematics will offer girls greater access to more highly valued career opportunities, is also evident in other curriculum documents, as illustrated in this statement in *English in the New Zealand Curriculum*:

> Although girls are more successful than boys in English at school, their attainments in English are not always transferred into the full range of vocational training and employment options.
> (Ministry of Education, 1994, p. 13)

Thus girls' choices are still seen as being the source of "their" problem – especially in a labour market that places a high value on masculinist forms of knowledge, an argument that is not very different from those which were offered in the late 70s and early 80s (summarised in Norman, 1983).

Why is it that girls' educational achievements cannot be simply recognised for what they are – good achievements? Why is it that the

increase in girls' achievement, relative to that of boys, is seen by many as a problem? (see, for example, Fergusson & Horwood, 1997; Kenway et al, 1997a; Nash & Harker, 1998; and a large number of recent articles in the popular media). Why is it that girls' participation and achievements in education are always conceived of as being, in some way or other, problematic?

For me, many of the answers to questions such as these are to be found in the work on girls and mathematics of the British educational psychologist, Valerie Walkerdine. She found, over many years of research in this area, that, no matter what kinds of empirical data were produced as evidence of girls' capabilities and success, in all kinds of mathematics, at all levels, girls were still perceived (by their teachers, their parents and others) as "having a problem" with mathematics, as not having what it "really takes" to be successful at mathematics (Walkerdine, 1988; 1989; 1990). She has demonstrated how, when faced with the evidence that girls' performance is, on average, equal to if not better than that of boys, teachers (and others) almost invariably argue that this performance is the result of "hard work" or "rule-following behaviour". In other words, their performance is *not* achieved through the possession of whatever it is that is required for true success in mathematics (that is, rationality). Poor performance by boys, on the other hand, tends to be accounted for by comments such as "has ability, but is lazy". Walkerdine argues that work which continues to document girls' *good* performance is futile, and, in addition, that such work functions to replicate what she refers to as the "circuits of proof" via which the problem of girls and mathematics is produced in the first place. She argues that we will *never* be able to know the "truth" about girls; that the performance of girls will *never* be empirically verifiable, and that we should not be asking what the "truth" about girls "really" is (that is, are they really good at maths or not), nor should we be trying to prove that they are (or are not) good at maths. The questions we should be asking are rather different ones. As she puts it, "The question is not, 'Are the arguments true?' but 'How is this truth constituted, how is it possible, and what effects does it have?'" (Walkerdine, 1989, p. 27).

Clearly, there ***is*** still an issue with girls and science/mathematics education. But this issue does not have to do with girls' choices to participate (or not) in these subjects, nor does it have to do with their achievement in them. These are simply the surface manifestations of a much deeper problem.

My point, in this paper, is to argue that the problem of girls and science/mathematics education, as identified in the work of Valerie Walkerdine, and explored in the work of a great many other feminist scholars, is not "fixable" via attempts to tinker with its surface manifestations, but requires solutions which attempt to deal with it *where it is produced*, that is, in the deepest levels of our thinking.

As a number of feminist philosophers have shown, throughout the history of Western thought, the meaning of the concept of rationality, while it has changed considerably, has, nevertheless, always been closely associated with whatever at the time were considered masculine qualities (see, for example, Lloyd, 1993). Following from this, others have shown how the development of scientific and mathematical knowledge – knowledge which is clearly very closely associated with the concept of rationality – has been possible only on the basis of its exclusion of all that is regarded as feminine (see, for example, Bordo, 1987; Irigaray, 1987; Jay, 1981; Keller, 1985). One consequence of all this is that any attempt to insert women (or girls) into these disciplines inevitably produces a certain amount of anxiety, and is, therefore, strongly resisted. As Walkerdine (and a number of others) have demonstrated, given the ways in which gender functions symbolically within the Western/scientific conceptual system, it is not possible for girls to achieve well in science and mathematics, *and* to still be seen *as girls.*

There is plenty of evidence that girls and women in general understand all this only too well, at the unconscious – if not also the conscious – level. This can be seen, for example, in the huge body of work in psychology documenting the lack of confidence by girls and women in, and/or underestimation of, their ability as scholars, and in work which demonstrates women's difficulties with representing themselves to themselves as fully-fledged, adult, "knowers" – or creators of – knowledge, and as having independent authority over that knowledge (Gore, 1992; Jones, 1991; Luke, 1996; Sartori, 1994; Walkerdine, 1990). Other work, especially that focussing on girls' understandings of their own educational performance, shows that achievement, especially when it is at a very high level, is highly problematic *for the girls themselves* (Davies, 1989; Fine, 1992; Middleton, 1993). In a recent study of ideas about success and failure among middle-class girls, Helen Lucey shows that the conceptions of success held by the girls in her study are strongly driven by the fear of failure, a fear which is masked by the discourse of rationality (Lucey, 1996).

Success, for the girls in this study, involved finding ways to *appear* in masculine subject positions – that is, powerful and rational subject positions – while failure involved being positioned in feminine subject positions – that is, as being power***less*** and ***ir***rational. It is clear that, for these girls, their achievement of success, particularly in traditionally masculine subjects such as mathematics and science, is only the *appearance* of success, it is a charade or a masquerade – in the sense that none of them really believe that they are "supposed" to be in these positions. Thus, for them, because the appearance of rationality is always an illusion, it is necessarily experienced by them as *irrationality*.

It is clear, not only that girls in general, no matter what their ethnic origins or class backgrounds are, *cannot* "do anything", but also that, at a very deep level, they do not *believe* that they can. Despite all the years of feminist struggle, and the associated increase in young women's participation and achievement in education, it is still very difficult, if not impossible, for women to be genuinely autonomous actors in the public sphere and/or the creators of new knowledge, while simultaneously retaining their identity *as women*.

The field of gender and science education research, however, has been characterised more by its distance from the ideas just outlined, than by its engagement with them. In the publications through which it represents itself, the field appears to be continuing work "as usual", using a set of key propositions and theoretical arguments that are more or less identical to those that were used in the very early work. This apparent stability is not explainable via the argument that the problem of gender and science remains stable, much as it has always has. Nor is it explainable via the argument that no better explanations or solutions appear to be available. For a variety of reasons (many of which probably have to do with some of the more uncomfortable implications of work such as that described above), it appears that the field of gender and science education research has largely ignored the very substantial intellectual debates that have been taking place in certain other, closely related, fields: for example, the literature on the epistemology of science (especially the feminist analyses and critiques of it); the feminist theory literature; the queer theory literature; the literature on feminist research methodologies and feminist pedagogies; and the literature on postmodernism/globalisation, and its implications for education and work in the future.

Taken together, these literatures form a powerful critique of the two categories central to research on gender and science education

"girl/woman" and "science", both of which are, in this field in general, assumed as being givens, as being common-sense categories, the meaning of which can be taken for granted. As outlined above, there is now a great deal of work in which the status of science as objective, rational, value-free, neutral knowledge is called into question. Similarly, in recent feminist theoretical work, the status of the categories "woman", "sex", and "gender" as pre-existing, natural, stable, coherent givens is problematised, (as are "race" in post-colonial theory, and "sexuality" in queer theory – see, for example, Butler, 1990; Fuss, 1989; Gates et al, 1985; Jagose, 1996; Riley, 1988; Weed & Schor, 1997). In the field of gender an d science education, however, while there is a great deal of concern for the absence of women from science, at the same time there is a reluctance to grapple with the implications of science's inextricable association with masculinity. This reluctance is articulated clearly by Joan Solomon, for example, when she says that the radical feminist critique of science and society (such as that developed by Sandra Harding) "is uncomfortable for science educators" as they tend to take science as a given, rather than seeking "to ensure that a new science emerges" (Solomon, 1997, p. 409). As a result, the field continues to be dominated by a series of rather authoritarian attempts to convince girls to behave differently, and to make different choices (in the face of often quite obvious and un-theorised resistance by the girls themselves – see, for example, Ellsworth, 1987; Kenway et al, 1997b; Lather, 1991), and by strategies which tend to obscure both the subtleties and complexities of the problem, and the possibilities for dealing with it in new and different ways.

There is also a reluctance to deal with the political implications of the contradictions within some of the claims made within this body of work. In the early work, as outlined above, drawing on conventional liberal political theory, girls were assumed to be the equal of boys, with the result that strategies for helping girls to be more like (and thus supposedly more equal to) boys were developed. Later, drawing on radical feminist theory, there was a focus on girls' *differences* from boys. This emphasis established "girl" as an "identity category" within science education which is different to, and separate from, that of "boy", a strategy which has a number of important effects. Firstly, once difference has been claimed, within the terms of conventional liberal political theory, it becomes very difficult to subsequently make a claim for equality, which, in this tradition, is the main, if not the only, basis on which one can make representations in the name of social justice

(Rancière, 1992). The strategy of advocating girls' difference from boys also invites – and contributes to – girls' continued exclusion from science, via their construction as "different": that is, as "lacking" or "deficient", as not "having what it takes" to be a scientist. In addition, it establishes a basis on which further claims can be made for the creation and recognition of the needs of a variety of *other* new identity categories – for example, Maori, gifted students, students with special needs, gay/lesbian students, and so on – categories which, for the reasons outlined above, are unlikely to be successful as a basis on which to make claims for social justice (Yeatman, 1994). The recent development, in educational contexts, of the discourse of "diversity" (Gilbert, 1998), and the appearance of the statements on Maori and Science, Students with Special Abilities in Science, and Students with Special Needs and Science in *Science in the National Curriculum* is, I think, evidence that this is exactly what has happened.

It is clear that the problem of gender and science education is vastly more complicated, philosophically and sociologically speaking, than has been allowed in most past and current research work in the area. In my view, solutions to this problem are unlikely to appear from within the theoretical frameworks which currently form the basis of most work in this field. Following Valerie Walkerdine's demonstration of the futility of continuing to pursue the "truth" about girls' capabilities and achievements, I think that the focus on the features of girls as a group (or on those of any other social group) is, in this context, a blind alley from which we should retreat. Instead, our attention should, in my view, be focussed on developing strategies which are capable of dealing with the symbolic functioning of gender, on the one hand (Gilbert, 1996), and which are also capable of unsettling the assumptions about "woman" and about "science" which lie at the heart of the problem (Gilbert, 1997).

Notes

1. For Beeby, while "equal educational opportunity" is *both* an important social good *and* an important part of the basis upon which state provision for schooling is justified, it is, nevertheless, probably not achievable, and is, therefore, a "myth".

References

Allard, A., & Hildebrand, G. (1993, July-August). Gender construction and science teacher education: Models for change. In S. Haggerty

& A. Holmes (Eds.), *Transforming science and technology – our future depends on it: Contributions to the seventh international Gender and Science and Technology conference.* University of Waterloo, Ontario, Canada.

Baker, D., & Leary, R. (1995). Letting girls speak out about science. *Journal of Research in Science Teaching, 32*(1), 3-27.

Baker, R. (1990). *Girls and science: Time for positive action*. Paper presented at the Forms 1-5 science syllabus teacher refresher course, Hamilton.

Baker, R., & Leahy, H. (1992). Beyond access: Curriculum development and the position of girls. *Delta, 46*, 41-45.

Bearlin, M. (1993, July-August). Transforming primary science teacher education: A longitudinal study. In S. Haggerty & A. Holmes (Eds.), *Transforming science and technology – our future depends on it: Contributions to the seventh international Gender and Science and Technology conference*. University of Waterloo, Ontario, Canada.

Beeby, C. E. (1986). Introduction. In W. L. Renwick, *Moving targets: Six essays on educational policy*. Wellington: New Zealand Council for Educational Research.

Bell, B. (1988). Girls and science. In S. Middleton (Ed.), *Women and education in Aotearoa.* Wellington: Allen & Unwin/Port Nicholson Press.

Blithe, T., Clark, M., & Whitwell, K. (1990). Gender and ethnic differences in first year university mathematics. In S. Forbes, T. Blithe, M. Clark & E. Robinson (The Equity in Mathematics Education Group) (Eds.), *Mathematics for all: A summary of participation, performance, gender and ethnic differences in mathematics in New Zealand secondary schools and first year university courses*. Wellington: Ministry of Education.

Bordo, S. (1987). *The flight to objectivity: Essays on Cartesianism and culture.* Albany, NY: State University of New York Press.

Burns, J. (1984, August). Girls in science. In *Towards the year 2001: Proceedings of the New Zealand Science Teachers' Association 4th biennial conference*. Victoria University of Wellington. Wellington: New Zealand Science Teachers' Association.

Burns, J. (1988, September). *From changing women to changing science*. Paper presented at the biennial conference of the New Zealand Science Teachers' Association, University of Auckland.

Burns, J., Baker, R., Bird, L., Bogie, M., and Hodson, A. (1989). *New Zealand scientists: Pioneer women*. Wellington: Women in Science Education.

Butler, J. (1990). *Gender trouble: Feminism and the subversion of identity*. New York, Routledge.

Davies, B. (1989). *Frogs and snails and feminist tales: Preschool children and gender*. Sydney, Allen & Unwin.

Department of Education. (1944). *Report on the post-primary school curriculum* (The Thomas Report). Wellington: Department of Education.

Department of Education. (1976). *Education and the equality of the sexes: A report on the national conference in International Women's Year 1975*. Wellington: Department of Education.

Department of Education. (1980). *Sex-role stereotyping in science textbooks*. (Research report series; No 3). Wellington: Department of Education (Research and Statistics Division).

Department of Education. (1986). *Girls and science*. (Curriculum Review in Science: Discussion Paper No 2). Wellington: Department of Education.

Ellsworth, E. (1987). Why doesn't this feel empowering?: Working through the repressive myths of critical pedagogy. *Harvard Educational Review, 59*(3), 297-324.

Farmer, B., & McCowan, L. (1991). SOS – Skills and Opportunities in Science for girls: An intervention programme to promote the physical sciences. In L. Rennie, L. Parker & G. Hildebrand (Eds.), *Action for equity: The second decade: Contributions to the sixth international GASAT conference*. Perth: Curtin University Key Centre for School Science and Mathematics.

Fergusson, D., & Horwood, J. (1997) Gender differences in educational achievement in a New Zealand birth cohort. *New Zealand Journal of Educational Studies, 32*(10), 83-96.

Fine, M. (1992). *Disruptive voices*. Michigan: University of Michigan Press.

Fry, R. (1985). *It's different for daughters: A history of the curriculum for girls in New Zealand schools, 1900-1975*. Wellington: New Zealand Council for Educational Research.

Fuss, D. (1989). *Essentially speaking: Feminism, nature and difference*. New York: Routledge.

Gates, H. L. (Ed.). (1985). *"Race", writing and difference*. Chicago: Chicago University Press.

Gilbert, J. (1990). *Secondary school students talking about science: Language functions, gender and interaction in small group discussions*. Unpublished MA thesis, Victoria University of Wellington.

Gilbert, J. (1996). The sex education component of school science programmes as a "micro-technology" of power. *Women's Studies Journal, 12*(2), 37-57.

Gilbert, J. (1997). *Thinking "other"-wise: Re-thinking the problem of girls and science education in the post-modern*. Unpublished PhD thesis, University of Waikato.

Gilbert, J. (1998, November). *"It's life, Jim, but not as we know it": The trouble with girls' achievement in traditionally "masculine" subjects at school*. Paper presented at the Girl trouble? Feminist theory and young women/girls conference, University of Waikato.

Gilbert, J., & McComish, J. (1990). Science learning, language and feminist pedagogy. *SAME Papers, 1990.* Hamilton: University of Waikato Centre for Science and Mathematics Education Research.

Gore, J. (1992). What we can do for you! What can "we" do for "you"?: Struggling over empowerment in critical and feminist pedagogy. In C. Luke and J. Gore (Eds.), *Feminisms and critical pedagogy*. New York: Routledge.

Greenfield, T. A. (1995). An exploration of gender participation patterns in science competitions. *Journal of Research in Science Teaching, 32*(7), 735-748.

Harding, J. (1985). Values, cognitive style and the curriculum. In *Girls and science and technology: Contributions to the third GASAT conference*. London: Chelsea College Centre for Science and Mathematics Education.

Hildebrand, G., & Allard, A. (1993, July-August). Transforming the curriculum through changing assessment practices. In S. Haggerty & A. Holmes (Eds.), *Transforming science and technology – our future depends on it: Contributions to the seventh international Gender and Science and Technology Conference*. University of Waterloo, Ontario, Canada.

Irigaray, L. (1987). Is the subject of science sexed? [Translated by Carol Mastrangelo Bove.] *Hypatia, 2*(3), 65-87.

Jagose, A. (1996). *Queer theory*. Dunedin: Otago University Press.

Jay, N. (1991). Gender and dichotomy. In S.Gunew (Ed.), *A reader in feminist knowledge.* London: Routledge.

Jones, A., & Jacka, S. (1995). Discourse of disadvantage: Girls' school achievement. *New Zealand Journal of Educational Studies, 30*(2), 165-175.

Jones, K. (1991). The trouble with authority. *differences, 5*(1), 104-127.

Keef, S. P. (1990). Direct entry to university from the sixth form: Gender performance differentials in first year of study. *New Zealand Journal of Educational Studies, 25*(1), 71-74.

Keller, E. F. (1985). *Reflections on gender and science*. New Haven: Yale University Press.

Kelly, A. (Ed.). (1981). *The missing half: Girls and science education*. Manchester: Manchester University Press.

Kelly, A. (Ed.). (1985). *Science for girls?* Milton Keynes: Open University Press.

Kelly, A., & Weinreich-Haste, H. (1979). Science is for girls. *Women's Studies International Quarterly, 2,* 275-293.

Kenway, J. (1993). "Non-traditional" pathways: Are they the way to the future? In J. Blackmore & J. Kenway (Eds.), *Gender matters in educational administration and policy: A feminist introduction*. London: Falmer Press.

Kenway, J., & Willis, S. (1995). *Critical visions: Policy and curriculum rewriting the future of education, gender and work.* Canberra: Australian Government Publishing Service.

Kenway, J. & Willis, S. (with J. Blackmore & L. Rennie). (1997a). *Answering back: Girls, boys and feminism in schools*. Sydney: Allen & Unwin.

Kenway J., & Willis, S. (with J. Blackmore & L. Rennie). (1997b). Are boys victims of feminism?: Some answers from Australia. *International Journal of Inclusive Education, 1*(1), 19-35.

Kirkwood, V. (1995). Gender issues and constructivism: Reflections on praxis. *Access: Critical Perspectives on Cultural and Policy Studies in Education, 13*(2), 144-155.

Kirkwood, V., Elliot, J., Graham, B., and Houston, A. (1990). Toasted bread and other things. *Investigating, 6*(2), 20-23.

Lather, P. (1990). *Getting smart: Feminist research and pedagogy with/in the postmodern*. New York: Routledge.

Lewis, S. (1993, July-August). Including gender in higher education science and engineering courses. In S. Haggerty & A. Holmes (Eds.), *Transforming science and technology – our future depends on it: Contributions to the seventh international Gender and Science and Technology Conference.* University of Waterloo, Ontario, Canada.

Lloyd, G. (1993). *The man of reason: "Male" and "female" in Western philosophy.* Routledge: London.

Lucey, H. (1996, January). *Transitions to womanhood: Constructions of success and failure for middle and working class young women*. Paper

presented at the British Youth Research: The New Agenda conference. Glasgow University.

Luke, C. (1996) Feminist pedagogy theory: Reflections on power and authority. *Educational Theory, 46*(3), 283-302.

McClintock Collective (1993a, July-August). An introduction to the McClintock Collective science teaching strategies. In S. Haggerty & A. Holmes (Eds.), *Transforming science and technology – our future depends on it: Contributions to the seventh international Gender and Science and Technology Conference.* University of Waterloo, Ontario, Canada.

McClintock Collective (1993b, July-August). A gender and science course for teachers. In S. Haggerty & A. Holmes (Eds.), *Transforming science and technology – our future depends on it: Contributions to the seventh international Gender and Science and Technology Conference*. University of Waterloo, Ontario, Canada.

McDonald, G. (1992). Are girls smarter than boys? In S. Middleton & A. Jones (Eds.), *Women and education in Aotearoa 2*. Wellington: Bridget Williams Books.

Middleton, S. (1993). *Educating feminists: Life histories and pedagogy.* New York: Teachers' College Press.

Middleton, S. (1990). Women, equality and equity in liberal educational policies 1945-1988. In S. Middleton, J. Codd & A. Jones (Eds.), *New Zealand education policy today: Critical perspectives*. Wellington: Allen & Unwin.

Ministry of Education. (1991). *Girls in science: A professional development guide for teachers of science*. Wellington: Ministry of Education/ Learning Media.

Ministry of Education. (1992). *Mathematics in the New Zealand curriculum*. Wellington: Ministry of Education/Learning Media.

Ministry of Education. (1993a). *The New Zealand curriculum framework: Te anga marautanga o Aotearoa*. Wellington: Ministry of Education/ Learning Media.

Ministry of Education. (1993b). Science in the New Zealand curriculum. Wellington: Ministry of Education/Learning Media.

Ministry of Education. (1994). *English in the New Zealand curriculum*. Wellington: Ministry of Education/Learning Media.

Ministry of Education. (1995). *Technology in the New Zealand curriculum.* Wellington: Ministry of Education/Learning Media.

Ministry of Women's Affairs. (1992). *The status of New Zealand women*. Wellington: Ministry of Women's Affairs.

Nash, R., & Harker, R. (1998). *Making progress: Adding value in secondary education.* Palmerston North: ERDC Press.

Norman, H. (1983). *Girls and science*. (Research report series: No. 32). Wellington: Department of Education (Research and Statistics Division).

Parker, L. (1991). Gender issues for science and mathematics education: Materials for use in the professional development of teachers. In L. Rennie, L. Parker & G. Hildebrand (Eds.), *Action for equity – the second decade: Contributions to the sixth international GASAT conference*. Perth: Curtin University Key Centre for School Science and Mathematics.

Parker, L., Rennie, L., & Fraser, B. (1996). (Eds.). *Gender, science and mathematics: Shortening the shadow*. Dordrecht: Kluwer.

Parker, L., Rennie, L., & Hutchinson, P. (1985). Teacher inservice as an avenue to equality in science and technology education. In *Girls and science and technology: Contributions to the third GASAT conference*. London: Centre for Science and Mathematics Education, Chelsea College, University of London.

Rancière, J. (1992). Politics, identification and subjectization. *October, 61*, 58-65.

Riley, D. (1988). *Am I that name?: Feminism and the category of "women" in history*. London: Macmillan.

Rosser, S. (1990). *Female-friendly science: Applying women's studies methods and theories to attract students*. New York: Pergamon.

Roychoudhury, A., Tippins, D., & Nichols, S. (1995). Gender-inclusive science teaching: A feminist-constructivist approach. *Journal of Research in Science Teaching, 32*(9), 897-924.

Sartori, D. (1994). Women's authority in science. In K. Lennon & M. Whitford (Eds.), *Knowing the difference: Feminist perspectives in epistemology*. London: Routledge.

Segal, G. & Cosgrove, M. (1993, July-August). Developing an inclusive technoscience learning environment. In S. Haggerty, & A. Holmes (Eds.), *Transforming science and technology – our future depends on it: Contributions to the seventh international gender and science and technology conference*. University of Waterloo, Ontario, Canada.

Seymour, E. (1995). The loss of women from science, mathematics, and engineering undergraduate majors: An explanatory account. *Science Education, 79*(4), 437-473.

Smail, B. (1985a). An attempt to move mountains: The Girls Into Science and Technology project. *Journal of Curriculum Studies, 17*(3), 351-354.

Smail, B. (1985b). Organising the curriculum to fit girls' interests. In Kelly, A. (Ed.), *Science For Girls?* Milton Keynes: Open University Press.

Smail, B. (1985c). Encouraging girls to give physics a second chance. In Kelly, A. (Ed.), *Science For Girls?* Milton Keynes: Open University Press.

Solomon, J. (1997). Girls' science education: Choice, solidarity and culture. *International Journal of Science Education, 19*(4), 407-417.

Sturrock, F. (1993). *The status of girls and women in education and training in New Zealand.* Wellington: Ministry of Education/Learning Media.

Walkerdine, V. (1988). *The mastery of reason: Cognitive development and the production of rationality*. London: Routledge.

Walkerdine, V. (1989). *Counting girls out*. London: Virago.

Walkerdine, V. (1990). *Schoolgirl fictions*. London: Verso.

Weatherburn, J. (1985). *Women's abilities in science*. Wellington: Victoria University of Wellington, Department of Chemistry.

Weed, E, & Shor, N. (1997). (Eds.). Feminism meets queer theory. Bloomington: University of Indiana Press.

Weinburgh, M. (1995). Gender differences in student attitudes toward science: A meta-analysis of the literature from 1970-1991. *Journal of Research in Science Teaching, 32*(4), 387-398.

Whyte, J. (1985). *Girls into science and technology*. London: Routledge & Kegan Paul.

Whyte, J. (1986). *Girl-friendly schooling*. London: Methuen.

Yeatman, A. (1994). *Postmodern revisionings of the political*. New York: Routledge.

The author

The author is currently a senior lecturer in the School of Education at Victoria University of Wellington, and was formerly (1995-97) a lecturer in the Mathematics and Science Education Centre at Victoria University of Wellington, an assistant lecturer in the sociology of education at the University of Waikato (1993-94), and a secondary school teacher of biology and science (1982-91). Her research interests are in feminist theory; in gender issues in education; in the sociology and philosophy of education; and in science and technology education.