Can you decipher this riddle? A young boy is injured in a car accident. His father is in the car with him and is injured as well. He is rushed to the emergency room of a nearby hospital. The physician on duty takes one look at him and says ‘I’m sorry, I cannot attend to him. He is my son’. Who is the physician?

Hopefully, your answer to this question required very little thought and was easily answered. Unfortunately, in some circles it has proved to be quite a teaser. Of course, the physician on duty is the boy’s mother – a logical deduction since the father was in the accident as well. Yet for too many, that deduction is not quite so simple. It may be surprising to see how many gyrations some make around the riddle rather than think that the physician could be a woman. Indeed, stereotypes and norms around the roles of women often blind some folks to what should be a simple solution.

In South Africa, as in many other societies, gender stereotypes about acceptable roles for women have hindered women from entering fields of study such as maths, engineering, science and technology and information technology and from filling significant roles in these sectors of the economy. The effect of this is evident. A cursory overview of South Africa reveals a severe skills shortage particularly in the areas of science and engineering. This is understandable when you consider the lack of female scientists and that women constitute over 50 percent of the population.

Women predominate in all service and support occupations – in clerical, catering and retail spheres. Where women are in manufacturing, they are in unskilled and semi-skilled grades. Even well qualified women tend to enter jobs like teaching and nursing, rather than entering management or scientific and technical occupations (Coats, 1994). For women previously classified as African, Indian and coloured, racial barriers present an additional obstacle to their entrance into science and technology fields both within the academic and economic sector. Not only is it counter-productive for the economy for this trend to continue but it is also clearly disadvantageous for women. Particularly, since it remains true that traditionally male-dominated disciplines such as engineering, science and mathematics are more financially lucrative and allow men more prestige and power. Furthermore, with economies increasingly based on the extensive use of computer-based technologies, it will be detrimental to the position of women for women to remain clustered in the arts and the humanities.

Under-representation of women
Swainson (1993) has argued that the lack of access of women to higher education as well as the concentration of female students in the caring professions, such as teaching and
nursing, is an important factor in the subordination of women. Indeed, Elizabeth Fennema (1984) has argued that without 'mathematical knowledge and skills, women will never be able to achieve equity in society'. In order to begin to address this situation, it is necessary to understand the obstacles that women face entering science and technology occupations. In general, women's underrepresentation in science occupations can be traced back to their position in education. Clearly, one reason for the lack of female scientists today is their meagre numbers in education. Historically, education under apartheid failed to prepare the majority of South Africa's population for their place in an industrialising economy. Women, and particularly black women, were some of the least prepared. The consequences of this have been severe in terms of the wastage of human potential and a shortage of appropriate skills.

The first generation of women attending mission boarding schools were not encouraged, if even allowed, to obtain an academic education or skills training. For African women in particular, the focus was domestic training. Deborah Gaitskell (1988:158) has noted that mission education for girls was 'vocational, domestic and subservient'. In the 19th century, missionaries were concerned with preparing African women to be good Christian wives and mothers as well as training them in domestic skills such as sewing, cooking and laundry work (Gaitskell, 1988).

The girls that were deemed the brightest were allowed more advanced academic schooling and were trained as teachers. They were also prepared to be the wives of teachers and preachers in the newly emerging male black elite.

For the girls, however, who did not attend these missionary boarding schools, primary education was less gender slanted. The only subject taught specifically to girls was sewing. Industrial training was not introduced for them until the upper-levels where girls would often receive housewifery training, while the boys would be taught some sort of trade.

In more recent times, the problem for women often begins at the secondary level where girls are often actively discouraged from studying science and from considering a career in science (Thomson, 1994). This discouragement follows through to the university level where a lack of funding and a poor support structure in the areas of career counselling and mentorship further reduce the number of women entering into science and technology occupations. Furthermore, the stereotyping of roles in textbooks, in teaching materials, and in the attitudes of teachers, often limits the achievement of girls. Girls come to accept certain fields of study as being 'soft' and therefore 'more feminine'.

Choice of career
Mathematics, physics and technical subjects are considered to be 'hard' and therefore...
more suitable for boys than girls. The absence of suitable role models further compounds this problem (Lockheed and Gorman, 1987). The predominance of male science teachers helps to create a void in terms of suitable role models for young, aspiring scientists who happen to be female. The masculine image of science is also discouraging for young girls. This coupled with parental expectations and beliefs, virtually steers girls away from maths and science classes (Lockheed and Gorman, 1987).

Those who do enrol in science classes often receive differential treatment from teachers. Even female teachers tend to favour boys and often expect them to do better than girls. Girls' peer environment is another factor which affects their decisions to enrol in a science or maths class.

To further impede women's progress, career guidance counsellors frequently steer women away from careers in sciences. They are frequently directed to disciplines that are deemed more suitable for women. Although this may not be explicitly communicated, girls often find more support, financially and morally, when they select careers such as nursing or teaching. This has led to a landscape where women are concentrated in the arts and humanities. Generally, men far outnumber women in engineering, science and industrial arts enrolment, while women outnumber men in business (computer science/secretarial) and home economics (Shindler et al, 1996; Government of South Africa, 1997).

Based on 1995 Information Directorate figures from 15 of 21 universities (Government of South Africa, 1997), women graduates account for only nine percent in engineering, 28 percent in agriculture, 38 percent in medicine and 47 percent in sciences. The most severe inequalities, however, exist among black women, in terms of general enrolment in higher education and especially in scientific/technological fields of study. A significant proportion of African women are enrolled for part-time studies in education, languages, the social sciences and humanities at UNISA and Vista. In 1991, 94 percent of African students enrolled in engineering at Technikons were male (Government of South Africa, 1994).

The poor representation of women, particularly black women, in the fields of science and engineering, is reflected in women's position within the labour force, as the table (below) demonstrates.

### Gender and Race Breakdown of Top Occupational Categories

(Manpower Survey, 1991)

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Total</th>
<th>African</th>
<th>Indian</th>
<th>Coloured</th>
<th>White</th>
<th>%women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineer</td>
<td>16125</td>
<td>125</td>
<td>4</td>
<td>4</td>
<td>226</td>
<td>1.5%</td>
</tr>
<tr>
<td>Manager/</td>
<td>49613</td>
<td>43</td>
<td>613</td>
<td>43</td>
<td>3658</td>
<td>7.6%</td>
</tr>
<tr>
<td>Director</td>
<td>2714</td>
<td>4</td>
<td>20</td>
<td>7</td>
<td>495</td>
<td>19.4%</td>
</tr>
<tr>
<td>Advocate</td>
<td>12778</td>
<td>211</td>
<td>317</td>
<td>19</td>
<td>1246</td>
<td>14.0%</td>
</tr>
<tr>
<td>Medical GP</td>
<td>660</td>
<td>21</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3.3%</td>
</tr>
<tr>
<td>Physician</td>
<td>1425</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>95</td>
<td>6.7%</td>
</tr>
</tbody>
</table>

In 1991, only 1.5 percent of women were engineers. Moreover the percentages for women in all categories are distressingly low. When African women are considered, the picture is even more dismal. There were no African women engineers and architects. Indeed, of all the women in professional and technical occupations, only 1.6 percent of them were African.

It needs to be noted that the privileges that white women have enjoyed through access to political and economic power has made it easier for them to secure employment in professional areas that have been closed to black women.

With this understanding of the educa-
tional landscape, some have argued that facilitating women’s access to education and to science fields will resolve their underrepresentation in the science professions. Access to education will affect the empowerment of women. Other theorists argue that greater access to education, science or otherwise, is not the answer to women’s oppression. They note that inclusion in a system whose fundamental design includes female oppression will not alleviate women’s burdens. They point to the fact that where women have been ‘included’, they generally fill the lower levels of the employment hierarchy, and their progress is arrested by the proverbial glass-ceiling effect. Other theorists argue that women’s oppression is rooted in the capitalist system of production that serves to oppress both men and women. Maggie Coats (1994:22) argues that:

> Women are prepared only or mainly for the traditional role of women in the home and in the family. This is an entirely satisfactory position for capitalism. Workers are cared for by women, new workers are reproduced and reared by women, and women are available for a variety of low paid, unskilled, part-time and probably temporary jobs. in response to the needs for labour at any given time.

Socially constructed norms

Regardless of what theory we subscribe to, in order to understand women’s position in society and their position in the male-dominated fields of science, it is necessary to examine the ideologies, stereotypes and societal norms that dictate what roles are suitable for women. Indeed, scholars like Namboze (in Malcolm et al, 1985) see an examination of the culture and politics of education and the workplace as one of the keys of change. The sexual hierarchy, as evidenced within both the education and labour sector, is not the dictate of biology but is the result of socially constructed norms (Bourque and Warren, 1990). Lockheed and Gorman (1987), through a comprehensive review of literature found that most studies reporting sex-related differences in science and achievement offer a variety of socio-cultural reasons for these differences. These include the pressure on women to conform to societal norms of what is considered feminine. Ideas about the appropriate roles for women in the labour market and in society, or about the biological unsuitability of women for science, act as major obstacles to women in science.

Furthermore, it is necessary to include the historical racial constraints imposed on black women within the context of apartheid South Africa. A dismantling of negative societal norms and stereotypes concerning women is imperative. An approach that simply calls for the inclusion of women is completely insufficient. Instead, what may be required is the systematic and steady imple-
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mentation of ideals that are designed to radically, albeit slowly, alter socially constructed norms. Some may be sceptical regarding the effectiveness of this approach in recognition of the institutionalisation of societal norms. While this is certainly true, South Africa's present restructuring of its institutions provides a rare opportunity for the implementation of gender equity policies. The following recommendations should be seen as incremental steps in the transformation of society.

Balancing the scales

With socio-cultural norms and stereotypes, ideologies, and economic considerations all weighing against a woman's chances for successful entrance into science fields, it is imperative that policy-makers and stakeholders within the education sector give serious consideration to the needs of their female student population. Indeed, it may be necessary that a certain number of bursaries and scholarships in science fields be designated for women. Some may argue that this will place a stigma on women's abilities and that female scientists will be considered less qualified and as having received a hand up and not fully deserving of their jobs. I think it is important to point out that many female scientists find themselves in this position anyway. It is certainly worth the risk of making it worse, if it means that the system will allow more women to enter science fields and thereby begin to balance the scales. When every other scientist is a competent female, it becomes that much more difficult for the stereotyping of women to continue. As such, these measures are by no means patronising or extreme.

If we agree that women are disadvantaged in gaining access to science fields for the reasons discussed and if as a nation, South Africa is serious about fully utilising the potential of all its citizens, then they become very appropriate and quite necessary.

The other option is that we allow women, as a group, to continue to lag behind, with some exceptional females managing to break through the sex-stereotyped barriers.

Furthermore, in order to begin to overcome some of the stereotypes regarding women and to dismantle the masculinisation of science, it is necessary to employ the use of popular media in promoting an image of science and technology as an attractive and accessible field for women. The presence of female lecturers and female scientists will serve as an encouragement to young aspiring scientists. The images in textbooks and popular print need to reflect women in important scientific roles. As South Africa embarks on the rather ambitious project of re-writing many of its text books so that they are reflective of South Africa’s population and accurate in terms of its history, it is also a key opportunity to make the books gender-sensitive. Special mentoring programmes will also allow girls exposure to science. 1998 has been declared the year of Science and Technology and national efforts are underway to demystify science in the eyes of students and the public in general. This certainly is an opportune time to launch various initiatives that will specifically target young women.

At the higher education level, specific mentoring programmes are needed between undergraduate and graduate students and women already working in the field. Mentors that can act as role models for younger women will boost the chances of girls successfully completing their education. It is the appropriate time to establish programmes for women to interact with each other in a mutually supportive network. For decades men have had access to the 'old boys network' that has provided them with connections which have led to access to institutions, to jobs and to promotions.

Certainly, it is possible for women to create a similar information network where news, jobs, research, bursaries and funding opportunities can be circulated. The importance of this cannot be overstated, particularly when one considers the often insurmountable obstacles that women face in the...
male-dominated world of science and technology. Mentor networks can be further expanded through the use of electronic initiatives. With the growth of information and communication technologies, it is now possible for women in South Africa to interact with other women in other parts of Africa, Europe, the United States and the world generally. Mentors and mentees need not even reside on the same continent. Some may be sceptical about this approach, particularly in view of the infrastructure needs in South Africa. While this is a very real consideration, the possibility of community use of technology may in a very real way compensate for this deficiency. The development of telecentres (see page 78) is one way to increase access to information and communication technologies (ICTs), especially for scholars and teachers.

Further, information dissemination techniques can make material widely available to a larger number of women. Information accessed through the Internet can be reproduced in the form of newsletters that can reach women who may not have personal access to a computer or who may not be able to utilise this technology. While we continue to hammer away at societal norms, government policy must continue to open the doors for women through equal employment policies. Women have to be vigilant that discriminatory hiring policies are eliminated and that they are paid the same rate for the same work as their male counterparts and have access to the same work training opportunities. While South Africa can boast of having one of the most progressive constitutions in relation to the advancement of women, and fora for the discussion of gender policy, it is critical that legislative reform be translated into real benefits for women. In order for women to take their rightful place in science and technology as South Africa enters the 21st century, the dismantling and reconstruction of societal norms concerning the roles of women must take place along with the creation of an environment that is ‘woman-friendly’. Supportive networks should be instituted and gender-sensitive government policies on science and technology implemented.

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FOOTNOTES
1. Women account for 45 percent of graduates at ter-
tiary level (Government of South Africa, 1997).
2. There is difficulty in locating current enrolment and
graduation figures for black women in the science
and engineering subjects or research subjects.
Women in the Social Sciences, on the other hand,
have received support and bursaries in the Women-
in-Research project (Centre for Science Development,
1998) which has audited women's research in the
Social Sciences and the Humanities and compiled
an on-line searchable data base, the Directory of
Women Researchers. Perhaps because of the rela-
tively few numbers of women in these sectors, no
such work is evident in the sciences and engineering
disciplines. The foundation for Research and
Development which produces regular statistical
reports on enrolment of women and men, does not
break these down by race. This would have helped
to provide a more recent picture and to gauge in
what way enrolment has changed.
3. Shindler et al note (1996) that gender stereotyping in
enrolment in Colleges of Education persists. Women
comprise 100 percent of home economics students.
However, women are also studying some technical
subjects, mathematics (71 percent) and computer sci-
ences (64 percent) in significant numbers.

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