

# Science: a masculine disorder?

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*Science is based on the professional creation and certification of knowledge which is tied to powerful interest groups, notably the state, corporations and the scientific profession itself. Patriarchy is based on male control of dominant social structures and the exclusion of women from positions of power through means such as direct discrimination, socialisation and the gender division of labour.*

*Patriarchy within the scientific community is manifested through male control of elite positions and various exclusionary devices. The scientific method incorporates masculine features such as the objectification of nature. Scientific knowledge is masculine in its neglect of women's experience and its adoption of paradigms built on assumptions of competition and hierarchy.*

*Four model strategies are analysed for challenging masculine science and building alternatives. Each of these strategies has strengths and limitations. Between them there may be hope for denting masculine-science-as-usual.*

WE HAVE BEEN INVOLVED in a recently established Australian group called Women in Science Enquiry Network. WISENET was formed with the aim of increasing women's participation in science and examining employment and education structures which restrict women's scientific opportunities. WISENET has helped us focus on the issue of how science is constructed and how to go about changing it to make it a more egalitarian activity.

There is little point in working on a series of bandaid treatments which do little to alter the way in which science is practised. We believe that, in order to achieve any lasting change in masculine science, it is valuable to have developed a long term strategy which incorporates a structural analysis of the major forces operating to construct both science and patriarchy in particular ways.

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Science and patriarchy then must be seen in the context of wider social relations. An individual action can be more effective if it fits into a well-planned overall strategy. If there are fundamental structural reasons for women's exclusion from science, then it is apparent that it is necessary to change those structures, hence the very nature of science before women can enter into a more egalitarian science.

Recent feminist analysis – growing as it did out of the militancy of the 1970s women's movement – was initially directed towards those areas of social relationship where women were most obviously oppressed. The family, the workplace, the process of socialisation and violence against women were areas that received much attention.

For many women working in science, such analyses did not have the immediacy that they held for women in other fields. However from the late 1970s there has been increased interest in the position of women in science. One expression of this has been the search for those women who have made significant contributions in science but who until now have been overlooked<sup>1</sup>.

Such an approach not only underscores that women are capable of making contributions to orthodox science, but also that they most often work under less than favourable conditions. Sayre's detailed account of Rosalind Franklin for example shows her significant contribution to unravelling the structure of DNA despite exclusion and denigration from her male colleagues.

Other women, some of them working in science themselves, have written more explicitly of the problems faced by women working in science<sup>2</sup>. Many such studies explicitly bring out the discrimination against women.

Complementing this approach is that taken by those specifically focusing on the reasons why there are not more women involved in the sciences. Several writers have examined science education, particularly looking at the reasons why girls leave science in their school years<sup>3</sup>. Following the observations that boys get more teacher attention and girls have less confidence in their ability<sup>4</sup>, in Australia there have been some experiments with all-girls science and mathematics classes.

There has also been analysis of the way in which science is constructed to reflect male values<sup>5</sup> and suggestions about how to create a different sort of science. Arditti<sup>6</sup> for instance argues for a feminist perspective which "would re-introduce and re-legitimize the intuitive approach".

Another approach is that of the Brighton Women's Science Collective in *Alice Through the Microscope*<sup>7</sup> and

essays in *Women Look at Biology Looking at Women*<sup>8</sup> which emphasise the social construction of science in an attempt to show that for women biology is not destiny: women biologically can do science.

Further, these authors emphasise that the biology which shows that women should behave and think in a certain way is socially constructed. Anne Fausto-Sterling<sup>9</sup> analyses the change that would occur to science if more women entered it.

In approaching the problem of developing a strategy to challenge and change masculine science, we decided to examine briefly science and patriarchy separately. Therefore, we first spell out our view of science in the context of dominant political and economic relationships. Then we look at patriarchy in a similar fashion. After this rather formal beginning, we are in a position to examine the specific connections between science and patriarchy. We look in turn at the relationship of patriarchy to the scientific community, to scientific method and to scientific knowledge.

The point of all this analysis is to throw some light on the different options for action. We analyse four 'model' strategies which are aimed at turning science into a non-sexist, more egalitarian activity. This involves changing both science and patriarchal relations, for as our analysis shows the two are closely bound together. Long-term structural change in science must be predicated on changing the relations between men and women.

### Important aspects

Three important aspects of science are the scientific community, scientific practice or method, and scientific knowledge. Scientific practice and knowledge constitute a way of examining and ordering the natural world. This definition emphasises science as a social construction<sup>10</sup>. It implies not only that natural processes are studied, but also that some are deemed more worthy of study than others. Science acts as a lens through which the world is perceived and as a filter through which potential knowledge is channelled.

Science is embedded in a set of social, economic and political relations embodied through patriarchy, the state and the dominant economic mode of production. These factors are mutually constitutive of each other and push scientific research into specific channels. Not only do dominant social structures influence scientific research in terms of what subjects are worth studying and what questions are worth asking, they also influence the preconceptions of scientists as they engage in examining the natural world.

In this section we focus on the role of the state and economic structures in shaping science.

State funding of research delimits scientific endeavour since some research projects are deemed more worthy of funding than others. The military, itself part of the state apparatus, employs a large fraction of practising scientists worldwide. The channelling of large numbers of scientists into the military area helps to set research priorities for many non-military scientists as well. Much of the scientific attention on areas such as plasma physics, incapacitating drugs, meteorology, gravitational anomalies and nonconforming behaviour derives from military funding and interest<sup>11</sup>.

The state offers legitimation of 'science' through the education system, state-funded research centres and grants to institutions. In the case of schools and tertiary institutions students are taught which avenues of inquiry constitute 'science'. A perception of the natural world is taught and

data is organised according to a learned set of criteria.

Further, the hierarchical division of scientific knowledge into discrete disciplines serves to reinforce the idea that certain questions are more important than others, and that some questions are appropriate in one discipline but not in another. This process serves to set the limits in which scientific inquiry can occur. Students are also taught to work within disciplines rather than exploring the area of overlap between disciplines.

Strong links exist between state and economic structures and the two often have a high level of similarity in their priorities. Under both state socialism and capitalism, a particular type of science is promoted and legitimated through its economic application. Bureaucratic incentives and corporate funding ensure that much scientific research is geared towards commodity production.

In medical research for example, a disproportionate amount of money is spent on research into diseases of the affluent such as cancer, heart disease and diabetes. The products of such research are commodities geared towards a market which can afford them. Far less research is directed into preventatives such as lifestyle changes, which are not marketable, or into the diseases of third world countries, in particular the diseases of poverty.

The same applies in the energy area. Research has been directed into non-renewable energy sources such as coal, oil and uranium, sources where profits can be maximised rather than renewable sources where bureaucratic control or corporate profit are more difficult to achieve.

### Scientists

Scientists as individuals are influenced at an ideological level. This occurs with the filtering of ideas that the scientific community considers legitimate and worthwhile to pursue. It occurs also at the level of dissemination of information — information is made available on areas that are considered important.

Here again a hierarchy in science exists in that ideas are less likely to be transmitted between disciplines than within disciplines. Scientists' attitudes, which include an anthropocentric view of the world and domination of nature, can lead to an instrumentalist approach to the subject matter.

For example, laboratory animals are often treated as just another piece of the apparatus. Such an approach allows and enables a distancing between the scientist and the subject matter, hence the results of an experiment. This means that science has a subjective element to it<sup>12</sup>.

Science, by offering a legitimation all of its own, in turn influences dominant relations, leading to a congruency between the objectives of the two. By making scientific knowledge inaccessible to most people, for example through jargon and technical devices not widely available to the public, scientists have created for themselves a mystique which enables them to maintain their position as discrete elites. Combined with a hierarchical professionalism, this separates science from the public.

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Scientists as a group have a vested interest in promoting research which will ensure dependence on them, and in maintaining control over the knowledge that is disseminated. The knowledge of the construction of nuclear weapons is a good example. Scientists involved in nuclear weapons research are entirely dependent on state funding, but at the same time the state has become tied to the nuclear weapons scientists who monopolise expert understanding of the subject.

One result of this symbiosis of nuclear weapons scientists and the nuclear state is the strong influence of certain pro-nuclear elite scientists on government decision-making in the nuclear field<sup>13</sup>. Another and more telling consequence was the concerted attempt by both the United States government and many high ranking scientists to prevent open publication of the 'secret of the H-bomb'<sup>14</sup>.

Medical researchers also have an interest in mystifying knowledge, thereby removing control from ordinary people and placing it in the hands of the experts. It is in the interests of the medical profession to propose solutions which rely on their knowledge rather than on democratising knowledge. Preventive medicine is such an example; rather than being taught in schools with an emphasis on lifestyles and diet, it is administered by specialists.

Science is used to validate and support existing social formations such as the division of labour and racism. The focus on genetic explanations for human differences partly arises because of the political use of such explanations in legitimating inequitable social arrangements.

The search for genetic determinations of 'intelligence' has been most associated with debates over ethnic superiority and inferiority, and discriminatory practices and policies. The process here is of 'objective' science being used to legitimate a social process that is in the interests of an elite group<sup>15</sup>.

Before looking at how patriarchy interacts with science, we next take a separate look at patriarchy on its own.

### **Collective domination**

Patriarchy can be defined as a set of social relations which maintain the collective domination of men over women.

As in the case of science, we view patriarchy as a social structure — a set of social relationships involving power — which can only be understood in the context of other important social structures. In this section, we describe briefly the influence of two major social structures, the state and the mode of economic production, on relations between men and women, and then examine the influence of patriarchy on these structures.

The state provides opportunities in a number of ways for men to dominate women. Perhaps the most important is the bureaucratic organisation of most parts of the state. Bureaucracies are based on hierarchy and a division of labour. Most of the key bureaucracies in the state are controlled by men, and they can use their formal organisational power to keep women in a subordinate position, for example by:

- excluding women from jobs, especially top jobs;
- defining certain occupations as suitable only for one sex, such as typing for women and electrical work for men;
- supporting laws, policies and practices which support patriarchy, such as the 'family wage' or limited provision of child care;
- supporting practices by other organisations, such as corporations and trade unions, which keep women in a subordinate position.

It is significant that the military, a key bastion of state power, totally excludes women from many areas, and is pervaded by strong and often vicious anti-women attitudes. The monopolisation by the military and police of what is claimed to be legitimate violence is linked to the social ascription of dominance and aggression to men and of submission and passivity to women.

Sometimes there are initiatives from the state to support women's rights, such as equal opportunity legislation. Such initiatives by themselves do not necessarily undermine the support for patriarchy which is provided by the state due to its hierarchical structure.

Economic relations help in the maintenance of patriarchy. A key link here is between commodity production and male domination in the more highly valued public sphere. The modern division of labour has been established in a way that allows men to dominate; men are assigned to the 'public' sphere, working away from home to produce commodities (goods or services which are not directly consumed).

The commodity sector of the economy allows the development of extreme inequalities in power and wealth, either in a market economy or a bureaucratised economy (whether in the form of oligopolistic capitalism or state socialism). The hierarchies in such an economic sector allow for control by men. Men use their power in this system to keep women subordinate, with the same mechanisms as used by the state.

Women in this mode of production are assigned to the private sphere, even if they work for a wage outside the home. 'Women's work' is largely for direct consumption: housework and child rearing. The use value of such work has potentially liberating aspects because it is under direct control of the worker, but at present is mainly restricted to the household unit where it is severely devalued compared to paid outside work.

Thus the 'private' sphere is one in which women's work provides services to men but gives women little status or power. Economic systems based on a division of labour and commodity production which sustain the public/private split thus provide great scope for male domination.

### **Social construction of roles**

Associated with the interaction between the state, the mode of production and patriarchy are various ideas which help to legitimate male domination and also to socially construct gender differences. One such idea is that of 'combat' in the military. Women are not supposed to be involved in combat roles. In practice, the definition of combat is different in different times and places. The key aspect of 'combat' is not the activity in question, but the exclusion of women from a core set of roles which are given a high social status<sup>16</sup>.

Similarly, the definition of women's work in the economy as a whole — such as the areas of teaching, nursing and clerical work — has nothing to do with differences between women and men and everything to do with the social construction of roles<sup>17</sup>.

We have outlined how the hierarchies and the division of labour associated with the state and the mode of production allow opportunities for men as a group to dominate women, and as well for some men in high places to dominate other men. Men are not just casual or adventitious beneficiaries in this process. They actively use their power as men to sustain the social structures which perpetuate their power.

## Male bonding serves to support other hierarchies: among low level officer or factory workers, it is used both to exclude or marginalise women, and to mobilise support for the work hierarchy

For example, male bonding in many realms, from the government to corporations, serves to support other hierarchies, as when male bonding among low level office or factory workers is used both to exclude or marginalise women and also to mobilise support for the work hierarchy<sup>18</sup>. Many men support the public/private split because of the personal benefits it brings them.

In many cases, social structures, such as the state and the mode of production, are forced to accommodate patriarchy. For example, by the logic of commodity production both men and women should participate in paid labour equally. The continuance of 'women's work' in the home restricts the expansion of commodity relations. This restriction is imposed by the power of men over women.

Likewise, an 'ideal' bureaucracy would be gender-blind. In practice, bureaucracies adapt their practices to accommodate patriarchy, and indeed make every attempt to use male domination to sustain themselves.

So far we have looked briefly at how science is shaped by the context of the state and the mode of production, and how male domination interacts with them. In both cases a system of power adapts to a wider system of power. The key resource of the scientific community in this system is a monopoly on specialist technical knowledge which can be used for practical applications and for social legitimations.

The key resource behind male domination is the gender division of labour (both inside and outside the home) and the current male control of key positions in the state, corporations, the professions and other groups. The types of power exercised in science and in patriarchy thus are rather different.

We turn now to how these two systems interact, first looking at the scientific community. We discuss not only the science/patriarchy connections, but also why patriarchy has been a blind area in analysis of the nature of science.

### Patriarchy and the scientific community

If science is a social process, then it follows that it is constructed by the people working within it. Most scientists are men. Women involved in science tend to be disproportionately concentrated at lower levels and hence denied access to decision-making processes. This automatically means that science has a sexist bias.

Both inside and outside the scientific community, men perpetuate a science that is for men. This works on several levels. Firstly, quite directly through research priorities, men largely control the decision-making process and hence are able to decide what constitutes science. Science fits the model that previous men have constructed, and creative processes outside this paradigm are not included and given the status of science.

Science is taught through a formal education system which clearly delimits the boundaries between 'science' and 'not science'. At the research level again it is men who largely control the decision-making process of where funds will be

allocated. Parallel endeavours outside this structure are not accredited with the status of science.

Midwifery and folk medicine, for example, often controlled by women, do not have the status of medicine practised through the university-trained medical profession, which has been a traditional male domain<sup>19</sup>. In relation to the scientific disciplines there is a hierarchy in which the 'hard' sciences such as physics and chemistry — where men are found in their greatest numbers — are higher status than the 'soft' sciences, such as biology, where there are more women.

Male domination within the scientific community is closely tied to male domination in the large-scale social structures which shape science, notably the state and the economics system. Most of the elite decision-makers in these fields are men, who work together in a way which maintains male-oriented scientific priorities.

For example, state funding strongly favours capital-intensive, large-scale research facilities and projects built on hierarchy and division of labour in the scientific research team. In this way the male-dominated hierarchy within the scientific community is perpetuated. An alternative model of research based on a proliferation of small-scale projects under local community control is not compatible with control by state or scientific elites.

The large-scale power structures of the state, the mode of production and the scientific community provide the first main avenue for male domination in science. The second main way in which men retain their dominant positions in the scientific community is through socialisation.

The influence of patriarchy in this case enters through the family, interpersonal relations, schooling, peer groups and the mass media. The social construction of male and female genders begins at birth. Male babies are encouraged to take a more active interest in mechanical objects and the natural world, whereas female babies are encouraged to respond to the emotions of others. The process of socialisation continues at the school level where girls lose interest in the sciences<sup>20</sup>, and continues at tertiary levels and in the workforce.

As one goes through the educational system there is a gradual movement of women away from science, and in particular, away from more abstract science. Girls may see science as too difficult, as too remote from their everyday concerns, and as having a masculine image<sup>21</sup>. By the time the research level is reached, few women remain.

Those women who do enter the scientific community often adapt by taking over male values. Such women have often had to adopt, at either a conscious or subconscious level, a 'masculine rationality' in order to participate in what is a male defined area. Young women scientists usually have male models to follow, since scientific research is an apprenticeship system based on 'homosocial reproduction'<sup>22</sup>.

Men in research positions tend to choose like-minded people to follow in their footsteps. This system ensures not only that like-minded people continue to practise science, but also that what constitutes science is defined by people working with a similar world view.

Geraldine Finn has made the link between gender and science quite explicit when she states that "science's theory and practice embody male norms — and thus exclude women almost *a priori*". According to Finn, women are seen as "intuitive, emotional, dependent, not good at abstract and objective thought"<sup>23</sup>.

Men on the other hand are thought to be good at abstract and rational thought. In other words, science has its own

inbuilt gender bias; it is a male construct and predominantly a male activity. Whether such a construct is 'objective' is most certainly open to debate.

Biology for example has been used to show substantial differences between the sexes. These differences are then used to validate a division of labour where women are relegated to the reproductive area and men to the productive area. Social values have then been attached to these two spheres whereby women's work is seen as less important than men's work.

### Scientific method

Applied to scientific method, the division of science into disciplines including the 'hard' chemistry and physics and softer 'natural sciences of biology' sets up a hierarchy. This hierarchy is reflected at a project level whereby large projects are split into more manageable parts and there is a definite division of labour, for example research scientists to provide ideas and research assistants to wash up. It is no coincidence that this hierarchy reflects the stereotypic gender division where women are found at the lower echelons.

The subject/object division, an intrinsic part of scientific method, allows researchers to distance themselves from the natural world. Such an approach allows an instrumentalist approach to natural objects in scientific experiments and an anthropocentric view of the universe.

### Scientific knowledge

Scientific knowledge is closely intertwined with other aspects of science, notably the scientific community and the methods used for carrying out scientific research. Contrary to prevalent ideas, scientific knowledge does not sit pristinely on its own, isolated from social origins and influences. Instead, it is socially conditioned just as other parts of science are. One of the conditioning forces is patriarchy.

Here we look at three overlapping types of influences of patriarchy on scientific knowledge: the choice of topics for study, the content of scientific theories, and the boundary between science and non-science. In each case it will be found not only that patriarchy influences the nature of scientific knowledge, but also that scientific knowledge influences patriarchy, often in a reinforcing manner.

#### *Choice of topics for study*

To conceptualise the influence of patriarchy on scientific knowledge, the well-known idea of a scientific paradigm is valuable<sup>24</sup>. Generally, a paradigm provides a framework for doing science which suggests what evidence to search for, how to interpret it and what sort of hypotheses to make.

The usual idea of a paradigm, as used in the social study of science, refers to conceptual frameworks within the ambit of the ongoing work of scientists. The influence of patriarchy is usually more general than this: it provides a social framework within which scientific developments occur.

Clear examples are found in the often closely related areas of medical and psychological research. It is here that the wider social assumptions about women's inferiority combined with male domination within these professions have led to a systematic denigration, trivialisation and lack of interest in those health problems associated with women. This is seen both at the research level and in the application of knowledge. The severe effects of hormone replacement therapy or hormonal contraception are not considered important enough to warrant investigation of alternatives.

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## **In medical and psychological research, the wider social assumptions about women's inferiority combined with male domination in the professions have led to a trivialisation of women's health problems**

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There is also a more frequent dismissal of women's physical problems by doctors and researchers. The denigration of women's health problems becomes a vicious circle when the lack of medical understanding is then used to justify ongoing neglect. Women who are excluded from the decision-making process of what constitutes science have little control over directions of research in these areas and the application of knowledge<sup>25</sup>.

The search for genetic determinants also links in with male-female relations. More recently sociobiology has been used to legitimate the genetic explanation for behaviour. One example is the search for genetic factors in the measured differences between males and females in certain types of spatial ability<sup>26</sup>. The sociological question is, why is so much effort put into the hypothesis that males may be genetically superior in spatial ability, or mathematical abstraction, than into hypotheses based on social origins of these differences?

The answer is that widespread assumptions about male superiority in related socially prestigious arenas (engineering, mathematics) lead to attention to genetic explanations. Popular accounts of even tentative findings which suggest genetic components in the mathematical ability of some males often contain a clear implication: there is no need to investigate or redress biases between boys and girls in upbringing, experiences, incentives, facilities and expectations regarding mathematics and related disciplines.

#### *Content of scientific theories*

The second patriarchal influence on scientific knowledge is on its content and structures. In most of the social sciences, women are invisible: their experiences are overlooked and their role is stereotyped. The traditional form of these disciplines can truly be called 'men's studies'<sup>27</sup>. For example, psychoanalysis denies the reality of the rape of female children by fathers or other males in the family: from Freud onwards, women's accounts of their experiences were interpreted as psychological, for example as wish-fulfilment<sup>28</sup>.

Though this is difficult to demonstrate, patriarchy may also play a role at a more fundamental level in knowledge construction. One possible influence is the preference for explanations involving hierarchy and competition:

- taxonomy is built on assumptions of hierarchies among species;
- long-favoured theories of cellular organisation have been based on the assumption of hierarchy with the genetic material in the leading role<sup>29</sup>;
- evolutionary theory in its origin and development has drawn upon ideas of hierarchy and competition provided by the social and political environment in which the theory developed and prospered<sup>30</sup>;
- neo-classical economics is founded on assumptions of individualism and competition;

- the mathematical theory of games is built around the idea of individual players competing for discrete rewards;
- 'scientific management' is founded on the fundamental distinction between the manager and the worker, as well as on the detailed division of labour<sup>31</sup>.

The delineation of connections between the structure of scientific theories and wider social values is one of the most difficult areas for the sociology of science. In the examples above, patriarchy is only one influence. The development of evolutionary theory, for example, was also certainly influenced by prevailing ideas involving class inequality.

The influence in the other direction – scientific knowledge being used to justify or attack social structures – is clearer. Evolutionary biology was blatantly used to justify capitalism and related inequalities, as the term 'social Darwinism' so clearly testifies. Male domination is often seen as the 'natural' consequence of the nature of the world.

For example, neo-classical economic theory has been used to legitimise the existing distribution of wealth and privilege, in spite of the fact that gender-segregated labour markets are quite incompatible with the working of a 'free market'. In the reverse also, social relations are used as a framework for examining and explaining the natural world in an anthropomorphic way. Thus, scientific knowledge and social relations reinforce each other<sup>32</sup>.

#### *Boundary between science and non-science*

The final influence of patriarchy on scientific knowledge which we raise here is patriarchy's impact on the boundary between science and non-science. 'Science' and 'non-science' are socially constructed categories: it can be argued that they cannot be defined by absolute criteria such as logical coherence<sup>33</sup>.

According to what it means in practice, 'science' is something done by scientists, namely full-time professionals working as part of a system set off by formal training, privileged access to resources (salaries, equipment), formal methods of communication (journals, conferences), and location in hierarchical organisations (universities, government and corporate laboratories). Medical researchers studying viruses are considered to be scientists, whereas women's health workers studying the distribution of particular syndromes are not.

There are whole areas of 'rejected knowledge'<sup>34</sup> ranging from Velikovsky's theories to dowsing. Knowledge which is allowed into the scientific pantheon is that which is sanctioned by the professional gatekeepers, and almost without exception this means knowledge which is controlled or monopolised by the professionals. Popular knowledge, no matter how useful, accurate or systematised, is not accepted as scientific. This includes trades and skills such as cooking and sewing.

While patriarchy is only one influence on the creation of boundaries between science and non-science, however the boundaries are established, they generally help to maintain male dominance. 'Women's realm' – housework, child rearing, emotional support, and so on – is stigmatised as subjective and second-rate, and certainly far removed from the realm of 'science': but as we have already noted, science is subjective. To avoid this stigma, science claims objectivity for itself.

So well established is this separation that it is impossible for most scientists to conceive of scientific knowledge being developed or applied inside the home except through the medium of outside experts, such as the purchase of elec-

tronic equipment or visits by psychologists.

'Science' is conceptually entrenched as something that must be located among professional workers who are mostly men situated in the 'public' side of the public/private split. For those subscribing to this conventional conception of science, so congenial to patriarchy, the idea of 'science by the people' is virtually a contradiction in terms.

#### **Beyond masculine science**

The question we posed for ourselves from the beginning is, what can be done to turn science into a non-sexist, egalitarian activity? Our analysis assumes that an overturning of patriarchy in the wider society is necessary to achieve the same result in science. So we are after ways to promote equality for women within science as part of the wider struggle against patriarchy, and at the same time change science to be more in tune with an egalitarian non-sexist society.

We are concerned here with strategy, not simply with desirable goals. A strategy must be based on an analysis of the present situation, with a clear understanding of what sort of desirable future is sought. The strategy must take into account social forces which are likely to support and to oppose the desired changes. In looking at particular goals from the viewpoint of strategy, we are more concerned with the question of how to proceed in order to achieve sought-after goals than with the details of the goals themselves.

In looking at ways to challenge the science-patriarchy system, we first examine strategies for system intervention. After that we outline what this means for individual activists.

To simplify discussion of the many possible strategies for system intervention, we select out four 'model' strategies: getting more women into an otherwise unchanged science; changing science education; building feminist science; and democratising science. Of course, many actual strategies would include elements from these four, as well as other approaches. Our discussion here is aimed at suggesting the procedure for a wider analysis of strategies.

#### *Getting more women into an otherwise unchanged science*

This strategy is based on pushing for equality within the system of science as it is. Although at first glance it may seem entirely reformist, it has many implications. Some of the requirements – and actual initiatives – for the success of this strategy are as follows.

- Ending overt discrimination. Equal employment legislation is important here, and also the spreading of knowledge about the nature of gender discrimination and how to oppose it. This area holds the greatest promise for short-term success.

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**To get more women into an otherwise unchanged science, it is necessary to end overt discrimination, improve the image of female scientists, give child care and career support and have networks for women to support each other**

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- Role models. Opportunities need to be created for successful women scientists to be widely seen as successful and as desirable models to be followed by other women — and to be accepted and admired by men. This means changing the present portrayal of science as inherently 'unfeminine'. Publicity and networking are important for developing role models.
- Child care and career support. The obstacles to a career in science posed by child rearing by women and by lack of material and emotional support must be removed. The women's movement has been working towards these goals, but there is a long way to go before mothers can find it as easy and attractive to pursue science as fathers.
- Support networks. At the moment, male scientists provide a support network for their male colleagues and students. Women can provide some support for each other to offset their normal isolation. This is beginning to happen both informally and formally.

These areas for action imply considerable changes in social arrangements, but we think that this strategy to reform science and to overturn patriarchy has some severe limitations.

These arise from the basic premise of the strategy which assumes that women must adapt to science. Discrimination may be ended, but the criteria for success will still be the traditional ones involving specialist research in a narrow-track career in a system conditioned by the state, capitalism, and so on.

The role models are likely to be women who are 'honorary males'. Because science is assumed to remain hierarchical, instrumental and at the service of elites, it will continue to serve the wider interests of patriarchy. Perhaps the patriarchy will be reformed to allow some women — especially middle-class professional women — to hold a greater share of the positions of power. There will still be a dominant group based on male gender characteristics of competition, domination, and exploitation — only now more women will share these characteristics.

This strategy can neither be accepted uncritically nor rejected out of hand. It contains elements which have far-reaching consequences if followed through, but the main elements contain seeds of containment of any such consequences.

#### *Changing science education*

The programme here is focused on science education, including schooling at the primary, secondary and tertiary levels, and general public education about science. Whereas the first strategy emphasised providing support for women scientists, this strategy focuses on early and continuing socialisation through attitudes, education and information.

The strategy is based on the idea that women's socialisation into female roles combined with the social stereotyping of science as a male activity is the basic obstacle to women ever reaching equality within science. It assumes that initiatives to help women scientists will only aid a few as long as women are socialised into females-unable-to-do-science, or socialised to believe that as scientists they are only good at doing repetitive uncreative work.

The basic element of this strategy is developing non-sexist educational practices. This is a big task, and includes analysing how sexism enters classroom dynamics at the micro-level as well as promoting large-scale changes in decision-making on educational policy. There are many efforts being made in these directions, but the task is enormous. Further investigations continue to show the deeply embedded nature of

socialisation processes.

As well as changes in educational practices, this strategy can include a different portrayal of science to the general public through news reports, popular science journals, toys and hobbies, and personal contact with scientists.

The strategy is attractive, but there are two problems. First, there is no guarantee that equal education at bottom levels alone can ever be a basis for substantial change in professional science itself. The failed campaigns of reducing social class inequality via 'equal education' should be a salutary example here. Second, while this strategy attacks the science-patriarchy system at a deeper point than the first one, it suffers the same defect of aiming to change women to adapt to science.

#### *Building feminist science*

The aim here is to provide a complete alternative: alternative social relations between scientists, alternative methods, and alternative scientific knowledge. For feminists, the alternative to masculine science is feminist science. This might include egalitarian, co-operative interactions between researchers, teachers and learners working together in a mutual enterprise, and new sets of concepts and perspectives on the natural and social worlds: a feminist scientific knowledge.

It is not quite clear what this strategy means in practice, since so little has been done towards realising it. The best examples are in the areas of health and the social sciences. In the health area, the Boston Women's Health Collective<sup>35</sup> has shown how co-operative work can be done which re-focuses knowledge on medicine and health and makes it useful to a different group in the community, namely women.

In several of the social sciences, feminist researchers have challenged established ideas and frameworks and proposed feminist alternatives,<sup>36</sup> but the existence and meaning of feminist alternatives in the natural sciences remains to be shown.

The building of alternative science has some important features. It challenges science, rather than adapting women to it. And it puts the emphasis on building a new system, rather than wrenching or begging for concessions from the old system. Yet we think there are some severe inadequacies in this strategy, at least as presently outlined.

- There is no institutional base for developing a feminist science. The material resources for doing science are overwhelmingly in the hands of the state and the economic system. Unless autonomous sources of support can be developed — and this seems unlikely to occur for some time — the development of feminist science can at best be a marginal activity.

The alternative is to rely on feminist scholars in niches in the present system, but this has the limitation of constantly coming up against prevailing hierarchical and competitive interactions, and confronting the standard knowledge.

- There is little scope for actually using a feminist science. Present large-scale applications of science are overwhelmingly controlled by state bureaucracies (especially the military) and corporations. The obvious place to apply feminist science is in social movements, but most social movements are not geared to develop their own enterprises: they are mostly engaged in reactive protests, not long-term building of alternative cultures.
- The idea of 'feminist science' usually implies distinct differences from 'masculine science'. The danger here

is that 'feminine' characteristics will be used exclusively rather than incorporating the positive aspects of both genders. If feminist science establishes itself as different by being separatist and glorifying the feminine, it may end up perpetuating the status of feminine characteristics as second-rate.

- It is possible that feminist science might actually develop to some degree, but remain an isolated activity with no wider impact. Like some countercultural initiatives, the alternative would be allowed to exist so long as no major challenge emanated from it. Another fate would be co-option: the incorporation of key ideas from the feminist scientists into mainstream science, and the application of these ideas for traditional purposes.

#### *Democratising science*

The strategy here is to challenge the hierarchical and dominating aspects of science and to push for the widest possible participation in and local control over science. The democratisation is feminist if men and women are equals in this participation and control. The project of democratisation can readily be extended to include other groups, such as ethnic minorities, the poor and unemployed, the young and the old.

This strategy is aimed primarily at changing science rather than women. Unlike the strategy of building alternatives, it focuses on challenging and changing existing science, with the aim of altering the links between science and the major social structures of the state, the economic system and the professions, and replacing these links with ties to local communities.

What this strategy means in practice has not been systematically developed. Some elements might be:

- co-operative research by scientists;
- orientation of research projects to the needs of community groups<sup>37</sup>;
- communication and publication of results to public audiences;
- links between established scientists and social action groups such as trade unions and environmentalists;
- campaigns to include community representatives on panels to decide on funding for science and to evaluate research and teaching programmes;
- joint research projects involving professional scientists and 'non-scientists'<sup>38</sup>.

The democratisation strategy can draw on not only elements of the feminist movement but also on elements of others such as the environmentalist and the workers' control movements.

The limitations of this strategy reflect the strengths of the other strategies. First, 'democratisation', if carried out without close attention to wider structural aspects of patriarchy, may simply 'democratise' the existing male

power structures: research might be done co-operatively and be more oriented to community needs while still being male-dominated. Second, uncritical reorientation of present science to 'community needs' may incorporate too many features of current scientific knowledge and practice: community-based scientific research might still be oriented to manipulation and control.

#### **Implications for individual activists**

The four alternatives discussed above all involve interaction at a group level. While we see this as the most effective action it is not always possible. Like-minded people are not always available or accessible.

This does not however mean that an individual has nothing to offer. There are several options that may be taken by individuals.

There are two options we believe are relatively ineffective. The first is dropping out. This does nothing to change science. Rather, it strengthens the power of those working within the system as it effectively removes any source of challenge. A contrary option, staying in and keeping a low profile to consolidate one's position (the white ants in the woodwork approach) can have similar problems. Conventional science and supporting structures are supported and it may become increasingly difficult to step outside a dominant paradigm.

A more useful choice is to remain within conventional science, using this as a base to work towards alternatives. This may mean working part-time in social movements located outside mainstream science or working towards specific goals within mainstream science.

At an individual level, working within science may mean trying to do socially relevant research or at last 'neutral' research. This involves considering the implications of research before embarking on a given project.

It may also involve making comments on social or scientific issues. Working from a position within mainstream science, where one's credentials have already been established, may lend credence to such comment.

Finally, a scientist can use the workplace as a place to democratise the research or learning process. As an individual, a scientist by presenting alternative ideas can act as a role model for other scientists and students.

At a more direct level also it is possible to push for structural changes that can be accommodated within the mainstream scientific community. Examples are part-time careers and the removal of restrictions on newcomers such as age and training, both of which are of particular importance to women wanting to combine a career with child-rearing.

A second useful individual option is to drop out or stay out and to build an alternative science, perhaps working in a parallel community where such ideas are supported and valued. This has an obvious advantage over working within the system in that an individual's resources are not consistently channelled into justifying an adopted position.

One possible drawback is the tendency towards creating a parallel elite group. We see an important part of the alternative science strategy being the democratisation of knowledge, and working towards an alternative network rather than working on an individual basis.

It should be clear from our discussion that we do not think any of the model strategies is adequate in itself. We favour incorporating elements of each into a wider strategy.

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**Democratising science might mean research is done more co-operatively and be more oriented towards community needs, while still being male-dominated and oriented to manipulation and control**

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