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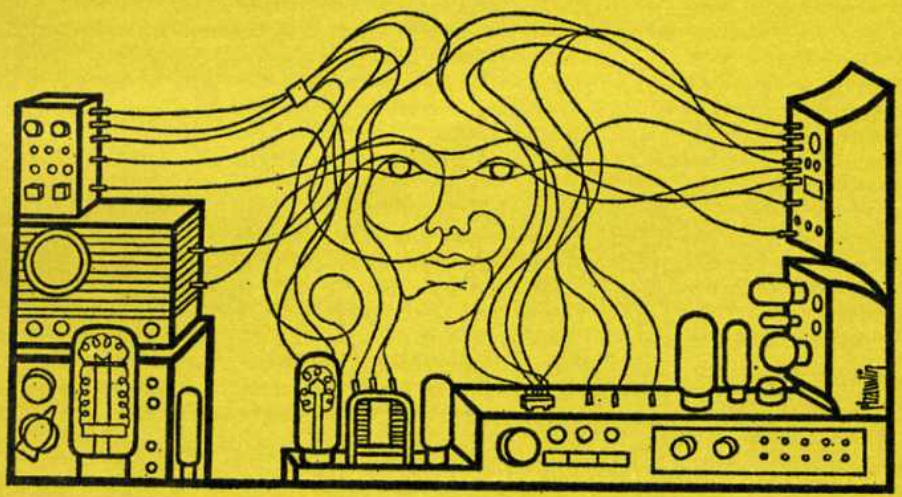

Women in the age of science and technology

Cover illustration by Jean-Louis Chauvin

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AN INVITATION TO READERS

Reasoned letters which comment, pro or con, on any of the articles printed in *Impact* or which present the writer's views on any subject discussed in *Impact* are welcomed. They should be addressed to the Editor, *Impact of Science on Society*, Unesco, Place de Fontenoy, 75 Paris-7e (France).

A CORRECTION

We regret that two errors were allowed to creep into an article by Dr. Alexander Kohn which appeared in *Impact of Science on Society*, Vol. XIX, No. 3, 1969. First: footnote 2, page 263, was accidentally interchanged with footnote 1, page 264. Second: footnote 3, page 265, erroneously ascribed the authorship of a 1962 *New Scientist* article to Dr. Kohn; this was, in fact, an editorial, and Dr. Kohn did not write it.

The editor comments

The shackles and the difference

In another context, this editor had the occasion to make two observations: 'The man who does not think that women are something rare and special is as stupid as the woman who does'; and again: 'It is so difficult being a man and so difficult being a woman, that no one should ever be forced to pay a penalty for it.'

The first was a sentimental outburst of *vive-la-différence*-ism, a grateful appreciation of the fact that the femininity which gives males so much pleasure is something women must work at and—praises be!—do.

As for the second, well, the penalty that many women want to make men pay is contained in the word 'emasculation'—and enough said of that.

The penalty that men have been making women pay for ages is that of de-individualization, a Procrustean fitting into a class stereotype having a standard set of characteristics tagged 'woman's role/femininity'.

Let us note that this problem of penalty-enforcing by and on both sexes has only been raised from its chronic, all-through-the-ages stage to an acute stage with the advance of science and technology, within perhaps the last century and at accelerating rate within the last few decades. For these have brought about an unsure transitional state between traditional secure notions of man-ness and woman-ness and new ones which are not yet defined. Everyone is difficult to live with when unsure and insecure.

This number is particularly concerned with women

and a succeeding number will deal with men. It is certain that women today are a problem to themselves and to men, unsure as they are of their place, particularly because many of them are diminished in their own eyes when they fill the traditional role of 'only a housewife'—as so many women express it—instead of following a bright modern career.

Science has made common currency knowledge that has largely destroyed old ideas that women are innately incapable of and disqualified from doing any particular kind of work (other than the heavily physical). Technology has opened the doors for women to work, providing jobs that fifty years ago did not exist. Education is the link between the two.

Together these form a powerful chisel, chopping away at the shackles of tradition.

Yet the shackles persist. Why? Why is it so hard to make the transition from the nest-building, baby-raising feminine creature of yester-year to the ability-using, fully-realized woman of tomorrow?

The answer is, of course, the importance of the difference. Both men and women are enormously fearful of losing the difference which is so necessary to make two together feel like a completion.

A breakthrough which will finally enable women to be fully emancipated, equal with men in their chances to be whatever they want to be, as well as women, can only be achieved when we have resolved the problem of preserving the difference without letting the difference be a penalty imposed for being a woman—or a man.

Bruno FRIEDMAN

Women in space

by Valentina Tereshkova-Nikolayeva

Does the female physical and psychological make-up bear the stresses of space flight as well as does the male? Does woman's complex reproductive system pose any special problems? The first woman in space answers these questions with a resounding 'no', though observing that the phase of the menstrual cycle does have a minor effect on a woman's resistance to stresses. At the same time she gives insights into her own training for orbital flight.

And then she affirms her conviction that a woman should always remain feminine, but that a career in science and technology is not antagonistic to this, but can instead be complementary.

Nearly seven years have passed since my earth-orbiting flight piloting the Vostok 6 spacecraft. The official statement said that the purpose of the flight was to continue 'the study of the influence of various factors on the human organism and to carry out a comparative analysis of the influence of these factors on man's and woman's organisms, to conduct new medico-biological observations, to test and further improve the manned spaceship systems in the conditions of a joint flight'. Thus, both the human being in space and the spaceship in flight were the objects of studies—the first steps towards getting humans accustomed to a medium entirely new to them.

This stage of development is now largely completed. Today Soviet craft of the Soyuz series or American craft of the Apollo series go up into space to carry out specific missions: say, to dock two vessels together to form a near-earth orbital station, to carry out metal-welding experiments in the conditions of vacuum and weightlessness or to bring samples of moon rock back to earth. Man's exploring, living and working in space has

FIG. 1. Valentina Tereshkova-Nikolayeva.

passed out of its early pioneering days and, though still pioneering, is approaching the stage of being a standard human activity.

But when I say 'man' do I mean 'man, the race' or merely 'man, the sex'? Is space to be an exclusive male domain or do women have a role to play in its conquest and utilization? Are there any reasons to be found in woman's physical or psychological make-up why she cannot participate in this future major human activity alongside men?

It is these questions that my flight was designed to answer and it is these questions that I wish to discuss in this article.

'HOW DID YOU BECOME A COSMONAUT?'

'How did you become a cosmonaut?' Over the years, this question has been put to me hundreds, if not thousands, of times. Despite the fact that I have actually been in space, it is hard to answer, just as hard now as it was before.

I did not even dream about space before the launching of the first Soviet artificial earth satellite in 1957. I was certainly aware of the sky, the stars and the moon, but just as everyone else was, as our distant night ceiling. The cosmos invaded my life much later. But I'd better begin at the beginning and briefly describe my life before I was called to space.

My childhood was not too joyous. I was born in a small village in 1937 and was not yet three years old when I lost my father, who had volunteered for the army. At five, I was carrying meals to my mother who worked out in the fields. It was a long way to go through the thick rye, with the sun beating down mercilessly. I seldom cried in my later years and it is probable that this was because I had learned to restrain myself in my early childhood.

During the hard years of the war bread and potatoes were in very short supply, and milk was available only on special occasions. In those years I learned to value bread and to like work, however hard or even boring it might be. It was rather early in life that I learned that people live by their work.

Later we moved to my grandmother's place in Yaroslavl and it did not take me too long to turn from a village girl into a factory girl. My grandmother and my mother worked at the Krasny Perekop mills. At first, I went to an evening school and began to work at a tyre plant. But then, in 1955, I entered a textile course in a technical school and took a job at the Krasny Perekop mills, too.

At the mill, I was active in public service work and the mill's Young Communists elected me their organizer. This work taught me to believe in people and to love them—it was both useful and instructive.

Without giving up my job at Krasny Perekop, I graduated from the correspondence department of the Light Industry Technical School. I became deeply interested in the problems of industrial equipment, but the truth is I never abandoned the great dream of my life, which was to become an airplane pilot.

I have mentioned my pre-space biography just to indicate that my life was nothing out of the ordinary. I was raised without a father, just like many of my contemporaries. Like other Soviet young people I studied, worked and was keen on sport and, I tell you frankly, I found it hard sometimes to combine the three.

Among my sports was parachute jumping. Many girls at the mill were as keen on this as I was. It did not cost us anything to participate—on the contrary, the air club encouraged us in every way. This experience later proved quite useful to me.

Space entered my life on 12 April 1961. As I mentioned above, I was living in Yaroslavl and working at the Krasny Perekop mills, turning out technical fabrics, when Yuri Gagarin became the first man to fly in earth orbit, thus showing that manned space flights were possible.

The news about the great event spread through the city at lightning speed.

'Let me take a look at him!' the girls at the mill exclaimed, snatching newspapers from each other's hands. They admired the charming smile of the first cosmonaut and found him manly, firm-willed and very personable. But this was

not the most important thing: what was equally exciting was that Yuri Gagarin, the first man in space, was once a foundryman, a factory worker like us.

Not long after Gagarin's flight, representatives of a public service society devoted to maintaining good relations between the civilian population and our defence forces visited our air club, as well as others. They let it be known that more cosmonaut-trainees were needed and held exploratory general conversations with young women in the air club who had reached the high level of parachutist, first degree. Chatting easily, they probed our feelings and reactions to Gagarin's flight and to space work in general. And they asked if we might be interested, as women, in becoming cosmonauts. Many of us did. From those who expressed themselves as candidates, they made a preliminary selection, a short list, composed of those they felt were the best qualified from a number of air clubs. I was on that short list, I am happy to say. Later, I was summoned for further appraisal.

After my arrival in the town of cosmonauts, I had to pass a thorough medical inspection and do a series of testing training sessions before I was finally enrolled in the cosmonauts' unit.

General Nikolai Kamanin, the head of the unit, told me: 'You, Valya, are the first girl in the unit. Others will follow you soon. But you were not the first girl to ask to be sent up in space. You had a predecessor thirty years ago.'

In 1927, Olga Vinnitskaya, a young woman of Rostov, wrote the following letter to Professor Tsiolkovsky:[1] 'Esteemed Professor, I have learned that the German flier, Max Valier, is going to fly to the moon. Having read some of your books I now see that there is nothing impossible about flying to the moon. Therefore, I make so bold as to ask you whether you can talk Valier into taking me along. Or should I wait until the Russians fly? It is better to be with one's own people, isn't it?'

Tsiolkovsky's answer was rather restrained: 'The newspapers, magazines and inventors go in for science fiction too much. You should not let yourself be carried away by it. It will be good if you and I live to witness trans-atmospheric flights. But I admire your courage very much.'

Tsiolkovsky did not live to see the first space flights. I don't know whether Olga Vinnitskaya did. We are luckier.

WOMAN IN TRAINING AND IN FLIGHT

The Girls' Sub-unit attracted close attention on the part of the medicos and biologists. Two opposite viewpoints were current at the time. Some said that woman's organism can easily adapt itself to all the difficulties connected with high stress in blast-off and landing and with the state of weightlessness. Their opponents were of the opinion that the fair sex is less adapted to all the strains of space flight than men are, that space makes no

1. Konstantine Eduardovich Tsiolkovsky (1857-1935), a mathematician and pioneer theoretician of space flight, who forecast the use of liquid fuels in large-scale rocketry and who made important contributions to the theory of space vehicle design.—Ed.

polite allowances for women being the 'weaker sex'.

The women's training programme was exactly the same as the men's. Just like the men, we worked out on running tracks, were spun on the giant centrifuge which revolves you in three planes at once, and stayed in the heat chamber and in the silence chamber.

My fellow girl embryo cosmonauts and I did a lot of parachute jumping and although the programme was difficult —landing on land and sea, bailing out any time of the day and night—we coped with it successfully. This was due to the fact that many of us had previously gone through the air-club schools.

The state of weightlessness—a complex and strong irritant affecting the whole of the human organism—evoked more apprehensions than all the other numerous factors involved in space flight. We were trained to stand weightlessness in a special laboratory in a fast plane, whose arced flight path produced this state for several seconds.

Contrary to expectations, the women adapted themselves to the state of weightlessness much faster than the men.

The general training programme included practice flights on board piston and jet planes. We studied scientific and technical subjects, such as astronomy, geophysics, rocket engineering, radio engineering, the spaceship and its systems, and a few others. The regimen of studies and training was very demanding.

As I recall that intensive training, I think about the question I am often asked: 'Can severe physical training be the chief factor interfering with women's taking part in space flights round the earth and in flights to the moon and other planets?'

A woman's flight into space produced the evidence to show that the organism of a woman can cope with all space flight factors no worse than that of a man.

I am often asked, also, to make a comparative analysis of the merits and demerits of the women's and men's organisms under the conditions of space flight. It would be much more appropriate to put this question to a physician or a physiologist, but I will try to answer it from my own knowledge and experience.

The factors of space flight that have their effect on a cosmonaut, whether man or woman, can be roughly divided into three groups: those produced by the dynamics of the flight; those brought about by a prolonged stay in the spaceship cabin; those typical of space itself as an environment.

Let us begin with the third group. The factors typical of space are ionizing radiation, vacuum and meteorites. All these are clearly lethal for any living being, and no line of distinction can be drawn between men and women here.

As for the second group of factors—that of prolonged stay in the spaceship cabin—no substantial difference between men's and women's reactions to prolonged sensory isolation and restricted movements has been established.

The effects of prolonged sensory isolation were studied in the silence chamber which was used during cosmonaut training. In view of the results of those tests, I don't think it is right that women are much more emotional and sociable than men, that they are psychologically more unstable and bear isolation

from the outside world and silence much worse than men. I personally did not observe a difference between the sexes—and I painstakingly compared my behaviour in the silence chamber with that of the men cosmonauts.

Finally, high gravity loads and weightlessness fall into the first group of space-flight factors, those conditioned by the dynamics of flight.

Men and women have identical vestibular systems—the apparatus in the inner ear which is responsible for maintaining equilibrium—and any vestibulary troubles which may arise from a stay under weightless conditions—or their absence—are due not to sex differences, but to individual differences. There is every reason for saying, on the basis of investigations carried out on board aircraft, that in the conditions of short-time weightlessness, women's co-ordination of movements is much more precise and confident than men's.

As for physical stresses, a series of numerous experiments involving women showed that they stand weightlessness no more poorly than men. Also, throughout the pre-flight training period women bore prolonged high-gravity overloads produced on the giant centrifuge and high momentary overloads produced on catapults as well as the men.

A question of major concern is, of course, how woman's complex reproductive system is affected by space-flight conditions. It has been learned that the effect of prolonged weightlessness on the pelvic organs depends on the phase of the menstrual cycle. Stresses have the worst effect on a woman around the time of ovulation, which comes, generally speaking, around the fourteenth day after the beginning of her menstrual period.

The results of these investigations can be always taken into account for the take-off and landing of a spaceship with a woman on board. In orbital flights and space flights outside the influence of earth's gravity, the phase of the menstrual cycle has no substantial importance.

The following conclusion suggests itself: despite her physiological differences, a woman can stand all the conditions of space flight as well as a man. This is not merely a theoretical conclusion. It was proved in practice on the sunny Sunday of 16 June 1963, when Vostok 6 took me up into orbit.

The flight was meant to last one day, but there was an understanding that if I felt quite well it would be prolonged by two more days. I felt fine and made forty-eight revolutions around the earth during the three-day orbiting.

There is hardly any need to recall now my programme of work on board the spaceship, for much has already been written about all aspects of this flight. But I want to point out here that the Vostok craft proved very responsive and easy to control.

I should only like to add that neither at blast-off, nor in orbit, nor at landing, did I have any unpleasant sensations such as nausea, dizziness or just ordinary fear. I felt much as if I had been on earth.

Shortly after my flight I married cosmonaut Andrian Nikolayev. Our healthy and cheerful daughter, Alyonka, is another proof that flight in space has no harmful effects on women.

If the cosmos is as open to women as it is to men, the reader may ask: 'Why

then haven't any women been sent up on space missions for nearly seven years and why are not such flights being planned for the future?'

It is quite easy to answer this question. Any major endeavour—space exploration, in particular—requires rational and well-thought-out efforts. My flight in 1963 was useful because it graphically proved women's potentialities in the new and sensational field of space exploration.

However, the testing period has been replaced by the clearly defined working period when the ships' manœuvrability and docking techniques are being developed and when experiments are being carried on in the craft. In this stage it is hardly expedient to form mixed crews because this would involve extra problems which, though not too complex, do not justify themselves under the conditions of limited volume and weight capacity obtaining in contemporary spaceships, where every centimetre and every kilogramme must be used to the maximum.

When orbiting space stations with broad functions are put up, then women will be members of the crew. Among us there are many first-class meteorologists, radio operators, biologists, astronomers and physicians who can serve.

The further penetration into outer space involving great increases in the ships' capacity and in the distance and duration of flight, up to a few years, the creation of artificial gravitation and closed life cycles in these craft—this stage of space exploration will be impossible without women taking part, without mixed crews.

For nature created men and women not to live apart, but for shared life and work. There is a profound moral and physical harmony in this alliance which has been tested through millennia, and it will never be broken wherever human beings settle—in the depths of the world ocean or in the 'ethereal cities' in round-the-sun orbit which Konstantine Tsiolkovsky dreamt about.

Let me emphasize that this participation of women alongside men in space work can go beyond merely membership in space crews—and already does.

Behind the few who fly in space stand thousands and tens of thousands of others whose contribution is indispensable, and their numbers already include many women. I can speak about the feminine contribution on the ground to the over-all space effort only in the most general terms, but I can say that many women—physicians, coaches and instructors—took part in preparing my own space flight.

I have seen numerous women at the Institute of Space Medicine and at the Institute of Space Research. I have met them at the plants where spaceships are assembled, have seen them busy at drawing boards, in chemical laboratories, at control panels and at individual spaceship units.

Cosmonautics as a science and an industry is as accessible to women as any other sphere of science and technology.

WOMAN'S 'WONDERFUL MISSION' AND HER PARTICIPATION IN SCIENCE AND TECHNOLOGY

After my space flight I visited many countries and continents. Everywhere, I

was given a very cordial reception, especially by women. And I was pained to see that in many parts of the world women are not given the opportunity to place their gifts, keen intelligence and sharp intuition at the service of the entire society, to contribute to the general human spiritual heritage.

Recently I read the words of Friedrich Schiller to the effect that owing to her nature and her wonderful mission, woman cannot and should not share the field of science with man. One can understand the sentiment underlying this assertion of the German poet, but nowadays the affirmation is unacceptable.

I have nothing against woman's 'wonderful mission', but I am against having this 'mission' be her only or predominant one.

Women's entry into professional work—intellectual life, if you like—began first in the human sciences and then spread to the natural sciences. Women today can—and many do—feel as much at home in the scientific and technical fields as in any other field of mental activity.

Let me briefly discuss the role that women are playing in the scientific and intellectual life of my own country. In fact, women form a majority in the sphere of intellectual activities, for they make up 59 per cent of the Soviet intelligentsia. It is worthy of mention that, in addition, there are 425 women deputies in the Supreme Soviet of the U.S.S.R.

Turning to the world of science and technology in particular, we find that women constitute 45 per cent of all the Soviet scientists and research associates and represent 80 per cent of all our medical doctors and 36 per cent of all our engineers (as well as 35 per cent of all our lawyers). In the last seven years alone, the number of women scientists in the U.S.S.R. has increased from 128,000 to about 300,000.

We have 1,300 women who have attained the very summit of their professions—those holding the title of Academician or Corresponding Member of the Academy of Sciences or professor.

I believe—and this I say in conclusion—that a woman should always remain a woman; and nothing feminine should be alien to her. At the same time, I strongly feel that no work done by a woman in the field of science or culture or whatever, however vigorous or demanding, can enter into conflict with her ancient 'wonderful mission'—to love, to be loved—and with her craving for the bliss of motherhood. On the contrary, these two aspects of her life can complement each other perfectly.

Feminine intellect and the demands of science[1]

by Eleanor E. Maccoby

It is probable that the comparatively low intellectual achievement of women in science, as well as in other fields, is based on the fact that they think differently from men. They think less analytically and so are less original, as well as less capable at mathematical subjects.

The development of the ability to think analytically is related to the development of the qualities of independence, initiative and assertiveness—qualities thought of as 'unfeminine'. While women, as a group, may be innately less aggressive and independent than men, social moulding discourages these qualities in those girls who are potential intellectual achievers. Thus, we are sacrificing feminine intellectuality to archaic and rigid conceptions of 'femininity'.

It is universally known that the intellectual achievements of women, over the course of history, rank considerably lower, in quality and quantity, than those of men.

One explanation offered for this difference is that up until very recently women have had far less access to the opportunities of education than have men. Yet even today, some forty years after the opportunities for higher education have been opened to large numbers of women, the differences persist. In the field of letters, where women are presumed to have special aptitudes, more men than women are productive, creative writers. And in the field of science the imbalance is even greater: the Madame Curies are notable by their rarity and our colleges and universities turn out but few women who become intellectually excited by a scientific research problem or who organize

1. This article is largely based on my chapter, 'Woman's Intellect' in S. M. Farber and R. L. Wilson (eds.), *The Potential of Woman*, New York, McGraw-Hill, 1963.

varied data into a new hypothesis or theory.

One index of productivity is publication. (Though this measure has some defects, it is difficult to find a better one.) One 1956 study of 400 Ph.D.s from Radcliffe College[1] showed that as a group they published considerably less than men of comparable jobs and rank; also, that half of them had published little or nothing since earning their advanced degrees. Evidently, even access to excellent graduate training did not eliminate the difference between the sexes in intellectual achievement.

What are the reasons for the relatively low level of feminine intellectual achievement?

It is reasonable to believe—and has been offered as an explanation—that woman's social sex-role is more incompatible with the life of an intellectual than is a man's. It is difficult to continue in the single-minded pursuit of a set of ideas while being a competent wife and mother —more difficult than for a man to do so while a competent husband and father. Yet it is necessary to ask whether these matters of conflicting interests and responsibilities constitute the entire explanation for women's lack of signal accomplishment in the intellectual sphere. I am inclined to think they do not.

One bit of evidence comes from the study of Radcliffe Ph.D.s already cited: the ones who had married had published as much as those who had not; this would appear to indicate that even an unmarried professional woman (who presumably is more comparable to men with respect to the non-professional demands on her time) is either under some special restraint affecting her intellectual productivity or lacks in some degree the positive motivation that would optimally affect her work.

If we examine woman's intellectual performance through a large range of her life cycle, we find other reasons for suspecting that it is not just the conflicting demands upon her time created by marriage and children that interfere with her achievement. Rather, it appears that some of the constraints upon her intellectual achievement make themselves felt long before marriage and continue to be present during those long years from thirty-five to sixty-five when the most demanding phase of child-rearing is over—the period when many men are at the peak of their productive careers.

It seems possible that these constraints may be some relevant early-formed personality traits, or even some early-established basic qualities of mind, that characterize women and that bear upon intellectual performance. Likewise, the possibility exists that innate hereditary qualities, mental and behavioural, affect woman's intellectual productivity. It is these factors that I would like to explore in this article.

SEX DIFFERENCES IN INTELLECTUAL ABILITIES

Let us review what is known about the differences in the intellectual abilities of

1. Radcliffe Committee on Graduate Education for Women, *Graduate Education for Women*, Cambridge, Mass., Harvard University Press, 1956.

the two sexes and about the development of these intellectual abilities, particularly in girls.

In attempting to determine the particular intellectual qualities of females—if indeed there are such special qualities—it will be necessary to put the stress on the ways in which the performance of girls, taken as a group, differs from that of boys, as a group. Yet let me emphasize at once that there are a great many ways in which the two sexes are alike intellectually, and also that there is a wide range of variation within either sex. This stated, let us attempt to draw a quick picture of some of the average sex differences in intellectual functioning which are reliably established.

General intelligence

The Stanford-Binet intelligence test, which was for many years the most widely used individual test, revealed few differences between boys and girls in total 'intelligence' as this test measured it. It was not widely known or understood that during the development of the test, when many items were being tried out for possible inclusion in it, items which consistently revealed sex differences were discarded from the test whenever possible. Clearly it is not possible to use a test standardized in this way to investigate the magnitude of the sex differences in intellectual function.

The same observations apply to other widely used intelligence tests. Whether sex differences are found on any particular test will depend on the items included—whether there are more items of a kind on which one sex normally excels.

In general, however, there is a tendency for girls to score somewhat higher on tests of general intelligence during the pre-school years, boys during the secondary school years. There is a possibility that the latter finding is in part a function of differential school drop-out rates: more boys drop out, leaving a more highly selected group of boys in secondary school. But some—though not all—longitudinal studies in which the same children have been tested repeatedly through their growth cycle show greater gains for boys than girls. The changes in tested intelligence that occur during late adolescence and adulthood also appear to favour men somewhat; that is, women decline somewhat more, or gain somewhat less, depending on the test used.

Verbal ability

Through the pre-school years and in the early school years, girls exceed boys in most aspects of verbal performance. They say their first word sooner, articulate more clearly and at an earlier age, use longer sentences, and are more fluent. By the beginning of school, however, there are no longer any consistent differences in vocabulary. (In interpreting such facts relative to precocity, we should remember that performance on the sorts of tests we have been able to devise for very young children does not predict very well what intellectual level the individual will ultimately reach. Furthermore, we know that girls develop physically somewhat faster than boys; this same slightly advanced time-table may apply to the maturation of certain motor and perceptual abilities that underlie intellectual performance—

but this rate of maturation doesn't necessarily imply anything concerning ultimate level attained.)

Upon entrance into school, girls learn to read a little more easily, and more boys have reading problems severe enough to call for special remedial reading programmes. But the differential between the sexes on some aspects of verbal skill soon begins to disappear. During the school years, there are no consistent differences to be found in vocabulary; and after about the fifth or sixth grade, most studies show the boys to be doing as well as the girls in reading comprehension. The girls do continue to excel in 'language' skills such as spelling, punctuation and diagramming sentences. They also excel in measures of 'verbal fluency'; for example, they write longer themes, they can think of more words with certain characteristics in a short time, and they can tell longer stories in response to stimulus pictures.

Mathematical skills

Now consider mathematical skills. It is commonly supposed that in this area men have a consistent edge over women. It may come as a surprise to you as it did to me, when I reviewed the test results bearing upon mathematical abilities,[1] to discover that the sexes do not differ consistently in the early and middle school years. Of course, during much of this time, it may be a misnomer to say that we are dealing with 'mathematical' abilities. It would be more accurate to say that the skill usually measured between the ages of 7 and 11 or 12 is skill at arithmetical computation. Children are also given some of the so-called arithmetical reasoning problems at these ages—questions about how long would it take three men to dig a basement if seven men can do it in two-and-a-half days, or how long it would take a bullet to travel from one train to another if the speeds of the two trains and the time since starting are given—and girls appear to be able to handle these questions about as well as boys.

It is not until secondary school that we begin to get quite consistent sex differences, with the boys forging ahead when they come to analytic geometry, trigonometry and algebra and doing considerably better in tests involving quantitative reasoning. By the time the Scholastic Aptitude tests are administered for admission to university or college, we find that boys score on the average as much as 50 points higher on the mathematical portion of the test, while girls are scoring only 8 to 10 points higher on the verbal, or 'language', segment.

Of course, girls do not as frequently elect to take the more advanced maths courses in secondary school, and it is difficult to know whether this is true because they lack the ability to handle the material or whether their interests lie elsewhere. The career fields which will require training in maths—engineering and the natural sciences—are primarily masculine fields, and girls may stop taking maths simply because they are preparing themselves for more feminine occupations.

1. Roberta Oetzel, 'Selected Bibliography on Sex Differences', in: E. E. Maccoby (ed.), *The Development of Sex Differences*, Stanford, Calif., Stanford University Press, 1966.

Another possible explanation exists, however: that girls may indeed more often lack certain abstract or analytical qualities of mind that are not called into play during the learning of square root, decimals, etc., in the earlier grades, and that it is not until mathematics becomes more abstract (as it does in geometry and algebra) that this particular deficiency becomes a handicap to them. At the moment, we lack definite data that would make it possible to choose between these alternatives.

Girls' characteristic difficulty with geometry, however, does probably relate to a fairly consistent sex difference that may be detected at a considerably earlier age. Throughout the grade school years, boys do better than girls on test of 'spatial' ability.

'Spatial' tests require the subject to visualize, for example, how many surfaces there would be on the opposite side of a pile of cubes—the side the viewer cannot see—or to select from an array of jigsaw drawings those that would fit together to form a designated pattern. Another element in spatial ability involves finding a simple figure which is embedded in a more complex one. Newspapers sometimes carry drawings of landscapes in which one can find animals or human faces involving the same lines that are first perceived as parts of clouds, leaves or tree trunks. The trick in finding these hidden figures is to be able to break away from the 'set' that is established by the entire drawing of the landscape—to respond only to an isolated segment of the drawing and to avoid being influenced by the momentarily irrelevant parts.

There are formal tests of the ability to perceive parts of a visual field analytically, and the results very consistently show that boys perceive more analytically, while the girls are more global, more influenced by all the elements of the field together.

One such test is the so-called rod-and-frame test, used extensively by Witkin in his studies of individual differences in underlying modes of perceiving.[1] In this test, the subject looks at an illuminated frame resembling a picture frame; within this frame is an illuminated rod, which can be adjusted through various degrees of tilt to an upright position. The subject's task is to adjust the rod so that it is perfectly vertical. Girls are consistently more influenced by the position of the frame: if it is tilted, they think the rod is upright when it is tilted to correspond to the tilt of the frame rather than when it is truly upright. Boys, on the other hand, are more able to ignore the frame and adjust the rod to the true vertical.

It is on the basis of tests of this kind, as well as the embedded-figure test, that girls have been labelled more 'field dependent' by Witkin and others.

It is interesting to note that the greater field dependence of women and girls has been found in studies of people in a variety of cultures, from Western Europe to Hong Kong.

It appears entirely possible that some of the difficulty many girls have with the kinds of analytical processes required in secondary school maths could be traced to this earlier-established difference in

1. H. A. Witkin *et al.*, *Personality Through Perception*, New York, Harper & Row, 1954.

their mode of dealing with a stimulus field.

Related to the greater field dependence of women is their greater difficulty in breaking an established 'set'. Let me illustrate what is meant by set. Suppose you were asked to say what number would come next in a series of numbers. We would begin with some easy series. For example, given the series 2, 4, 6, 8, you could easily say 10 comes next. Or after 2, 4, 8, 16, 32, you would say 64 comes next. Now try this one: 14, 23, 34, 42, 50, 59, 72, 81.... Even if you knew New York very well, you would have difficulty recognizing these as the stops on the Eighth Avenue subway, because you were set for an entirely different kind of number series. If you had not had the other two series first, you might recognize this series immediately and be able to continue it.

There are special test problems which are designed to test an individual's ability to break away from an established set, to restructure a situation for a fresh attack on it, and men do better on such tests than women.[1]

Another kind of task that deals with analytic ability and illustrates the difference between the sexes in their mode of dealing with problem materials is one developed by Kagan *et al.*[2] Subjects are given an array of pictures or drawings showing a variety of objects and people with a variety of postures, modes of dress and states of activity. The subjects are simply asked to group together the pictures that seem to belong together. Girls are more likely to form what Kagan calls 'functional' groupings. For example, they will group together the picture of a doctor, a nurse and a wheel-chair, because they are all associated with the care of sick people. Boys, on the other hand, will be more likely to form groups by selecting some detail they have in common—for example, grouping together all the pictures of people who have their right arms raised. This kind of grouping Kagan calls 'analytic' grouping, and the fact that boys do this kind of grouping more may be regarded as another instance of their tendency to break down a percept, to deal with detailed elements rather than the whole.

Creativity

There are relatively few studies comparing the sexes on aspects of creativity, and the results obtained depend on the definition of the term. If the emphasis is on the ability to break set or restructure a problem, there is a tendency for boys and men to be superior, particularly if the problem involves a large perceptual component. Breaking set is involved in the tasks used to measure 'analytic ability' and 'spatial ability' discussed above.

If creativity is thought of in terms of divergent thinking (generating a variety

1. H. Guetzkow, 'An Analysis of the Operation of Set in Problem-solving Behavior', *Journal of Genetic Psychology*, No. 45, p. 219-44, 1951; E. J. Sweeney, 'Sex Differences in Problem-solving', dissertation submitted to Stanford University, 1953.
2. Jerome Kagan, Howard A. Moss and Irving E. Siegel, 'The Psychological Significance of Styles of Conceptualization', in: J. C. Wright and J. Kagan (eds.), *Basic Cognitive Processes in Children* (*Monographs of the Society for Research in Child Development*, Vol. 23, No. 86, 1963).

of ideas relative to a problem), as distinct from convergent thinking (solving a problem that has only one right answer) the evidence appears to favour girls somewhat, although the findings are not consistent. A task requiring children to think of ways in which toys could be improved showed that, in the first two grades of school, each sex was superior when dealing with toys appropriate to its own sex, but by the third grade, boys were superior on both feminine and masculine toys. On the other hand, girls and women do better on a battery of divergent tasks measuring the variety of ideas produced for the solution of verbally presented problems.[1]

Achievement

Girls get better grades than boys throughout the school years, even in subjects in which boys score higher on standard achievement tests. In adulthood, after graduation from school, men achieve substantially more than women in almost any aspect of intellectual activity where achievements can be compared—books and articles written, artistic productivity, and scientific achievements. A follow-up study of gifted children showed that while gifted boys tended to realize their potential in their occupations and creative output, gifted girls did not. This is a most significant fact and the possible reasons for it are discussed later in this article.

How large are the group differences between the sexes discussed here? It is difficult to find a satisfactory answer to this question because of the different mathematical methodologies used in the studies concerned. None the less, the information existing does suggest that sex differences in spatial ability and in some aspects of analytic ability are substantial from the early school years on, and that sex differences in mathematical reasoning by high-school age are also substantial, while differences in verbal ability are less marked.

ANALYTIC THINKING AND INITIATIVE

I would like to suggest, on the basis of the facts presented above, that the difficulty girls have with doing high-level work in maths and science is only partly a result of the fact that these subjects are required for preparation for engineering and other distinctly masculine occupations. I suggest that girls on the average develop a somewhat different way of handling incoming information—that their thinking is less analytic, more global, and more perseverative—and that this kind of thinking may serve them very well for many kinds of functioning but that it is not the kind of thinking most conductive to high-level intellectual productivity, especially in science. (Let us be careful not to exaggerate the magnitude of these sex differences: though there are consistent differences in the averages for the two sexes, many

1. H. J. Klausmeier and W. Wiersma, 'Relationship of Sex, Grade Level, and Locale to Performance of High I.Q. Students on Divergent Thinking Tests', *Journal of Educational Psychology*, No. 55, p. 114-19, 1964; D. Tremblay, 'Age and Sex Differences in Creative Thinking Potential', paper presented at the American Psychological Association's annual convention, 1964.

women think analytically and many men do not.)

Why do some people develop more analytic modes of thought than others? So far, we are only beginning to make a research attack upon this question, but this work already seems to show some consistent trends. The key to the matter seems to lie in whether, and how soon, a child is encouraged to assume initiative, to take responsibility for himself, and to solve problems by himself, rather than rely upon others for the direction of his activities.

An early study by David Levy was among the first to suggest the importance of independence training for certain intellectual functions.[1] He studied a group of boys whom he labelled 'overprotected'. The behaviour of the mothers of these boys was extreme in the direction of 'babying' them at a late age; for example, some of the boys, at age ten or eleven, were still being dressed each morning and led by the hand to school by their mothers. These overprotected boys were quite good in their language work at school—were good readers, for example—but they were notably poor at maths.

Dr. Lucy Rau and I at Stanford University studied a group of children who were good at verbal tasks but poor at maths or space tasks and compared them with children who were good at maths or space tasks but relatively poor at verbal tasks. Dr. Elizabeth Bing observed these children in interaction with their mothers. She asked the mothers to give the children some problems and noted how much the mother became involved as the child worked on the problems. It was evident from Dr. Bing's reports that the mothers of the highly verbal girls—to discuss only the girls—were intrusive: they offered suggestions, praised the child for performing well and criticized her for performing poorly. The mothers of the girls who were best at maths or spatial tasks, however, more often left their daughters to solve the problems by themselves.[2]

Still another piece of evidence comes from some exploratory work of Witkin, Dyk, Faterson, Goodenough and Karp, who wished to discover what conditions of a child's life were associated with his being field-dependent versus field-independent on the rod-and-frame and the embedded-figures tests.[3] Through interviews with the mothers, Witkin learned that the mothers of the children who were analytic in their perceptions had given the children quite a bit of freedom to explore the environment at an early age and had tried to encourage them to do things on their own initiative. By contrast, the mothers of the children who were 'field-dependent' in their perceptions had kept their children quite closely tied to the maternal apron strings, had constantly warned them about the dangerous aspects of the environment and had been, in general, unwilling to tolerate self-assertiveness in their children.

There were many other things that characterized these two groups of mothers

1. D. M. Levy, *Maternal Overprotection*, New York, Columbia University Press, 1943.
2. Elizabeth Bing, 'The Effect of Child Rearing Practices on Development of Differential Cognitive Abilities', *Child Development*, No. 34, p. 631-48, 1963.
3. H. A. Witkin *et al.*, *Psychological Differentiation*, New York, Wiley, 1962.

as well, so it is difficult to sort out the factors that were most crucial in the home lives of the children with different modes of perceiving. Yet the relationships that I have selected to report here are consistent with our own findings and those of Levy in suggesting that parental actions which foster the independence of children and encourage them to take initiative will be associated with analytic thinking in the children and good ability in the maths-science area, while continued close control and restriction of the child will be associated with the more field-dependent, or global, modes of thinking in the child and 'poor' ability in maths.

If this is true, we must ask ourselves whether girls are allowed less independence and self-assertiveness in early childhood than are allowed to boys. We have very little evidence indeed on this point. At the moment we will simply have to consider it an unanswered question whether parents give daughters and sons a different training for independence, and whether they do so to a sufficient degree to account for the differences between the sexes in their modes of perceiving and their differential skill at tasks, such as mathematics, which seem to require an especially high degree of analytical thinking.

ANALYTIC THINKING, MASCULINITY AND FEMINITY

From what has been said so far, we begin to see that we cannot understand the intellectual performance of women and girls by studying this performance alone, for intellectual development does not occur as a kind of isolated 'unfolding' process obeying its own inner laws. Rather, it is responsive, in some degree, to the nature of the network of interpersonal relations in which the child is involved, and certain modes of thought may depend on the development of certain aspects of the person that we have previously thought of as 'personality' rather than as qualities of intellect.

Let me illustrate this point from another aspect. As you may know, the 'intelligence' of a child as it is measured by standard intelligence tests is not constant over the period from birth to maturity. Some children show progressive increases in IQ as they grow older; others show a progressive decline. There are a few centres of child-development research in the United States which have studied groups of children longitudinally—that is, they have followed the same children from very early childhood into adulthood—and it is possible to determine from their data what some of the factors are which are associated with progressive changes in children's intelligence test scores.

Sontag *et al.* at Fels Research Institute selected from their files some cases of children whose intelligence test scores consistently improved from pre-school years through age 10 and contrasted them with a group whose scores consistently declined during this period.[1] Among other questions, they asked: can one predict, from knowing something about

1. I. W. Sontag, C. T. Baker and Virginia A. Nelson, *Mental Growth and Personality Development: A Longitudinal Study* (*Monographs of the Society for Research in Child Development*, Vol. 23, No. 68, 1958).

the personality characteristics of young children, which ones will have rising and which falling IQs? The answer, they found, is clearly 'yes'.

The child at age 6, girl or boy, whose IQ will increase during the next four years is typically competitive, self-assertive, independent and dominant in interaction with other children. And the child who will show a declining IQ during the next four years is typically passive, shy and dependent.

It is most evident that the characteristics associated with a rising IQ are not very feminine ones. One of the people working on the Fels study I just mentioned was asked about what kind of developmental history was necessary to make a girl into an intellectual person. He replied, 'The simplest way to put it is that she must be a tomboy at some point in her childhood.'

Does this seem bizarre? Before we consider the implications for the raising of girls, let us see whether there is any other evidence, beyond the Fels study, for an association between the sorts of analytic thinking we have been discussing and the possession of non-feminine traits by girls. First of all, if we may consider high ability in arithmetic and maths as indicative of analytic skill (and it is known, for example, that skill in maths is correlated with ability to find embedded figures while verbal skill is not), then it is relevant to refer to a study of the autobiographies of a few famous women mathematicians, done by Plank and Plank.[1] This study revealed that women mathematicians had one important element in common: they all described an unusually close relationship in childhood with their fathers, rather than their mothers, and they attempted to pattern themselves on their fathers.

Related to this is the finding of Bieri and his colleagues, who devised measures to determine the degree to which a group of college women had identified with, or patterned themselves upon, each of their parents.[2] They found that women who were especially good at finding the hidden figures in the embedded-figures test were more strongly identified with their fathers than their mothers, while the reverse was true of the women who were relatively poor at solving such problems.

The women in this study were also given a test designed to measure their acceptance of authority. Those who were good at solving the embedded-figure problems tended to be low in acceptance of authority, another indication of the importance of autonomy on the development of this particular kind of analytic thinking.

In still another study, college students were given problems to solve, many of which required breaking of set, or 'restructuring'.[3] For both sexes, the students who were most skilful at problem-solving were

1. Emma H. Plank and R. Plank, 'Emotional Components in Arithmetic Learning as Seen through Autobiographies', *The Psychoanalytic Study of the Child*, Vol., IX, New York, International Universities Press, 1954.
2. J. Bieri, 'Parental Identification, and Within-sex Differences in Cognitive Behavior', *Journal of Abnormal and Social Psychology*, p. 76-9, 1960.
3. G. A. Milton, 'The Effects of Sex-role Identification upon Problem-solving Skill', *Journal of Abnormal and Social Psychology*, No. 55, p. 208-12, 1957.

those who scored at the more masculine end of personality tests designed to measure masculine versus feminine traits.

Finally, our own work at Stanford, in which we selected groups of fifth-grade girls who were especially good at arithmetical or spatial tasks, revealed that: (a) the girls who did better on spatial problems than on other kinds of problems were somewhat more masculine and aggressive than other girls with similar total IQs and rather withdrawn from social contact with their age-mates; (b) the girls whose area of greatest competence was numerical tasks were popular with their class-mates, largely because they were accepted as being highly competent in planning and organizing. According to their own report, these girls were also less likely than others of similar IQ to ask their parents for help when they encountered difficulty in solving a problem. When the girls were observed in interaction with their mothers, it was the girls who were especially good at verbal tasks who most often asked their mothers for help; the girls who were best at either numerical or space tasks tended to work on their own.

Thus we see that these girls not only were characterized by greater independence while working on problems but also possessed some traits we think of as being more characteristic of boys: aggressiveness in the case of the high-space girls, dominance in the case of the high-number girls.

While this article is concerned particularly with the feminine sex, it is interesting to note that a number of studies indicate a correlation between high intellectual ability in boys and the possession of what are commonly considered as 'feminine' qualities.

'Masculinity' and 'femininity' have been measured in a number of ways. Some of the standard measures have a single scale running from masculine to feminine. Others measure masculinity and femininity independently, so that it is possible for an individual to score high on both measures if he possesses traits commonly labelled as characteristic of the two different sexes. Using the latter kind of measure, Roberta Oetzel found that among fifth-grade boys, total scores on the PMA test[1]—a measure of total intelligence—were positively correlated with femininity and slightly negatively correlated with masculinity. In other words, the brighter boys were considerably more feminine and slightly less masculine than their less intelligent peers. Among girls, however, total PMA scores were slightly positively correlated with both masculinity and femininity. This means that the high IQ girl is likely to be dominant and striving (characteristics labelled 'masculine'), but she may also act more 'grown-up' and be more anxious to do things for other people than her less intelligent peers (behaviours normally classified as 'feminine').[2]

Oetzel's study investigated sex-typing among groups of 11 year-old children with uneven profiles of abilities, and she found that the children who were more skilful at spatial tasks than verbal

1. Primary Mental Abilities test, containing separate subtests for different abilities, such as verbal, numerical, spatial and reasoning ability.
2. Roberta Oetzel, 'The Relationship between Sex Role Acceptance and Cognitive Abilities', unpublished master's thesis, Stanford University, 1961.

or numerical tasks tended to be low in masculinity if they were boys, high in masculinity if they were girls. This trend was confirmed in a study with the Fels longitudinal sample.[1] The low masculinity of boys who tested high on spatial ability is especially notable in view of the fact that boys normally score higher on space tests than girls do.

Both Barron and MacKinnon report that men who are outstanding in originality or creativity score more toward the feminine end of a single M-F scale than do their less creative counterparts.[2] This difference, they say, reflects a greater breadth of interests among creative men: such men have aesthetic interests, for example, and these are usually included as feminine indicators on an M-F scale because women are, on the average, more likely than men to have strong aesthetic interests.

The studies cited thus indicate that analytic thinking, creativity and high general intelligence are associated with cross-sex-typing, in that the men and boys who score high are more feminine, and the women and girls more masculine, than their low-scoring peers of the same sex. While there are a few exceptions in the literature to this generalization, the weight of evidence does support it.

It is important to note, however, that this cross-sex typing does not imply that intellectual individuals are sexually uninterested in, or unattractive to, the opposite sex. It merely means that they share more of the interests and activities normally characteristic of the opposite sex.

SOCIAL MOULDING OF FEMININE INTELLECT

It would appear, then, that what evidence we have indicates that girls who do well at the various kinds of analytic thinking we have been discussing are not very feminine creatures, at least not according to the standards our present society sets for feminine behaviour.

Studies of girls have repeatedly shown that they develop early a greater interest in other people, and in what other people think of them, than do boys; they tend to be more influenced by the opinions of others, and they are more conforming to what they perceive to be the social demands of the situations they are in. It is probably these conformist tendencies that help them to excel at spelling and punctuation—the kinds of performance for which there is only one socially prescribed right answer. But for higher-level intellectual productivity, it is independence of mind that is required—the ability to turn one's back on others at least for a time, while working alone on a problem—and it is just this which girls, from an early age, appear to find so difficult to do.

But of course, this is not true for all girls. So it is interesting to consider now what happens to a little girl who at pre-school age does have the qualities that

1. Eleanor E. Maccoby *et al.*, unpublished report, Laboratory of Human Development, Stanford University, 1963.
2. F. Barron, 'Originality in Relation to Personality and Intellect', in: *Journal of Personality*, No. 25, p. 730-42, 1957; D. W. MacKinnon, 'The Nature and Nurture of Creative Talent', *American Psychologist*, No. 17, p. 484-95, 1962.

could make her into an analytic thinker. She is full of curiosity, likes to explore things, is dominant and independent, probably likes to play with boys and wear blue jeans, and isn't especially interested in dolls. Assuming that her parents have been tolerant of her temperament, what takes place when she enters school?

One of the first blows is that the boys won't play with her any more; they form their own exclusive play groups, and she must fall back upon the company of girls. In many ways she is made to discover that she is not behaving as girls are expected to behave, and the disapproval she encounters generates a certain amount of anxiety.

This may sound like pure speculation, but there is some evidence that this is the course that development does take in girls who start out as tomboys. Sears traced the development of aggression, and anxiety about aggression, to be between the ages of 5 and 12.[1] The boys who were most anxious about aggression at age 12 were the ones whose parents had forbidden fighting when they were younger; at the age of 5 they had already become fairly unaggressive children. The girls who showed most anxiety about aggression at age 12, however, were the ones who had been fairly aggressive at kindergarten age. What is important for our present discussion is this: that the ones who showed the most of this kind of anxiety in middle childhood were the ones who had been trained in ways inappropriate to their sex in pre-school years.

In most American homes, the mothers assume a larger role in the discipline and caretaking of daughters, and the fathers in that of sons. However, the girls with high aggression anxiety levels in middle childhood had received an unusually high amount of both discipline and caretaking from their fathers. Furthermore, they had been encouraged to fight back when attacked by other children in the neighbourhood—an encouragement which is more often reserved for boys in the American culture. We see, then, that these girls were being to some degree masculinized in early childhood, and we can only assume that it was at least partly the social disapproval they encountered over their unfeminine behaviour that produced the anxiety they later manifested.

Social disapproval can have even more direct effects on the expression of feminine intellectuality, by affecting the will to try.

While the evidence is not clear as to whether boys or girls have a higher correlation between ability (as measured by IQ tests) and achievement, there are some indications that boys lead in this. One 1960 study of seventh-grade children, for example, found the correlation between ability and achievement to be higher for boys. Then, Coleman, in 1961, reported that among secondary-school students who were named as 'best scholar' the boys had higher IQ scores than the girls, despite the fact that the girls in the general population studied had higher average IQ scores.[2] He suggests that girls of this age

1. R. R. Sears, 'Relation of Early Socialization Experiences to Aggression in Middle Childhood', *Journal of Abnormal and Social Psychology*, No. 63, p. 466-92, 1961.
2. J. S. Coleman, *The Adolescent Society*, Glencoe, Ill., The Free Press, 1961.

are caught up in a 'double bind'. They wish to conform to their parents' and teachers' expectations of good academic performance, but fear that high academic achievement will make them unpopular with boys. As a result of these dual pressures, Coleman suggests, the brightest girls do creditably in school but less than their best. On the other hand, the brightest boys feel free to excel in scholarship and do so in fact.

Matina Horner has recently come to similar conclusions, based upon studies with intelligent college-aged men and women.[1] The subjects in her studies are asked to tell a story based on a 'clue'. For the women, one clue is: 'After first-term finals, Anne finds herself at the top of her medical school class.' A similar clue, but this time about John being at the top of his medical school class, is given to men. Men show few signs of conflict over success in the stories they write to this clue. Women, however, quite often manifest what Horner calls a 'motive to avoid success'. They say such things as that Anne is hated, that she is an unattractive bookworm, or that she lowers her performance on the next exam so that her boy friend can do better.

Horner also finds that in working on standard achievement tests, women do best working alone, and much worse when competing against men. Men, however, do better when competing against either sex than they do alone.

Many girls, in other words, are prevented from trying to do their best, particularly in competitive situations, by the belief that they will be seen as unfeminine.

A study following up a group of gifted children to determine what becomes of them in adulthood disclosed that, for girls, there was no relationship between IQ as measured during the school years and the level of subsequent achievement in their adult occupations; for boys there was a good correlation.

There is also evidence that girls who are under-achievers in secondary school usually begin to be so at about the onset of puberty. This is a further indication that the achievement drop-off among girls as they reach maturity is linked to the adult female sex role—to finding a mate and marrying.

Let me link up these findings with our present concerns with woman's intellect. Suppose a girl does succeed in maintaining, throughout her childhood years, the qualities of dominance, independence and active striving that appear to be requisites for good analytic thinking. In so doing, she is defying the conventions concerning what is appropriate behaviour for her sex. She may do this successfully in many ways, but I suggest that it is a rare intellectual woman who will not have paid a price for it: a price in anxiety. And this anxiety can do more than affect a woman's emotional life and personality; it can also have repercussions on her intellectual activity.

We are beginning to know a good deal about the effects of anxiety on thinking. It is especially damaging to creative thinking, for it narrows the range of efforts to find solutions to difficulties,

1. Matina A. Horner, 'Fail: Bright Women', *Psychology Today*, November, 1969, p. 36.

interferes with breaking set, and prevents scanning of the whole range of elements open to perception. When anxiety facilitates performance, as it sometimes does, it facilitates already well-learned tasks, but it is antagonistic to breaking new ground.

INTELLECTUALITY AT THE PRICE OF FEMININITY?

From the standpoint of those who want women to become intellectuals, the above is something of a horror story. It would appear that even when a woman is suitably endowed intellectually and develops the right temperament and habits of thought to make use of her endowment, she must be stout of heart to resist society's pressures and remain a whole and happy person while pursuing her intellectual bent.

For parents and educators who are charged with the responsibility of raising and training girls, the requisites for intellectual development in girls appear to pose something of a dilemma. Shall mothers encourage whatever tomboy tendencies they find in their young daughters? Shall teachers attempt to free girls from the emotional involvement with others that helps to make them so tractable in the class-room?

I do not mean to imply that the concerted efforts of parents and teachers together would necessarily serve to make girls just like boys intellectually. I think it is quite possible that there are genetic factors that differentiate the two sexes and bear upon their intellectual performance, other than those having to do with what we have thought of as innate 'intelligence'. For example, there is good reason to believe that boys are innately more aggressive than girls—aggressive in the broader sense, not just as it implies fighting, but as it implies dominance and initiative as well. If this quality is indeed one which underlies the later growth of analytic thinking, then boys have an advantage which most girls, being endowed with more passive qualities, will find difficult to overcome.

Yet it appears likely that the way children are dealt with by the adults responsible for their care, and the social roles girls know they are preparing themselves for, also have a major bearing on whether girls will develop the characteristics that will be conducive to the growth of higher-level intellectual skills.

In so far as child training does have an influence, parents and educators have some difficult value judgements to make. What kinds of women do they want to produce? Do we want to encourage intellectuality in women if it must be done at the expense of femininity?

We appear here to be caught in another double-bind. Yet need it be so? May not there be some other alternative? Could not our current definitions of the feminine woman and girl undergo some revisions without any damage to the essential functions of woman? Does a woman really need to be passive and dependent in order to be sexually attractive to men, or in order to be a good mother? Could we not accept and encourage the active, dominant, independent qualities of the intellectual girl without labelling her as masculine, while encouraging in her whatever aspects of femininity

are compatible with an analytic quality of mind?

I recognize that I am raising some controversial and intricate issues here, for the social and economic role of woman is by very necessity a dependent one during her child-bearing years. But these years have become a much smaller segment of her life span than they once were. I ask whether our whole definition of femininity should be such as to prepare a woman only for this short segment of her life.

The possible biological origins of sexual discrimination

by Lionel Tiger

Why is it that in the vast majority of societies men run the show and women are relegated to the smaller domain of the household, that men are almost universally the aggressive and dominant ones and women the passive and dominated? Is it purely because of the persistance of tradition?

From indications found in the group life of non-human primates, our nearest animal relatives, Professor Tiger suggests that the Darwinian law of species survival evolved large, dominant males, forming strong bonds with other males which helped in organizing and managing the community, and evolved females oriented towards the propagation and stabilization of social structures.

THE BIOLOGICAL BASIS OF BEHAVIOUR

For too long many social scientists have paid inadequate attention not only to the work and thought of behavioural biologists but also to the biological aspects of human behaviour. Sociologists, political scientists and economists have used a model of man in which biological factors were unimportant, or at least residual; no ready means of assimilating information about other living systems than the human has been available to researchers into human social action.

It thus remains the case (though this will change rapidly in the next decade) that undergraduate and post-graduate students in the social sciences almost never are required to demonstrate any serious proficiency in biology. Though they may be subjected to an immense and sophisticated burden of methodological and mathematical instruction and they will learn very well indeed how to collect and handle data, they are hardly likely

to learn what data to gather in the first place—in the sense that students of other animals are guided by biological principles to determine what behaviour patterns and what events in the lives of animals reflect a species' central problems, concerns and adaptations.[1]

One serious social and scientific consequence of this is that—as usual—women have suffered particular deprivation. Because of the blurring of biological distinctions, even the categories 'maleness' and 'femaleness' have been inadequately treated—perhaps much less than the less significant and less provocative categories 'rich' and 'poor'. The overt and surprising reason for this is that it has been tacitly assumed that in all spheres except the explicitly reproductive males and females are much the same. To suggest otherwise implies biases of a quasi-racial kind. Moreover, there was also an implication that female equality in practice might be eroded by the assumption of female difference in theory.

My argument in this essay is that it is necessary to see biological factors as of prime importance in discussing maleness and femaleness. This involves understanding human evolution, human neurophysiology, cross-cultural regularities—in general, the biological infrastructure of human social relationships. Knowing as we do the importance of socio-sexual differences in many mammalian reproductive systems, perhaps it will not surprise if, employing this perspective, we learn that we are a species boasting considerable male-female differences which extend and ramify more widely through our human societies than many of our theories of socialization, organization and action in general would have us recognize and predict.

In this brief essay I want to comment about differences in male-female social organization. The suggestion is that, not unreasonably, these social differences bear relationship to biological realities of the human species which in turn are functions of human evolution and of a particular set of primate adaptations; these adaptations include both those uniquely our own and those we share with some other primates (with whom we find we share behavioural characteristics, just as earlier we were surprised to find that we share significant physical ones). The broad outlines of the argument are more fully presented in my book *Men in Groups*;[2] here, I want to discuss the significance this argument may have for our social theories and action.

In essence, the position derives from the following set of ethnological observations and theories. The behaviour of animals evolves just as physical structure does, and both structure and function (which is a systematic way of saying behaviour) reflect animals' evolutionary adaptation to their material and social environments. This adaptation is always mediated by processes of sexual selection which Darwin first explicitly described. The social behaviour of animals is, hence, not altogether sudden. It is not, in other words, only the expression of particular

1. For an American illustration of this point see: 'Written Doctoral Examinations in Sociology at Some Leading Universities', *The American Sociologist*, Vol. 4, No. 3, August 1969, p. 189-226.
2. Lionel Tiger, *Men in Groups*, Random House, New York; Thomas Nelson, London, 1969; Robert Laffont, Paris, in preparation in French.

local and ephemeral circumstances. Even relatively complex social propensities can be programmed genetically—just as the extraordinarily complex life cycle, for example, is programmed by genetic codes and finds its expression in a reciprocity between the particular 'programmed energy' of an organism and the concatenation of habits, practices, situations and likelihoods which is a social culture.[1]

As far as humans are concerned, the problem of isolating genetically determined, behaviour patterns is magnified because we are fond of creating elaborate and sometimes secretive social systems.

HUNTING, THE MASTER PATTERN

It could be said that our most elaborate biological adaptation is to create culture. But if culture is our most complex concoction, it remains unchallenged by anthropologists and biologists that hunting is the master pattern of the human species. It is the organizing activity which integrated the morphological, physiological, genetic and intellectual aspects of the individual human organisms and of the population who compose our single species. Hunting is a way of life, not simply a 'subsistence technique', and it involves commitments, correlates and consequences spanning the entire biobehavioural continuum of the individual and of the entire species of which he is a member.

'That man achieved a worldwide distribution while still a hunter reflects the enormous universality of this kind of behavioral adaptation . . . he practiced hunting for 99 percent of his history. . . .'[2] In other words, our practice of hunting was the infra-structural condition of our specialized evolution, and though it is tempting to see in this only a confirmation of theories of human bloodiness and evil, it remains the case that hunting was a co-operative activity and that in the acts of pursuit and slaughter there was selective advantage to those individuals able to work together, attuned to each others' needs, resources and states, and willing to mould their individual behaviour to the collective pattern of the group.[3]

The critical subordinate section of this argument (for our purpose here) is that hunting was an all-male enterprise and that just as there was selection *for* co-operative hunting males, there was selection *against* both those females willing to hunt and those males agreeable to female participants in their hunts. The reasons for this proposition depend on a variety of individually disputable bits of evidence. But their over-all implications seem to point forcefully in the direction of an increased differentiation of male-female behaviour through evolution at the same time as there was probably a decreased physical differentiation.

Of course, differences in running methods, throwing skills, temperature

1. For a succint description of these principles, see: Konrad Lorenz, 'The Evolution of Behavior', *Scientific American*, December, 1958.
2. William S. Laughlin, 'Hunting: An Integrating Biobehavior System and Its Evolutionary Importance', in: R. B. Lee and E. I. DeVore (eds.), *Man the Hunter*, p. 304, Chicago, Aldine, 1968.
3. A recent discussion of this form of co-operation is by Robert Bigelow, *The Dawn Warriors: Man's Evolution Toward Peace*, New York, Atlantic-Little, Brown, 1969.

adaptability, effects of physiological changes, etc., were clearly both the cause of and the effect of differentiated hunting experience. At the same time, the intriguing hypothesis remains that an important feature of this behavioural differentiation was the development of differing interests in and capacities for social bonding. Just as selection for reproduction operated by establishing and consummating bonds between males and females (and this was broadly programmed—for example, to follow puberty), so selection as a result of hunting depended on the readiness of the organisms concerned to form male-male bonds for these purposes while at the same time rejecting male-female ones during the hunting period. Presumably this applied too during those preliminary and celebratory-recriminatory events which were probably essential to the prosecution of strenuous tasks involving considerable technical and co-operative skills.

The fact that we have been a hunting species for probably one million years and possibly up to 26 million underlines the significance of this hypothesis of male-male linkages for the establishment of species-specific patterns of behaviour. These must remain influential today, if only as parameters in terms of which the force and effect of the patterns may be altered or vitiated by cultural factors and by the existential circumstances of particular individuals.

BIOLOGICAL DETERMINATION OF WOMEN'S ROLE

But what has all this to do with women today?

At one level the role of biology in constraining the lives of women is obvious. Reproduction involves pregnancy and at least a short period of commitment to highly demanding offspring whose physical needs are not only inconsiderately recurrent but also who make psychological claims on mothers' time and energy. These claims can be avoided only by: (a) inadequate mothering, whose effects on the entire life span of the offspring we are now beginning to appreciate not only from data on humans but in essence from such studies on non-human primates as the Harlows'; (b) by a system of servants which relieves mothers of many of the burdens of rearing children (but not of having and dealing with servants); (c) a communalized system of child-rearing ranging from the kibbutz to a system of crèches and day nurseries—the economic rationale for this, however, is not only to make it easy for women to have children but to make it possible for them to work in the economy more directly than as managers of private households and mothers; and finally (d) a cultural system in which children are raised by kin of either mother or father (social or biological) but in which, in any event, women do raise children at various points in their lives, even if these are not their own offspring.

This much is obvious, and though societies respond in various ways to the problem of aiding and mollifying the stresses of child-rearing, it remains the case that this process constitutes a real (if widely approved) impediment to following the same career pattern as men. A number of communities have provided for this by offering facilities for mothers

which allow them time off from work—either on a short-term or long-term basis—opportunities for retraining after an absence, the maintenance of pension and other rights, etc., and the retention of 'equity' in a career line in an organization, industry, or in the community at large. Despite these provisions, however, females typically constitute a more floating segment of the labour market, work at lower rates of pay and in lower-level positions, and are more likely to be dismissed by organizations retrenching their personnel.

In general, it remains the case that females, in virtually every society, are to a large degree excluded from positions of power and substantial reward. They are clearly subdominant and even where they are educated as well as males and possess equal economic resources, they fail to achieve posts, properties or honorific awards in any degree comparable to those of males. Moreover, they find themselves largely outside the major political, economic and military decision-making processes of our time.

Of course, this is not to recommend this situation, but to identify once again the gap between the ideology of sexual equality and the reality of an only tentative and sporadic movement to this equality.

My point is that the reason for this hiatus between wish and reality is not simply the result of male churlishness, chauvinism or fear. Nor is it similar to the differences between the privileges and opportunities of different economic classes or races in stratified societies. Nor is it solely the result of a coercive process of socialization which condemns disadvantaged females to live equably and with misguided self-satisfaction. Simple-minded though it may seem, perhaps the difficulty females have faced arises in good measure because the rhetoric and the dream of equality have allowed communities to avoid coming to terms with real differences between the sexes—differences which go beyond the explicitly reproductive, and which have to do with the conduct of social affairs on even its most abstract and complex levels.

To help understand this suggestion in its proper context, it may be useful to look briefly at the social behaviour of other primate males and females, bearing in mind that we are primates ourselves—though different from all the others—and that it is possible that we share some ancient core patterns of 'genetically programmed behavioural propensity' just as we clearly have in common certain evident physical structures and processes.

PRIMATE SEX BONDS AND GROUP STRUCTURE

An obvious feature of primate behaviour to which primatologists pay attention early in their research is male-female differentiation. In some species there is relatively little, except for the bearing and immediate rearing of children. This is particularly so among arboreal creatures for whom the problems of defence are more easily solved by fleeing up a tree than by generating defensive social organization. On the other hand, among terrestrial groups such as the south African baboon, the demands of defence on the savannah have led to the evolu-

tionary selection of males about twice as large as females, with large jaws and sharp canines, and in general physically equipped to defend the females and young of their communities.

A correlate of these defence patterns—which so far as we know involve males only—is that the males, both the dominant ones and the sub-adult ones, form 'bonds'—groups in which the individuals regard themselves as more significant to each other than to non-bond members. These are, in a real sense, 'personal' relationships, as distinct from aggregation-type encounters in which there is no real element of choice.

What is fascinating about these male bonds is that they seem to be associated with political dominance. This is, in turn, directly linked with the dominant males having the greatly preponderant sexual access to œstrus females. Thus, there is the clear implication that selection of males willing and able to form bonds with other males is a constant feature of these primates' reproductive function.

This introduces quite a new element into the whole matter of social bonds and their relationship to reproduction. Not only does a male animal have to want to and be capable of consummating an encounter with a fertile female, but to reproduce himself he must also be able to engage in relatively very long-term and elaborate social relationships with several other males. Though sub-adult males do form weak bonds (rather like human boys' gangs—and, as in the human, there are no female gangs), only dominant adult males seem to be able to form these with political effectiveness. The subdominant males appear to be incapable of forming strong bonds because even four or five of them are unable to combine to overthrow the leadership of the two or three dominants from whose bonds a great deal of super-individual power is generated.

Thus a picture emerges from generalizing about the terrestrial primates; it features the importance of bonds among males for the process of selection. An additional point of equal relevance is that the stability, order and defence of the community depend on the male-bonded individuals: politics and reproduction are closely linked. *Hence the Darwinian processes of natural selection involve a combination of sexual competence with females and social competence with males.* This in turn appears to stabilize communities, provide models for the young males, and seems, indeed, to conduce to the 'health' of females as well as dominant males.

(In one as yet unpublished study, it is noted that in a group of rhesus monkeys in which there was no male, the females were incapable of 'governing' the group and social tension and disorganization were constant. The introduction of but one adult male into the group corrected the situation immediately, and a more normal political and social pattern quickly returned.)

What is relevant in all this to our concern here is that primate females seem biologically unprogrammed to dominate political systems, and the whole weight of the relevant primates' breeding history militates against female participation in what we can call 'primate public life'.

This is not only to say that female primates have no social bonds. Of course

they do. First of all, they form intense bonds with their offspring and this bond is as crucial to group survival as the male-male bond seems to be.

Moreover, as we get more and better data about primate life it becomes clearer that there is something similar among some primates to 'kinship systems' among humans.[1] Particular individuals born of certain females recognize certain inter-generational relationships between each other, and in terms of the group as a whole there is a tendency for the offspring of high-status females to become high-status themselves. Rudimentary but functioning 'class structures' then appear to arise—not in connexion with any particular property or other resource but in terms of social relationships themselves.

That the young of dominant females should be more competent, more confident, and more capable of approaching the dominant males on whom 'advancement' depends, should not surprise us altogether. But that this is also a function of rather elaborate group-kinship structures suggests that even such complex patterns as these may be broadly rooted in a biological foundation and that the contribution of females to these systems is meaningful not only for their offspring but for the entire group and—presumably for the species as a whole.

Further, that this female participation seems to tend toward the formation of stratified rather than egalitarian communities must be an item to consider among those schools of thought which are based on the broad belief that more primitive states of society—such as animals enjoy—are open and pleasant by comparison with human ones, and that the contribution of females to social procedures must be generally wholesome, egalitarian, and contrary—so runs the diagnosis—to the dismal and unhappy hierarchical structures which males create and endlessly refine.

THE GENETIC FOUNDATION OF MASCULINE DOMINANCE

Let us return to the human case directly. In humans the bonding propensity of males—if it exists—would have been given an additional evolutionary emphasis by the function of hunting. It is important to remember that among non-human primates there is little if any differentiation between the sexes in the food-gathering activity. This is crucial, because if hunting in the human species was for males only, then a pre-existent male bonding pattern which we might have inherited along with the primates may have been strongly and unambiguously accentuated by our special human innovation of co-operative hunting. In other words, while in other primates the sexual division of labour had chiefly to do with defence and politics, in the human case this was expanded to include economics too, and herein may lie some of the resistance which human communities appear to show still to even the most sophisticated and ardent efforts to achieve sexual equality.

Every human community displays some sexual division of labour. The

1. Vernon Reynolds, 'Kinship and the Family in Monkeys, Apes and Man', *Man*, Vol. 3, No. 2, June 1968.

allocation of tasks may vary enormously. In one society a particular job will be for men and in another the same job for females. Some jobs will be done by both. But the significant regularity is that there is always some distinction between male and female work for some jobs and on some grounds. Sometimes these are linked to obvious physical factors: they involve speed, danger, muscular strength, etc. None the less, there is often no technological justification for the sexual distinction, and one is driven to the conclusion that the pattern of sexual division of labour may relate not only to real differences in skills, aptitudes and interests, but to a core pattern of the human primate: that in some circumstances, particularly those defined as dangerous, important for the community, or involving matters of high moment, males will exclude females from their groups and engage in male bonding undisturbed.

That this may be both a deliberate and an infra-social, broadly unconscious pattern—in the same sense as the male-female bond, based on sexual attraction and reproduction, is both conscious and infra-social—underlines the difficulty of doing something about this; it aggravates the difficulty of knowing precisely how to go about obtaining female equality in the labour, political, and associated spheres.

In other words, I am suggesting that a species-specific pattern of *Homo sapiens* is the creation of particular bonds between males, that these bonds are intrinsically related to political, economic, military, police and other similarly power- and dominance-centred social subsystems, that equal female colleagues—even one—could interfere with these bonding processes, that one reflection of this principle is the constant division of labour by sex, and that while conscious social management of these processes may of course alter or reverse them, the propensity to behave in this way will continue to manifest itself in each new generation until genetic change 'breeds it out'—a process which even under current circumstances is very improbable in any foreseeable future.

Of course, all this is impossible to prove in the sense that an exact and reproducible cause gives rise to an exact and reproducible effect. However, biologically speaking, a species is an experiment without a control group—except in so far as it bears systematic and acceptable comparison with other species[1]—and in the human case we can use cross-cultural data to point toward items of behaviour which are common to all cultures, thus species-specific, and those which are clearly culture-specific. Hence, I have argued that the ubiquity of the male dominance and female exclusion patterns which can be identified is a serious indication of the possibility that these patterns may originate in our genetic codes, and in the interactions between genetic code and social group and particular circumstances in which individual codes work themselves out.

It should not surprise us that maleness and femaleness as biological categories have elaborate effects on even complex technologically based behaviour. Both are clearly biological features of the core

1. Niko Tinbergen, 'On Aims and Methods of Ethology', *Zeitschrift für Tierpsychologie*, Vol. 20, No. 4, 1963.

of individual beings, and while there are many similarities between males and females, it is scientifically parsimonious to attend to the possibility that behavioural differences in other spheres are as significant as those in the reproductive.

At the outset of this essay I suggested that social scientists have paid inadequate attention to biological science and noted that this was particularly marked in the matter of male-female differences. It may be of interest to try to overcome this inadequacy and try to follow out some of the consequences of a revised view of control-by-genetic-process of broad social patterns and particularly of the effect of genes on the situation of women as well as on our attitudes.

HOW THEORETICAL EQUALITY CAUSES FACTUAL INEQUALITY

My basic proposition takes the form of a paradox: that the understandable and universally acceptable notion that males and females are equal and should have all equal rights of law, economy, politics, etc., has contributed to the practical inequality of females.

Theoretical sexual equality has forced rejection of any concern about sexual differences. The practical result of this has been the continued deprivation of females and the slowing-up of a process of opening opportunities to women in present structures, of changing the structures and of adding new ones to accommodate women. At the moment, it is women who must accommodate themselves, and they are being asked to compete with men in male-oriented institutions. The net result of this is their continued deprivation and a recently increased resentment and anxiety.

A number of obvious examples come quickly to mind. A variety of researches have confirmed what many other less-sophisticated communities have known all along—that the female menstrual cycle has some appreciable and predictable effects on female social, psychological and even technical behaviour. Crime rates, industrial accident rates and incidence of illness, for example, have been correlated with the regular cycle.

A recent report by K. Dalton of the University College Hospital, London, reveals that young women writing examinations are affected by as much as 14 per cent by the time of their cycle at which they undertake some tests. The implications of this simple finding are of course enormous. For example, persons wishing to enter graduate school in the United States of America must take special examinations on a national standard. Should a woman write these during her low-performance time, she begins with virtually a second-class result and the work of her previous years in the educational system and her own personal qualities and skills may be severely devalued. In good part this is because she participates in a system which does not formally recognize her femininity, admitting that it may be the cause of changes in behaviour or performance of direct pertinence to the educational system which has so expensively provided her the opportunity for seeking graduate training.

The same effect will operate less dramatically but with persistent consequences

throughout a young woman's educational career; it must also retain its impact during her functions in some job. This can become serious, not only for the individual woman's well-being and occupational success, but for the clients of her particular service or effort. The effect will be more clearly exposed as women increasingly perform tasks involving the exercise of technological judgement upon which depends the safety of other people. The relationship of the cycle to motor-car accidents has been pointed out; it seems inevitable that should women become airline pilots it will be necessary for their work schedules to conform to their biological rhythms—not because accidents are inevitable, but because they become somewhat more likely and hence a risk subject to control by conscientious managers.

Now, the writing of examinations and the flying of airliners are two rather extreme contrasts. But in both cases there is sufficient suggestion of the effects of the male-female difference on performance for sensitive communities to consider ways of mitigating the consequences of these for individual females and for the community at large. It seems likely that communities willing to take these factors into account will respond more suitably and immediately to situations involving real danger and the use of expensive artifacts such as aircraft and heavy industrial machinery.

The subtler and less tangible matter of scheduling educational, commercial, and other activities to take individual women's cycles into account seems much less likely to be implemented easily. Perhaps the two outstanding reasons for this are: (a) to do so would be to recognize formally and overtly real differences between males and females—something which communities have in a curiously successful and tenacious way managed to avoid doing, in the name of the ethic of equality, and (b) there appears to remain a widespread taboo of more or less severity against the formal statement by both men and women of the fact and occurrence of menstruation, though this depends on the attitude of the community involved, of course. It is not clear to what extent this is a function of females' desire to maintain some privacy in this respect, or of males' resentment and perhaps even fear of a process.

A study using the Human Relations Area Files by Young and Bacdayan describes an unusually bizarre correlation between political authoritarianism and the strength of taboos against various degrees of contact with menstruating females.[1] This suggests that there is considerable variation in this matter (as in any other) between communities and among individuals. It also portends that communities with relatively liberal political attitudes may be more likely to openly acknowledge the existence of the menstrual cycle and cope with its consequences. Yet, at the same time, in some such liberal communities—United Kingdom, the United States and Canada, for example—there is a particular reluctance to deal with such a female-specific matter as the cycle. Perhaps this is indeed for the first reason given above, namely that

1. F. W. Young and Albert A. Bacdayan, 'Menstrual Taboo and Social Rigidity', *Ethnology*, Vol. 4, No. 2, April 1965.

such an expression of difference might be construed as an expression of inferiority.

The particular reason for stressing the effect of menstrual cycling on work performance is that it is both relatively clear-cut and an excellent example of the general fact that the work patterns of industrial communities in particular are male-oriented. The 7-to-9-hour 5-to-6-day pattern of work of course represents the densest and apparently most efficient way of organizing the time of individual employees.

My point is very simple: were work adjusted to female propensities, as it is now to those of males, a more humane and effective 'fit' between system and individual could follow.

The same principle applies to the relationship of working mothers and children. It is customary that those employees with full privileges are full-time employees. Again, this is defined in male terms. However, there is no special reason, beyond habit, inertia, the reluctance to face complexity, etc., why mothers cannot be treated as full-time employees with full privileges—in proportion to their contribution—even if they work only a few hours a week, or one or two days, or three half-days, or according to any other arrangement which permits them to spend as much time with their young as they regard to be necessary, while participating in the wider tasks available in paid employment.

At the moment, in technologically elaborate communities it is chiefly the unpaid volunteer lady worker who is permitted a flexible participation in the socio-economic network. If such arrangements can be made for volunteer employees, it is not inconceivable that they can be made, too, for paid employees. This is not to say that no part-time job possibilities are open to females, for of course there are. But such employment is always secondary in importance and individuals are discouraged from seeing their work as part of a continuing career; the very fact of their responsibility to their families permits them only a partial commitment to their employers.

The same comment applies to phasing of female work over years as well as days. The community spends great sums of money educating women to undertake jobs which the rigidity of its own structure makes it difficult for them to assume and maintain should they wish to bear children and spend considerable periods of time with them for several years or until they enter school. Similar problems of pension rights, seniority, retraining, and continuity arise for the mother whose working career is interrupted as for the part-time worker.

It is curious that at the same time as various organizations and governments claim difficulty in attracting and retraining committed and competent skilled employees, systematic and seemingly insurmountable barriers are placed in the way of the largest single pool of available personnel to fill these posts. And not only do the pertinent organizations themselves lose, but so does the community in general because of the resentment, confusion and conflict of loyalties between past training and present situation which more and more females experience simply because more and more women are being elaborately and carefully educated.

MALE BONDS AND FEMALE EXCLUSION

Menstrual cycles and child-rearing are very obvious factors in any effort to assess the reality and possibility of female participation in what we can call the 'macro-structures of society'—those involving large-scale organization and the major corporate enterprises. More subtle but perhaps even more significant influence are the essentially primate valences—bonding tendencies—to which I referred earlier. I mean by this that the tendency for males to form bonds in work, fighting, politics, etc., and the more obvious but equally pervasive propensity for males and females to form at least ephemeral bonds centring round the process of sexual titillation and consummation, may be as formidable barriers to egalitarian female employment as the obvious ones directly related to reproduction. And an additional factor which has been often overlooked both by ethnographers and students of contemporary politics and economics is the apparent difficulty females have in forming the bonds necessary in order to manage structures involving power and wealth. Let us explore these factors in turn.

It should by now be clear that the proposition here is that if males bond because it is 'in the nature of the beast' to do so, then this places a considerable burden both on women seeking to join these bonds, and on those men willing to allow females into groups when this may signally affect the groups and the relations between group members.

One intriguing example of this phenomenon is the secret society; only exceptionally are these heterosexual. They are mostly all-male and when women do join them, this appears to mark the end of the society's particular drama and effect on its surroundings. This is, again, not to recommend a particular attitude or policy towards secret societies. But it is to suggest that they express certain effective propensities of the human male and that we can observe in these curious and unpredictable organizations a feature of male behaviour in the voluntary world which may find more formal expression in the more overt and legislated worlds of business, politics, etc.[1]

Team sport is another example of this phenomenon; with the exception of tennis and skating, team sports are overwhelmingly unisexual. Except for the most violent of sports, there is no reason why rules governing female participation could not be introduced and appropriate numbers of women join teams. But I suggest that team sports depend on the bonding process and that female participation is anathema to this and would severely curtail the enjoyment of both players and spectators because of the disturbance of the male socio-dramaturgy of sport.

Perhaps both secret societies and sports will be seen by some as a wretched and retrogressive failure of males to embrace a modern and wholesome sexual egalitarianism. It may also be sensible to see them as rather complex projections of species-wide (and their incidence is

1. See also Chapter Six of my book *Men in Groups*, op. cit., for a more detailed discussion of secret societies and male courtship and initiations.

species-wide) propensities for male bonding. In any event, they do exist (though secret societies are under considerable pressure, particularly in the United States) and represent a clue to what many men are concerned about and to the ways in which they willingly choose to spend their time.

If we apply the principles of these forms of association to other areas we can see that the rejection of female co-workers by males may stem from more than retrogressive pique, prejudice, lack of sympathy for females, or some other impetus regarded as malignant and uninformed. This means that coping with this rejection may involve dealing with subconscious processes which are possibly of ancient primate origin and which have for several million years and until just recently served very well for political and economic survival. What we may call 'the anti-female tradition', has its origins, then, not only in belligerent male chauvinist ideology and; in economic exploitation of females, but in a genetic process which evolved because pre-hominids found they could survive and reproduce better if they excluded females from the processes of political dominance, with survival further aided by the exclusion of females from the hunting party.

THE DISRUPTIVE MALE-FEMALE BOND

One obvious reason for such exclusions has to do with the male-female bond. This linkage, we know, can be extremely passionate and vexatious and it is of endless interest to observers of both fictional and real stories of romance. What Desmond Morris has called 'the pair bond' can be as ardently and obsessively maintained as any known among humans. While it can merge the lives of a male and female, it can also disturb class, religious and other social systems. Such is its strength that even the most persuasive rules of these systems are subject to disruption by a male and female caught in the bonding encounter. Yet while this bond can be intense it can also be ephemeral; this is the 'crush', the 'affair', the sporadic, problematic attraction of a male and female who presumably do not marry (though they may reproduce), some form of marriage being, presumably, the social end-product of this private valence. It is the ephemerality which is of interest to us here as we consider the role of females in male-dominated structures.

First of all, one may ask Desmond Morris: what about the *'au pair* bond', that common idyllic dilemma of the bourgeois male who finds his home occupied by a young woman with whom he is forbidden to engage sexually despite her proximity and possible attractiveness? After all, she was imported to solve his wife's problems, not add to them. While this is a frivolous example, it none the less underscores a particular feature of the male-female bond: that it is potentially disruptive, volatile, unreasonable, demanding, and very possibly hostile to the purposes which brought the male and female into contact in the first place. This is particularly so where the individuals concerned are relatively young and where they must spend extended periods of time together.

The implications of this for the

conduct of socio-economic and political activities are obvious. One of the intriguing features of business organizations and similar structures in Europe and North America is the lack of formal recognition of the problem posed by the pair-bonding impetus. There is, of course, an undergrowth of awareness. Private taboos or understandings abound: teachers may not 'pair-bond' with their student though students of other instructors may be more acceptable; and students at other institutions—why not?

The same rules of prohibited organizational incest are supposed to apply to relations between doctors and nurses, managers and secretaries, scientists and research assistants, and so on. That these are honoured in the breach as well as the observance suggests to some degree the difficulty of governing a highly charged primate pattern by the relatively fragile informal and even formal rules of organizations. And all this also suggests one further disadvantage which women face in their effort to secure comradeship with men in places of work—given the extant male-dominated structure.

The pair-bonding problem is soluble, with whatever strenuous efforts and accommodations that may be necessary, when the encounter is between unequal individuals. Doctors and nurses, actresses and producers, stars and starlets, can perhaps deal better with this disruption of formal relations than individuals in equal or near-equal positions.

Robin Fox has suggested that polygamy is not really about sex but about dominance, that sexual access is more important than sexual action.[1] His point is that polygamy may reflect human retention of the primate pattern where males dominate females and express this dominance in sexual activity. This point is, of course, contentious. But my argument remains that males and females of appropriate age and demeanour will seek some sexual *rapprochement* and that the conflict between formal colleagueship and differential sexual power may be disruptive in work and politics and other large-scale systems.

All this may seem far-fetched, and one dares broach this particular subject in this particular fashion only because of its obvious conflict with the demands of organizations for members to behave in formally sanctioned ways. Understandably, the introduction of this particular manifestation of sexual energy into organizations becomes more hazardous the higher in the hierarchy are the individuals concerned. Perhaps it is this combination—sex as a feature of male dominance, and sex as disruptive of relations between powerful equals—which augments the traditional cultural prejudice in very many communities against the installation of women in posts of power.

THE FEMALE-FEMALE BOND

Before concluding, I must make several remarks about another kind of bond, the female-female bond. The groups which females form appear to occupy themselves less with macro-structures of society than with micro-structures. In general, they

1. Robin Fox, 'The Evolution of Human Sexual Behavior', *New York Times Magazine*, 24 March 1968.

seem to be less persistent over time and involve fewer people in associations having less organizational and technical complexity, both in humans and the other primates.

Recently there have been several sets of data published about primate groups in which female-managed 'kinship structures' are significant for the continuity of primate bands across several generations, and even for the general guidance of the process of selection of male leaders.[1] Perhaps further research may reveal the female bonds that exist in the other primates, and that these serve evolutionary functions, particularly in the critical sphere of rearing the young and, through socialization, establishing the continuity of the future with the present. Be that as it may, the fact is that in the human case there is a highly significant division of food-gathering labour—as distinct from non-human primates, among whom all able individuals find their own food—and this suggests that the factor of male bonding among humans may well have been more important than among the other (vegetarian) primates.

Should we find that primate females specialize in social organization and the maintenance of kinship patterns, this could accord with human data about the centrality of the domestic arena for female action. Necessarily, the facts of reproduction govern this at certain stages of the life cycle. Thus, there is the real possibility that selection has always favoured females who have surrounded themselves and their children with a group of kin and other females who provide information, security and the simple and necessary ease of social contact.

As much as solitary hunters face a difficult task, so do solitary mothers. In so far as biological processes can select for such gregarious characteristics, it is possible that a female bonding propensity does exist, with a focus on the relatively intimate matters of families and children rather than on the macro-structures involving war, hunting, defence, sport, religion and so on, which appear in virtually all cultures to obsess and stimulate human males. A host of present data about the reluctance of females to work for, vote for, or otherwise be associates of other females would then follow from this fact—if it should be proven to be a fact—that females in groups function best when occupied with tasks in the community consistent with those appropriate to their more limited familial ones.

Again, this is not to recommend this situation, nor to excuse the difficulty females have in penetrating male-dominated organizations or in contriving all-female dominated ones. My purpose is to note briefly that just as in pair-bonding or male-bonding, female-female bonding may involve biologically determined infra-social processes. The factor of sexual competition for the attention and (implicitly) breeding potential of males is an additional restraint on the co-operation of females over extended periods of time and under various forms or degrees of social pressure.

I have tried to outline some of the parameters of biology within which efforts at social change may have to operate.

1. Reynolds, 'Kinship and the Family in Monkeys, Apes and Man', op. cit.

Defining or describing a situation is not to excuse it, but presumably to provide some factual and theoretical basis for changing a system once it is understood. That the existing state of affairs is all involved with passionately felt prejudices, aspirations, fears and uncertainties makes it all the more necessary to ask why the position of women in society after society has remained unsatisfactory to idealistic and enterprising men and women.

The conspiracy theory of why this is so, and the class theory—curiously mixed as it is with an overtone of prejudice similar to that of racism—may be insufficient axes around which a discussion can revolve, for such discussion must also take into account what new biological and other data we have which may be pertinent.

Of course, there are limits to the utility of a biological model, too—it is too easy for some to say that what is true because of biology must always remain social reality; but this is just not so. Our human biology is, however, the fundamental foundation on which social reconstitution must perforce be based. There can be no other foundation. And the task of ideologists and makers of public policy must be to incorporate biological reality into the idealism of their programmes and the scope of their extensions of human possibilities.

Women in science: Reminiscences and reflections

by Kathleen Lonsdale

In 1863, an expert reassured a British social science congress that 'if girls were encouraged to use their brains the excitement would not produce insanity'. Women today do indeed use their brains without addling them, but far from enough in the fields of science and engineering.

Dr. Lonsdale gives a diverting historical account of the penetration of women into British science and presents data showing how few their numbers still are. Then she analyses the reasons why so few enter the scientific and technical fields and suggests measures that will encourage more of them to discover the 'real thrill of scientific discovery'.

Only a few women achieve eminence as scientists.

The 1969 Fellowship of the Royal Society of London consists of 677 men and 20 women (five on the physical and fifteen on the biological sides). There are now sixty-seven foreign members, none of them women.

In the 1969 yearbook of the International Council of Scientific Unions (to which some ninety countries adhere) there is a list of the 721 officers and committee members of the council's various scientific organizations. Ten of these are women: four from France, three from Britain and one each from the Netherlands, the United States and the U.S.S.R.

Why is this so? Is it because women have only recently become accepted in scientific circles or interested in scientific careers? Yes and no. To begin to answer this question we must look back at least to the beginning of the nineteenth century. My answers will be based only on the history of those institutions in which I have been particularly interested (mainly British). I shall not attempt anything like a complete survey.

WOMEN IN BRITISH SCIENTIFIC INSTITUTIONS

The Royal Institution, London

For many years I worked in the Davy-Faraday Research Laboratories of the Royal Institution, London. These laboratories had been endowed and founded in 1896 by Dr. Ludwig Mond, and from the very beginning they were intended to be open to men and women alike.

Regulation 3 states that 'No person shall be refused admission to the Laboratory as a worker or as an assistant to a worker by reason of his or her nationality or sex'. It was not, however, until Sir William Bragg, the eminent crystallographer, became director in 1923 that the laboratory personnel included any considerable number (20 per cent) of women. Some of us came with his research team from University College, London; others came at his invitation or by their own application from other parts of Britain and from other countries.

The Royal Institution itself had, since its foundation by Benjamin Thompson, Count Rumford, in 1799, depended very largely upon the subscriptions of its members of both sexes. These members, however, did not need to have any scientific qualifications. All that was necessary was that they should recognize the importance of maintaining the 'benificent activities' of science by their patronage.

Fashionable ladies flocked to the lectures, although they were encouraged to do so in very different words by Thomas Young, Professor of Natural Philosophy from 1801 to 1803, and by Sir Humphry Davy, Professor of Chemistry from 1802 to 1823. Young, who was of Quaker stock and not given to flowery language, offered the serious study of science as a worthy alternative to 'the insipid consumption of superfluous time'. Davy, whose eloquence filled the lecture theatre to overflowing, referred to the charm of the ladies, the influence that this gave them over their husbands and sons, and the good example that they might set by their interest in science and in the support of science. It worked. They certainly helped to support the Royal Institution.

The British Association for the Advancement of Science

The fact that ladies were interested in science, at least socially, though seldom actively, is underlined by the early history of the British Association for the Advancement of Science (BA), which was founded in York in 1831, at a meeting of men only. The question as to whether women should be admitted to the social gatherings, even if not to the reading of papers, was seriously debated with reference to the 1832 meeting. But that meeting was to be in Oxford and that decided against it. The presence of ladies, wrote the Rev. Buckland to Mr. Murchison, would not be at all desirable 'especially in a place like Oxford!' This slur on an ancient and honourable town and university applied also, apparently, to Cambridge, Edinburgh, Dublin, Bristol and Liverpool, where the British Association met in the successive years 1833 to 1837.

But 1838 saw a change of heart. The meeting-place was Newcastle-on-Tyne, and Newcastle-on-Tyne was evidently all

right. Ladies were admitted; in fact 1,100 came, as compared with 1,300 men! They were, however, precluded from attending the reading of papers in the Section on Botany and Zoology 'on account of the nature of some of the papers belonging to the Zoology division'. On learning of this discrimination I naturally hastened to investigate the offending programme.

Most of the papers were descriptive of birds and fishes, but there were four which protective males might, I suppose, have regarded as possibly offensive to a delicate female sensibility: one was on 'The wild cattle of Chillingham Park' and that perhaps referred to bulls—necessary but not of nice habits; two others were respectively on 'Peculiarities of the reproductive economy of Marsupiata' and on 'Pouched rats'; the fourth was on the 'Reproduction of the Actiniae'. There was also an exhibit of the two sexes of a rare insect. Yet babies have always had to be born and women have borne them; and even in 1838 unmarried ladies could hardly have supposed that baby animals were found under gooseberry bushes or were brought by storks or in the doctor's bag. Well, well!

However, the presence of over a thousand ladies in the Newcastle meeting was disturbing. The male lecturers paid them lavish compliments: one (a clergyman) referred to them as so numerous and so beautiful that it seemed as if every sunbeam coming through the panes of the glass roof had deposited an angel! Charles Babbage, the originator of calculating machines and an early trustee of the BA, then began trying to estimate the number of panes in the roof, but gave it up. There were too many. His neighbour, Sir John Herschel, commented that for every little 'pane' there was a great pleasure and was so pleased with his own wit that he wrote to his wife and told her all about it. Perhaps it was not surprising that ladies were banned from the next two meetings, in Birmingham and Glasgow, and only re-admitted in modest numbers in 1841 at Plymouth.

At that meeting, however, one lady, Mrs. Davies Gilbert, contributed a paper to the Statistics Section. She was a landowner and a strong advocate of agricultural education in industrial schools in the country. She read papers on this and allied subjects in four successive years, and exhibited specimens of her own intensively cultivated wheat.

Subsequent papers by women were few. Lady Bentham gave one in 1855 in Glasgow entitled 'On an Improved Mode of keeping Accounts in our National Establishments'; and in 1856, in Cheltenham, Mary Carpenter spoke on 'Reformatory schools for ignorant and destitute children'. Perhaps the first paper in pure science by a woman was contributed in 1858 in Leeds by Miss R. Zorubin: 'On heat and on the indestructibility of elementary bodies.'

From the point of view of my title, however, the most important early paper was one 'submitted to the judgement' of the Section on Economic Science and Statistics by Lydia E. Becker at Norwich in 1868. This was called 'Some supposed Differences in the Minds of Men and Women with regard to Educational Necessities' and put forward as hypotheses: '(1) that the attributes of *sex* do not extend to the mind; (2) that any broad marks of distinction . . . are fairly traceable to the

influence of the different circumstances in which they pass their lives; (3) that the... tone of mind, habits of thought and opinions of men and women . . . do not differ more among persons of opposite sexes than they do among persons of the same.'

Miss Becker gave papers on various subjects in 1869, 1871, 1872 and 1874, but more than that, she and a number of other ladies inquired in 1869 (an important year, as will be shown later) whether ladies were eligible for election to the BA section committees, to the General Committee and to other offices in the association. The Council replied, a little coldly, that there was no rule against it, but in 1876 the Council took fright and did rule against it on the ground that it had never hitherto been the practice.

So the matter remained for nearly half a century. Then in 1913 Miss Ethel Sargant, an eminent scientist 50 years of age, became the first president of a British Association section (botany). She was also the first woman on the Council of the Linnean Society of London. In 1914 Miss E. R. Saunders, of Newnham College, Cambridge, also a botanist, became the first woman on the BA Council. The Council is a big body, however, and women members are still few.

In 1947 Dr. Winifred Cullis became an elected member. However, the term of office for elected members is limited to five consecutive years, and in 1954, after she herself no longer had this rank, she proposed me from the floor of the General Committee on the ground that there ought to be at least one woman member of the Council. I was not present but I am told by those who were that the looks on the faces of some of the then members of Council showed plainly that they did not at all agree with her. Nevertheless I was elected by the General Committee, which is the ultimate governing body of the British Association. In 1960 I was invited by the Council to become Honorary Secretary (a five-year office), in 1966-67 I was President of Section A (Physics and Mathematics) and in 1967-68 I became the first woman President of the British Association for the Advancement of Science itself. At no time did I personally encounter the slightest opposition or prejudice.

The University of London

I mentioned above that 1869 was an important year in the history of women in science. This was the year in which the first London University special examination for women was held, with six out of the nine candidates being successful. University College, London, was established by Royal Charter in 1836 and by 1850 the number of institutions affiliated to the University of London had risen to over fifty, located in all parts of the United Kingdom and in the colonies. But it was not until 1856 that the question of the admission of women as candidates for degrees arose, and the Senate of the University then ruled that it did not consider itself empowered to 'admit Females'.

However (according to the Centenary Lecture given by Dr. Percy Dunsheath to the Convocation in 1958) events outside the university prepared the ground for a change. Application for the admission of girls to the Oxford and Cambridge Local Examinations had been made and although

immediate consent was not given, yet extra copies of the Cambridge papers were supplied in 1863 to a committee of the National Association for the Promotion of Social Science and unofficial arrangements were made which allowed the examiners to mark the examination papers submitted by eighty-three girls.

The results of this experiment were solemnly discussed at a meeting of the National Association, at which (to quote Dr. Dunsheath) 'a physiologist said that although it was still a disputed point whether the female brain was capable of the same power of thought as the male brain, he was convinced that there would be less illness amongst the women of the upper classes if their brains were more regularly and systematically exercised'. He was probably right. Another expert assured the meeting that if girls were encouraged to use their brains the excitement would not produce insanity. Girls at a village school had been taught botany by a university professor and they were reported to be 'unusually intelligent, orderly and neat in their appearance and in special request as nursery maids'!

The Secretary of the Association reported that at the experimental examination 'nothing could have been more becoming and creditable than the conduct of the girls . . . in fact, I had far less trouble with them in the details of the business than I had with the boys'. The only somewhat adverse comment on the girls' written performance was that they often answered 'with great pains and correctness not the question set, but some other on the same subject'—a tendency not infrequently met with in examinees of both sexes even today.

In 1865 Cambridge and Edinburgh universities held local examinations for girls and decided to continue to do so. The Convocation of the University of London then recommended, in 1866, that the university should establish a special examination for women and a supplemental charter permitting this was obtained by the Senate in 1867. The first examinations, however, disclosed the very disconcerting fact that the women taking them excelled in classics, mathematics and science, rather than in the subjects previously supposed to be more suited to their sex. They were still not admitted to degrees, however, and repeated requests by the Convocation to this effect were repeatedly refused by the Senate.

In February 1877, the Senate decided to take advantage of a new Act of Parliament empowering the universities to grant degrees in medicine to women. Protests and deputations followed, urging the Senate to extend this concession to degrees in all subjects. In January 1878, a new supplemental charter was applied for and the following month the Dowager Lady Stanley of Alderley presented the Chancellor of London University with an address signed by 1,960 women thanking the university 'for the noble part it has taken in coming forward first among the Universities of Great Britain to propose to open all its Degrees to Women'.

Women were not admitted to German universities until 1908, according to Lise Meitner.

The Royal Society of London

The Zoological Society of London and the Royal Entomological Society admitted

women from the date of their incorporation in 1829 and 1833 respectively. The Linnean Society of London and the Royal Microscopical Society admitted women to Full Fellowship in 1905 and 1909. The Royal Society of London, founded in 1660, had never had any woman Fellows, although report has it that at one time the possible candidature of Mrs. Hertha Ayrton was discussed.

In 1919, the Sex Disqualification (Removal) Act removed all legal bars to membership in any body having a Royal Charter, but no woman was put up as a candidate for election to Fellowship of the Royal Society until 1944. In that year two certificates in favour of women were presented to the Assistant Secretary for Registration. One of these women, on the biological side, was the late Miss Marjory Stephenson, of Cambridge; I was the other, on the physical sciences side.

Sir Henry Dale was then the President of the Royal Society and, as he knew me well, he asked me to come and see him and told me of the fact, hitherto unknown to me, that I had been presented as a candidate for election. He asked me if I wished the certificate to go forward. My answer was very clear: not if it meant dissension among the Fellowship. I had no wish at all to be a bone of contention. Sir Henry was obviously astonished at my hesitation and he told me at once that he was sure that a majority of the Fellows would be pleased, but that in order to make doubly sure of this they would be consulted by means of a postal vote. This was done.

The proposals laid before the Fellows were that two sentences should be added to the Statutes: (1) 'Nothing herein contained shall render women ineligible as candidates.' (2) 'In the foregoing Statutes and in any Standing Orders of the Council and in any Rules and Regulations adopted by the Royal Society or by any Joint Committee for the administration of Trusts to which the Royal Society is a party, words importing the male gender [afterwards changed to 'sex'] shall include the female unless the context requires a contrary construction.'

When the poll was closed at 30 June 1944, 336 Fellows had voted in favour but with qualifications and only 37 against. Statutory form was given to the proposals on 12 October 1944 and Marjory Stephenson and I were duly elected on 22 March 1945. Since then, however, there has usually been no more than one woman elected each year as compared with some twenty-five to thirty-five men. Even this proportion is high compared with some other national academies of science.

Not even the most ardent feminist, however, could claim that this is due to sex discrimination. The fact is that there are not many women in the top ranks of research and so qualified for nomination to Fellowship. The same applies to the international scientific unions. None of them have any bar to the full participation of women, yet the number of women who serve in any high capacity is exceedingly small.

WOMEN STUDYING SCIENCE AND ENGINEERING

About ten years ago I made a careful, though limited, investigation of the relative numbers of either sex taking and

TABLE 1. Over-all results of General Certificate of Education (GCE) examinations, 1959

Level	Sex	Total entrants (thousands)	Percentage passed
Ordinary (O)	Boys	452.9	55.9
	Girls	394.8	61.8
Advanced (A)	Boys	88.3	68.1
	Girls	38.4	69.9

passing various examinations at different stages and registering at different British universities for science and engineering courses. I also have some more up-to-date figures, but I have found no reason to believe that the situation has changed substantially or that it is very different for different countries.

Table 1 shows how secondary-school boys and girls compared in taking the General Certificate of Education (GCE) examinations. It includes all subjects and reveals two significant facts: first, that in the over-all, at ordinary level (say 15 to 17 years) the girls do appreciably better than the boys (although they concentrate on different examination subjects); secondly, that at advanced level (say 16 to 19 years) there is a marked drop in girl entrants, though they still show a slightly higher percentage of passes than the boys. This, however, may well be due to selection and thus may conceal a slightly lower average performance by the girls.

TABLE 2. Results, by subject, of GCE examinations, 1957

Subject	Total entrants (in thousands)	Boy/girl ratio	Percentage of passes	
			Boys	Girls
Ordinary level				
Mathematics	123	2 : 1	59	58
Additional mathematics	<8	17 : 1	71	70
Applied mathematics	4	14 : 1	60	66
Physics	25	7 : 1	58	55
Chemistry	23	9 : 2	57	53
Physics with chemistry	<8	3 : 2	50	64
General science	13	3 : 2	51	59
Biology	31	2 : 5	58	58
English literature	70	3 : 4	54	66
Religious knowledge	17	1 : 3	48	64
Advanced level				
Mathematic subjects	18	7 : 1	70	72
Physics and chemistry	28	6 : 1	66	58
Biological subjects	10	11 : 8	61	67

Now, when we make a detailed analysis of girls' and boys' participation and results in different examination subjects, as in Table 2, some interesting points emerge. Relatively few girls enter for additional, applied or advanced mathematics, although those that do, being presumably selected, do well. Girls tend to take the easier options, physics with chemistry and general science, rather than the pure subjects, physics or chemistry. The boys who take these easier options, although still more numerous than the girls, are clearly those who are not expected to (and do not) do well. More girls than boys take biology at O level and more girls take biological rather than physical sciences or mathematical subjects at A level. For comparison two arts subjects (English literature and religious knowledge) are included. Here the female entry and performance are both relatively high.

These trends are continued and accentuated at university level. Table 3 shows that in subjects not taken at school, especially in engineering, technology and applied science, the female entry is low. In pure science subjects the female entry is below the average for all subjects, in the humanities it is above the average, although only in language, literature and area studies does it exceed the male entry. The proportion of higher degrees conferred on women is much lower than that of first degrees or diplomas.

In spite of a vast expansion of university places since 1938, the proportion of women full-time students is still low, though it has slowly increased from 23.1 per cent of the total in 1938-39 to 26.4 per cent in 1965-66.

The variation as between different

TABLE 3. University students taking full-time courses in 1965/66 in Great Britain[1]

Subject. Degrees and diplomas conferred	Total	Percentage of women
Engineering, technology and applied science	30 772	2.0
Agriculture, forestry and veterinary science	3 657	13.6
Architecture and other business and professional studies	2 839	20.1
Pure science, including mathematics	42 113	22.6
Medicine, dentistry and health	18 537	24.0
Social, administrative and business studies	32 117	32.2
Arts other than languages	9 076	35.4
Music, drama and visual arts	1 570	44.1
Education	5 750	46.3
Language, literature and area studies	22 176	53.8
First degrees conferred:		
Honours	23 683	27.1
Ordinary	8 387	27.9
Higher degrees conferred	6 498	9.3
Diplomas conferred	11 921	32.1

1. New subject grouping given in *Annual Abstract of Statistics*, No. 104, 1967, London, HMSO.

TABLE 4: Full-time students taking various university courses[1]

Subject	Sex	1955/56	1960/61	1965/66
Arts[2]	M	22 934	30 008	41 843
	F	13 713 (37.5)	16 378 (35.3)	28 846 (40.8)
Pure science	M	14 203	20 735	32 579
	F	3 930 (21.7)	5 718 (21.6)	9 534 (22.6)
Medicine	M	10 384	9 315	10 297
	F	2 957 (22.2)	2 961 (24.1)	3 089 (24.9)
Dentistry	M	2 286	2 461	2 549
	F	365 (13.8)	625 (20.3)	569 (18.3)
Technology[3]	M	11 226	15 880	33 659
	F	153 (1.3)	345 (2.1)	1 985 (5.6)
Agriculture[4]	M	1 706	1 806	2 057
	F	221 (11.5)	216 (10.7)	323 (13.6)
Veterinary science	M	1 024	1 125	1 103
	F	92 (8.3)	126 (10.1)	174 (13.6)

1. *Annual Abstract of Statistics*, No. 104, 1967, London, HMSO. The numbers given in brackets are the percentages of women students in each subject relative to the total number of students.
2. Including theology, fine art, law, music, commerce, economics and education.
3. Including engineering, applied chemistry, mining, metallurgy and architecture.
4. Including forestry, horticulture and dairy work.

science subjects at university level also reflects and accentuates the trends and differences shown at GCE level. My inquiries at a number of British universities about ten years ago showed that the number of women who qualify in physics and chemistry is only about one-twelfth of the number of men, whereas in botany and zoology the ratio is about one-half. Thus, the 22.6 per cent of all students taking science and mathematics who are women, as shown in Table 3, breaks down to only 8 per cent women of those taking physical sciences, 17 per cent of those in mathematics and 32 per cent of all taking biological sciences.

A different breakdown (Table 4) shows that the percentage of women taking pure science courses at the university has changed very little over the past ten years. There is, however, a large increase in the absolute numbers and a small increase in the percentages of women taking practical subjects other than medicine. The numbers of women taking engineering subjects is still, however, both relatively and absolutely low, in spite of the encouragement given them by the formation of such professional bodies as the Electrical Association for Women, under the inspired leadership of the late Caroline Haslett, and the Women's Engineering Society.

The evidence is that in the U.S.S.R.

there are far more women in technological jobs than there are in Britain or other Western countries, but relatively few of these are in top-level positions. This applies in Britain to all subjects, but to the physical sciences and technological subjects in particular.

To sum up, then, we observe the following:

First, that in the school-leaving examinations girls are already avoiding the stricter scientific disciplines on the physical side and are tending to choose the easier options of 'General science' and 'Biology'. In the humanities they outnumber the boys and also achieve as good or better examination results (Tables 1 and 2).

Second, fewer girls take advanced courses in any subject (Table 3). The enrolment of women students for full-time university courses has remained for the past thirty years at about one-third of the number of men students although with the rapid expansion of the university intake the percentage of women has slightly increased.

Third, the smallest relative enrolment of women is in the practical subjects not studied at school (Table 3) and particularly in technology (Table 4). In the pure sciences the percentages of women taking degree courses in physics and chemistry is very much smaller than those taking botany and zoology, with mathematics in between. The relative percentages choosing technological subjects is slowly increasing but is still small.

Fourth, at more responsible academic levels the percentage of women involved drops still lower, being very low indeed in science and technology. It is not surprising, therefore, that this lack of women in senior positions is reflected in the Fellowship of the Royal Society, the councils of other learned scientific societies and the committees of the international scientific unions.

REASONS FOR THE RELATIVE SCARCITY OF WOMEN IN SCIENCE

The 1956 British government report on technical education pointed out that girls are a match for boys at school, but relatively few choose to continue their education beyond the school-leaving age. The report suggests that: 'A great many girls do not see the point of further education once they have got a job. Their hopes are naturally bent on marriage and they fear perhaps—though there is much experience to prove them wrong—that by aiming at a certificate they may miss a husband.'

This was probably true once and it is probably true today at a rather low level of intelligence, but it does not explain why those girls who do continue their education tend to avoid pure science and, above all, technology. I believe that the reasons are many. Some are certainly connected with the expectation of marriage and of children, and others with the social attitudes of relations and teachers.

To begin with, as long as there are only a few women who have reached the top ranks in science and technology, so long will it seem to most girls, to say nothing of their teachers and parents, that this must be a most difficult option.

I well remember the opposition I met with from the headmistress of the second-

ary school that I attended when I told her of my intention to specialize in physics. She herself was a mathematician, and she knew that I had some mathematical ability. She wanted me to concentrate on mathematics and assured me that in physics there would be far more competition from men and that I would be a fool to think that, with my comparative lack of background of any practical skill and knowledge, I would be able to compete in a 'man's field'.

In fact, we had good science laboratories and a good science teaching staff. Ours was a 'dual' State school, girls' class-rooms on one floor, boys' on another and the laboratories, shared by both, on a third. Many girls' schools still do not have adequate laboratories for practical work, nor do they have well-qualified science and mathematics teachers, although this situation (as far as laboratories are concerned) is being slowly remedied, and at sixth-form level there is some sharing of teachers in short supply.

I tend to get asked to visit schools on special occasions: to open new laboratories or to distribute prizes and to speak to scholars and parents. On these occasions, and at other times, I do get the opportunity to talk personally with some of the girls who are about to enter the university. Quite often it happens that a girl with a good result in her Advanced Level examinations in mathematics, physics and chemistry, will choose to take courses in sociology, economics or some similar subject at one of the new universities.

At first I thought that this might reflect some serious purpose. Quite a number of people do feel that pure science is too easily misused, that the development and manufacture of new weapons of war or the exploration of space and of the surface of the moon are not the best ways of spending the world's resources in money, materials and talent. The current interest in the social sciences might reflect a desire that man should know himself and find a way of living with his fellows which is more sensible than our present competitive balance of power and terror.

My tentative questions along these lines, however, have resulted in some disillusionment. Girls have told me that they are intending to study for a degree in social science 'because it is fashionable', 'it is the thing to do, these days', or even more frankly 'it seems to be a soft option; you can 'get through' more easily than in the pure sciences'. Young women students who are nearing their final university examinations in pure science subjects have told me also that they want to get a job which does not involve responsibility. These same girls would cheerfully undertake the responsibility of running a home and of having and bringing up children, but they do not want a job that requires their single-minded devotion.

The fact is that most girls (about 90 per cent) will get married and that they will then have an average of 2.2 children. About one-third of these married women (35.7 per cent in 1966[1] as compared to 32.2 per cent in 1957) will be engaged in paid employment, full-time or part-time, outside their homes. It is

1. *Annual Abstract of Statistics*, op. cit.

exceedingly difficult to obtain any kind of domestic help. To do two jobs simultaneously, and to do both well, requires an unusual degree of determination and of organizational ability. It does not follow that these necessarily accompany an innate ability to shine at mathematics or physics.

A single woman may also—and frequently does—have the responsibility of caring for an ageing parent as she herself gets older. It is difficult to square this with a job that requires clarity of thought and probably a good measure of overtime if it is to be responsibly undertaken to a highly paid level. It is not at all surprising that the number of women who achieve or even desire such responsibility is small.

Of course there are many men nowadays, at least in Britain, who are very helpful indeed in the home and who take a pride in their family. But with the woman it is, and I think always must be, the first priority. If she does not do the work herself she undertakes its organization and regards herself as responsible for the solving of emergencies when these arise. Sir Lawrence Bragg once described the life of a university professor as similar to that of a queen bee, nurtured, tended and cared for because she has only one function in life. Nothing could be farther from the life lived by the average professional woman.

Moreover, the fact is that two-thirds of married women do not undertake paid employment outside their own homes, and that if a woman has children there will necessarily be periods when she is likely to be unable to go to work. Any prospective employer (or grant-giver) knows this and not every employer is willing to risk losing a key worker just at the stage where she has become really useful. It may follow, therefore, that a girl will find only subordinate positions to be available to her, especially if she is engaged to be married.

Some discrimination due to ignorant or selfish prejudice does still operate, but in general the difference between the earnings of men and women in Great Britain (Table 5) is due to the acceptance of junior posts by women, who find these easier to combine with home duties.

TABLE 5. Weekly earnings of British men and women, in 1966[1]

Category	Average for men			Average for women		
	£	s.	d.	£	s.	d.
Administrative, technical and clerical workers in industry	26	14	1	11	2	7
Manual workers[2]	20	6	1	10	1	4

1. *Annual Abstract of Statistics*, op. cit.
2. Full time: men (20 years and over), 46 hours per week; women (18 years and over), 38.1 hours per week.

TABLE 6. Effect of marital status on careers of women research scholars[1]

Grade and period	All		Single females	Married females	
	Males	Females		Continued	Discontinued
Science research scholars, 1891-1921	444	27	16	6	5
Overseas scholars, 1922-60	276	19	7	10	2
Senior students, 1922-60	145	7	5	2	-
TOTAL (excluding double holders)	852	53	28	18	7

1. *Record of the Science Research Scholars, 1891 to 1960*, Royal Commission for the Exhibition of 1851, London, 1961.

Where scientific research is concerned however, the 'wastage' due to marriage is much smaller than might have been anticipated. Table 6 shows that over a period of nearly seventy years the number of women holding '1851' research scholarships who have discontinued their work because of marriage is only about 13 per cent. It is significant that more than one-half of those obtaining scholarships have remained single. There have been 'drop-outs' also amongst the men scholars, some because they changed their profession (to law, the Church, etc.) or because their research training was only the prelude to some more lucrative position in business administration and not an absorbing lifelong passion. This of course may be true also of women.

HOW CAN MORE GIRLS BE ATTRACTED TO SCIENCE AND TECHNOLOGY?

Many girls do not choose physical science as a career because they have not learned its fascination and it seems more of an artefact than, for example, geography, a language or zoology. It is difficult enough to concentrate when you are young, the world is beautiful and life is before you, without deliberately choosing to concentrate on a difficult subject.

As for engineering, few girls have any mechanical training while they are young (unlike boys, who are expected to take things to pieces and put them together again) and the idea of a training, or a sandwich course, in technology really hardly occurs to them, or to their parents or teachers. They readily learn to use a sewing-machine but even that is hardly necessary in these days of ready-made clothes and there is in any case a big difference between using a sewing-machine to make clothes and taking a motor-bicycle to pieces for the love of it.

Organizations such as the British Association for the Advancement of Science (or the Znanie Society in the U.S.S.R.) can do a tremendous amount to bring home to girls, as well as to boys, the real thrill of scientific discovery and of usefully applied science and technology. More than a few young people have had their

life's work decided by a course of Christmas Lectures at the Royal Institution or by a science fair.

More could perhaps be done also, in a light-handed way (since few people like being preached at) to make parents ambitious for their girls as well as for their boys. Headmasters of co-educational schools have told me of the near impossibility of discouraging parents who urge their daughters to take any reasonably well-paid stop-gap job rather than to continue what they regard as a useless specialized education.

Above all, however, it should and could be made much easier for the qualified science graduate both to have her cake and eat it. If she has the ability to go to the top or even to do a reasonably competent job at an intermediate level she should not be debarred from doing so by what are essentially the routine duties of keeping the house clean, shopping and cooking, in addition to the personal claims of aged parents or of a husband and children. Life could be so much less complicated if adequate home help were available and if employers and universities, as well as concerned local authorities, would provide nurseries, kindergartens and kindly 'sitters' for babies or old people. Also, more part-time work at an advanced level should be available.

The woman scientist and engineer will still feel her personal responsibility; she will want to spend much of her time with her children, if she has any, but she should not have to be continually worried by a clash of interests, or live in dread of something going wrong with her arrangements. The woman who, like Professor Dorothy Hodgkin, has managed both to win a Nobel Prize in chemistry and to bring up a family of healthy and well-balanced, intelligent and socially active children, is a tremendous inspiration to other young women.

Any country that wants to make full use of all its potential scientists and technologists could do so, but it must not expect to get the women quite so simply as it gets the men. It seems to me that marriage and motherhood are at least as socially important as military service. Government regulations are framed to ensure (in the United Kingdom) that a man returning to work from military service is not penalized by his absence. Firms are also obliged to employ a certain proportion of disabled men. Is it Utopian, then, to suggest that any country that really wants married women to return to a scientific career when her children no longer need her physical presence should make special arrangements to encourage her to do so?

On the other hand, girls and women must be encouraged to accept responsibility outside their homes, particularly when they are young enough to have no urgent home cares. In my case I learned this at school, as head prefect, and then at the Bedford College for Women, University of London, where I took my first degree.

Personally I am extremely sorry to see the disappearance of all-women's colleges, for this very reason. They provided an admirable training ground for those capable women whose natural humility (an excellent trait in many circumstances) would lead them to take a second place in a mixed company of men and women. Women in science are, from this point of view, only a special case of women in the world.

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1. Not all the publications are referred to in the text, but all were used in the preparation of this article.

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Women and work (I): Feminine emancipation at an impasse

by Mária Márkus

The movement towards the emancipation of women, which depends upon their having economic independence and full equality with men in the world of work, is at a dead end, brought up sharply by the fact that though women now do take paid employment as a matter of course, they have not been released from their traditional burden of home and child care. In consequence, they remain basically a low-level, low-paid labour force, still largely financially dependent on men.

Two trends are in evidence to ameliorate this situation. One is typified in the United States, and the other in the Socialist countries. But neither provides a satisfactory answer.

THE EVOLUTION OF THE 'FEMININE PROBLEM'

The inequalities between men and women, which have existed throughout history and in almost all societies, only actually became a social problem and the basis of a social movement during the course of evolution of industrialized Western society. The factors that contributed to the development of this 'feminine problem' are many and complex, but we can mention two of the major ones.

One of these factors is that the evolving bourgeois society, with its growing middle class, emphasized equality as one of its basic credos—at least, formal legal and political equality. As a consequence, though certain traditional aspects of the position of women became social anomalies in the context of the new, widely accepted system of values, they continued to endure.

The second factor is the changed economic role of woman with the growth of industrialization. Previously, in agrarian-based societies, the family was not

only the basic cell of society, but also the basic unit of economic production. Within the confines of the family, both man and woman produced goods, largely for internal consumption, but also for exchange and sale. In addition to being the homemaker, the woman, for example, wove clothes, made candles, helped in raising livestock, etc. While the value of a woman's labour was not rated as high as that of the man's, none the less she was an economic producer, with some of the independence and dignity of this status.

But with the evolution of bourgeois society and the growth of specialization —characterized by such steps as movement into towns, growth of trade guilds, development of commercial enterprises and a strong business class, and then industrialization—all this gradually changed. The production of goods, which had once been done largely within the family, moved outside the home, into workshops and factories. Men moved outside the home, too, and continued as direct economic producers. But women remained behind, no longer as economic producers, but as the doers of domestic chores and the breeders and raisers of children. This meant that the sexual dualism received an economic emphasis, which became concretely manifested by the complete economic dependence of women on male 'breadwinners'.

It is precisely because social injustice to women had this strong economic foundation that the feminist movements which arose in the nineteenth century to battle for feminine emancipation demanded the right to work in addition to political and legal equality. This demand coincided with the needs of a burgeoning industrial society for cheap unskilled labour, on the one hand, and the need of the poorest families to supplement inadequate incomes, on the other.

However, the feminist movement saw the right of women to work not only as a matter of financial liberation, but also as the foundation which would enable women to exercise the human right of choosing and living the kind of life they wanted. This demand was particularly emphasized in those movements which were inspired by Marxism, since work in their ideology is a basic means of ensuring the development and fulfilment of the human personality.

THE DEAD END

Despite all this, it is precisely in this area of work that the emancipation of women has in certain respects reached a dead end in the developed and semi-developed industrial countries, which are the ones under discussion here.

As regards formal equality—political and legal equality—one can generally say that in both capitalist and Socialist countries the struggle for emancipation has achieved its principal objectives, though in almost every country there still remain a number of unsolved problems and inequalities supported by law. As regards employment, the figures show that the progress has been pretty impressive. There is no doubt that more women work today, more women occupy positions of importance in economic and public life, more women are being educated than ever before. Nevertheless, as a rough analysis of the relevant data will show, the changes in this area tend to be mainly quantitative

and do not show an essential change in the condition of women. Moreover, they do not even provide hope that a solution of the problem of inequality will be achieved in the near future.

The situation is made worse by the fact that compared with the end of the last century and the early years of this one, the intensity of the struggle for feminine emancipation has significantly diminished, although there are women's organizations in every country. It seems that the decisive majority of women accept the present far-from-equal situation, perhaps simply because there appears to be no alternative available.

In a certain sense women remain as they have always been, instruments in almost every field of life: instruments that will ensure replenishment of the population and the education of children, instruments serving the needs of the household and the sexual satisfaction of men, and last but not least instruments filling the variable needs of the national economy for low-grade labour.

Let me remark that the present contradictions and dilemmas as regards the emancipation of women are in many respects the same whatever the social system —whether it is capitalist or Socialist. This is true despite the fact that the Socialist countries have in several fields instituted measures (nurseries, kindergartens and day boarding institutions, subsidized by the State or by enterprises; laws that protect working mothers, etc.) which, it could be argued, provide a better chance for full emancipation, if these countries can more closely harmonize their efforts to maximize efficiency with their efforts to ensure a more humane and democratic way of life.

WOMEN AS LOW-LEVEL LABOUR

Today, outside the Third World, roughly every third woman is gainfully employed. Taking a job has become a general rule for unmarried girls, with the exception of those in certain traditional peasant communities, where employment opportunities are fewer. The type of girl who spends the time between leaving school and getting married at home doing nothing is definitely dying out. Likewise, the proportion of working women amongst those who are married and have families is also increasing everywhere in the world.

But this generally favourable picture changes considerably when we look at the occupational and employment structure of the feminine labour force. Relevant data clearly show that women work not as equals, but as a less qualified, cheaper labour force, generally under worse conditions and doing the least interesting work (Fig. 1). Thus, according to the 1960 figures, while 35 per cent of all those employed in Hungary were women, they formed only 20 per cent of all executives and professionals and only 15 per cent of skilled workers. On the other hand, 56 per cent of lower-grade administrative and commercial employees, 43 per cent of semi-skilled and 42 per cent, of unskilled workers were women.[1]

Associated with the generally lower working status of women is the fact that when they do highly trained work, it is frequently in those fields and professions

1. *The Position of Women at their Place of Work and at Home*, Budapest, Central Statistical Office, 1962 (in Hungarian).

FIG. 1. Women, the child-bearers, as cheap, low-grade labour in a developing country: a construction site in the Togolese Republic.

which have low social prestige. This state of affairs has two striking aspects. The first of these is the tendency, which can be observed in almost every country, for certain professions of high prestige and high income to go down significantly in the former and relatively in the latter, as soon as they are taken over by women.

The second aspect is the corollary of the first one. Women are only able to enter certain professions in large numbers once these, thanks to certain social and economic processes, have started to decline in prestige and relative income. This is generally true of the teaching profession, for example, and in certain countries a similar tendency can be observed in relation to pharmacists and certain branches of medical practice.

Even in these professions there is a serious discrepancy between the total number of women involved and those in responsible positions. Thus 86 per cent of primary school teachers in the United States are women, but only 50 per cent of primary schools are run by headmistresses; secondary schools are headed by women in only 9 per cent of the cases. Ten out of every hundred women who teach in a general school in Poland carry out the duties of a head, against 40 per cent of the male teachers.[1]

It follows from the above facts that the average income of women is well below that of men. This is reinforced by the well-known fact that very often women do not get the same pay as men doing the same work.

To justify this sort of discrimination you hear less and less these days of the argument that women are incapable of doing work that demands a high level of specialized knowledge and an ability to take decisions and give directions, though such views still survive in certain places. The argument one is more likely to hear is that women are not a stable and reliable labour force because of their role as child-bearers and child-rearers, with household duties that do not permit them to put as much thought and energy into their work as men do, and that therefore their work cannot be, from the viewpoint of pratical economics, equal in value to that of men.

There is no doubt that in the present situation certain facts justify this point of view. And it is further buttressed by the widespread general attitude that all women, regardless of their individual talents and interests, are destined by their biological characteristics for a role which, at least for a protracted length of time, necessarily disables them for carrying out any other social role with the necessary energy.

WOMEN'S 'SECOND SHIFT'

It is these facts and notions that have created the well-known problem of the 'second shift'—where a woman works one shift in office or factory and then works a second shift at home doing the household and child-care chores that are considered specifically hers. It is precisely this at-present-unresolvable problem of the double shift which to a large extent explains the current state of stagnation of the drive

1. M. Sokolowska and K. Wrochno, 'The Social Position of Women in the Light of Statistics', *Studia Socjologczne*, No. 1, 1965 (in Polish).

TABLE 1. Hours spent daily on work in the home

Country	Men			Working women			Non-working women		
	Married	Unmarried	Average	Married	Unmarried	Average	Married	Unmarried	Average
Belgium	0.6	0.4	0.6	3.3	1.5	2.7	6.0	3.4	5.6
Czechoslovakia	1.5	1.1	1.5	4.3	3.0	4.1	6.1	4.6	5.8
France	1.2	0.9	1.2	3.7	2.4	3.1	5.8	2.5	5.5
Federal Republic of Germany	1.1	0.8	1.1	4.5	2.3	3.6	6.3	4.6	6.0
Hungary	1.5	0.8	1.3	4.3	2.4	3.8	8.0	5.4	7.7
Poland	1.2	0.4	1.0	3.6	2.1	3.0	6.4	4.0	5.9
U.S.S.R.	1.1	0.7	1.0	3.5	2.4	3.1	6.3	3.4	4.7
United States	0.6	0.5	0.6	3.2	1.9	2.6	5.1	3.8	5.1

for feminine emancipation; it is just this which has betrayed the high expectations of the traditional feminist movements.

Let us look at some current facts and figures which reveal how demanding of time household duties are. Myrdal and Klein[1] quote the calculations of Tarras Saellfors showing that while all of Swedish industry uses only 1,290 million working hours annually, 2,340 million hours are spent annually in Sweden on shopping, preparing meals and washing-up.

Table 1, based on an international comparative study carried out by the Vienna Institute of the Social Sciences, shows the average number of hours spent daily on household duties in various countries by men and women.[2] These data do not include time spent with children, or on shopping, which would in general increase the figures here given by at least an hour a day in the case of married women holding jobs.

The ideologies of the traditional feministic movements held that household duties would be 'socialized'—largely taken over by service establishments provided by the society, as private or public enterprise; it was believed that this, together with a more equitable distribution of the remaining household chores among all the members of the family, would allow women to play their part in the world of work as equals, with the full opportunity to chose the way of life best suited to their personalities, abilities and interests. The figures in Table 1, as well as everyday experience, show that these hopes were not realistic, for all women, working or not, married or not, still put in far more time than men on household chores. This is further proven by data showing that women in large cities on the average spend more time on household duties than village women, though one would think that the greater availability of services and of household appliances would make the reverse true.

There are two reasons which it could be argued played a part in arresting the

1. Alva Myrdal and Viola Klein, *Women's Two Roles*, 2nd ed., London Routledge & Kegan Paul, 1968.
2. See: A. Szalai *et al.*, 'Recherche Comparative Internationale sur les Budgets Temps', paper presented at the Seventh World Sociological Congress, 1966.

'socialization' of household chores, at least to the extent needed. One of them is economic. In view of the fact that the services concerned are only moderately mechanized, their cost has become relatively high with spreading industrialization and with the rise in wages. Thus, if women, especially those with low qualifications and low income—which is the decisive majority—wish to replace their own work in the household with paid services (restaurants, laundries, etc.), their own incomes are not sufficient to cover the cost.

This creates a vicious circle. On the one hand, the low-paying work done by women prevents them from freeing themselves from any significant part of their household duties, while at the same time the burden of the 'second shift' does not allow them to improve their qualifications so they can do better paid work.

This economic reason is, however, insufficient in itself. For it is a fact that in a significant proportion of the families having good incomes the wife does a disproportionate amount of the domestic work herself, despite the existing technical and financial possibilities. A large proportion—varying from country to country—of even highly qualified women give up their professions, either temporarily or permanently, particularly after giving birth to a child. Apart from the question of bringing up children, it seems that another very basic and general factor is involved.

The chores and functions carried on in the household are intimately connected with the personal lives of the members of the family. The home is the centre around which their lives are organized, where highly individualized activities, such as consumption, relaxation, etc., are carried out. In modern society, impersonal, purely functional relationships put considerable pressure on every individual, often involving the danger of depersonalization. It is therefore understandable that there is a spontaneous resistance to the socialization of the household by the removal of any function at present associated with it, and a defence of the individuality of the home—and this is at the expense of the woman. Everyday observation, difficult to prove with data, suggests that this resistance is greatest, in fact, in those strata of society whose members have the smallest chance to express their personalities in a free and creative way beyond the walls of the home.

RECONCILING WORK AND HOME—TWO TRENDS

We can distinguish today two well-differentiated trends for reconciling the two realities of the modern woman's life: that increasingly she holds a job outside the home, and that she is, as always, homemaker and the bearer and raiser of children. One of these is typified by the pattern which has been established in the United States over the past ten years or so, and the other by the pattern which exists in the Socialist countries, though not there alone. Each of these has its advantages and disadvantages. Neither provides an ideal solution for the problem.

The American pattern is characterized by the fact that a girl works until married or until her first child is born, then withdraws from her employment, and then takes up work once again ten to twenty years later when the children are no longer small.

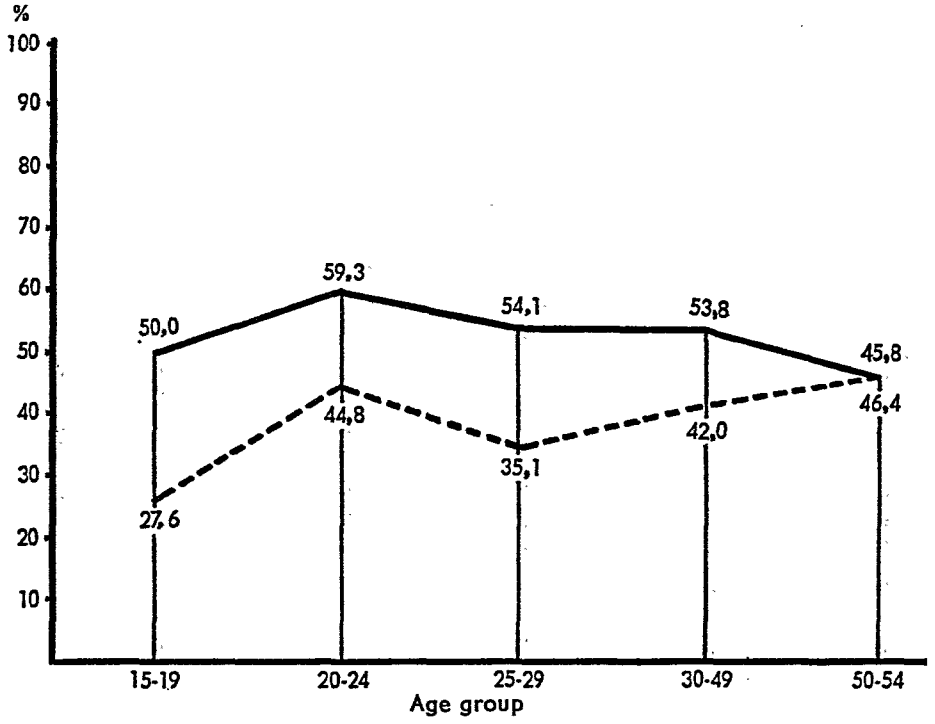

FIG. 2. The proportion of working women in different age groups in Hungary (——) and the United States (– – – –).

The pattern in the Socialist countries is that the majority of working women stay in employment until they retire, but receive various aids and concessions from the State and from the enterprises where they work to help them do so during the child-raising period.

Figure 2 shows how these two patterns differently affect the proportion of women who work.[1] Thus, for the Socialist pattern, as typified by Hungary, the proportion of working women stays relatively constant for all age groups, showing a slow gradual decline over the years from the peak attained in the 20-to-24 group. In the American pattern, on the other hand, there is a relatively sharp drop in the proportion of working women between the 20-to-24 and 25-to-29 age groups, followed by a gradual increase over succeeding age groups, with women resuming paid employment as their children no longer need close care.

Many enlightened supporters of the equality of women hope that the spread of the American trend will provide a definite solution to the feminine double-shift

1. Data from Julia Turgonyi and Susan Ferge, *The Working and Living Conditions of Women in Industry*, Budapest, 1969 (in Hungarian).

problem. They point to the fact that the average life-span of women has considerably increased, that the average number of children has considerably declined, and that therefore being a full-time mother involves no more than about fifteen years of a woman's life today. Women can have another twenty years which they can devote to their 'second careers', which can be either in the profession in which they were originally trained and perhaps worked, or a different one.

There is no doubt that in today's circumstances the American model does have certain attractive features, and not merely from the point of view of the children, who certainly need close relationships with specific adults during their early years, relationships which can generally be better provided by the family than by the best nursery. It has positive values from the point of view of women also, since they are relieved of the double burden at a time when home responsibilities are at their heaviest.

Yet it is obvious that this fifteen-year absence—or even less—from paid employment outside the home automatically disqualifies women from parity with men in this sphere, since they withdraw from it during the most active and productive period of their lives. Moreover, the fast pace of technological and scientific progress means that everybody who does not keep abreast by everyday practice is rapidly left behind. The prolonged withdrawal from work automatically perpetuates the present state of affairs in which most women do work that requires the lowest qualifications and consequently is the least creative, most monotonous and worst paid.

Not to accept this as a satisfactory situation does not indicate that one holds with the naïve view that would identify feminine emancipation with the abolishment of all the differences between the sexes, nor that one believes in any special 'myth' that paid work is a be-all and end-all. On the contrary, to accept this situation is to reconcile oneself to accepting that women *a priori*, because of their biology, must always have a much narrower choice of possibilities open to them than do men. Moreover, as long as gainful employment remains the chief basis, or at least a main basis, of personal independence, this situation preserves the traditional economic dependence of married women on their husbands.

This situation does not appear to be acceptable from another point of view either. Women who withdraw behind the family walls for an extended period of time significantly narrow their chances to establish connexions with other people outside the family circle. There is no need to detail the negative effect this has on the female personality. At the same time, however, this fact has wider repercussions. A family whose life is organized by a woman who is excluded from the wider circle of human relationships, who is largely cut off from the society at large and is therefore often no longer interested in it, has in many respects a narrowly conservative character.

It can be argued that this limitation of women's scope of interests plays a part in certain crisis phenomena of modern family life, especially in the growing conflicts between the generations. Only appropriate studies can show whether perhaps a mother's staying at home for a

prolonged period, though initially advantageous for the early development of the child, may not be paid for later in adolescence. (It should be added that the burden of the second shift so thoroughly occupies all the free time of a working woman that it can have as limiting an effect as staying too long at home.)

Now what about the Socialist pattern? It can be argued in the abstract that the trend dominant in Socialist countries (which also corresponds more to the traditional notions of emancipation) is a more positive solution of the problem since it makes work a permanent feature of a woman's life. This assertion, however, does not stand up when the present actual situation is analysed.

As was made clear earlier, for the great majority of working women today, permanent employment is paired with the tremendous burden of household responsibilities, which in Socialist countries take up even more time than in the highly developed capitalist countries owing to the lower level of technical development and the lower prevailing standard of living. This is true despite the fact that the State takes important and significant steps to ease this burden, principally by financing services connected with the care of children. The majority of these women work because of purely economic pressures and hold low-level jobs which are often more monotonous and done under worse conditions than average.

Some Socialist countries have lately taken steps which may shape the lives of women more towards the American pattern. In Hungary, for example, measures were recently introduced entitling a woman, after her twenty weeks of maternity leave on full pay, to stay at home until her child is 3 on leave of absence from her job. In the case of successive births this period is prolonged until the youngest child reaches 3. During this period the mother choosing to stay at home is paid 600 forints a month[1] for each child under 3 and the State guarantees that when she returns to work she will have employment similar to what she had before bearing the child, and with no loss of rights.

These regulations particularly help those women who do low-paid unskilled work and it is of course mainly these who take advantage of them. In their case, for financial reasons if for no other ones, home duties are a greater burden than average.

One cannot as yet estimate what long-term effects these measures will have on the position of women since they only came into force in 1967, though the reservations mentioned in connexion with the American model of course apply. Naturally, these long-term effects will be influenced by the economic and social development of the society itself.

From all the above, it can be said that the movement for the emancipation of women has reached an impasse filled with dilemmas, with no hope for an early real solution of the problems.

THE TRADITIONS BEHIND THE IMPASSE

One must always be mindful of the fact that the world which women wish to join

1. Approximately U.S. $51 per month at the official rate of exchange ($1 = 11.74 forints).—Ed.

as equal partners is the world of men, a world in which the leading and more enterprising roles traditionally belong to men. The objective reasons for the present stagnation of the emancipation of women were discussed above, and I should now like briefly to underline the influence of traditional attitudes.

Since—to modify Simone de Beauvoir's words to a certain extent—we are born neither men nor women but grow into such, the cultural patterns and values which influence this process largely determine the psychology and the attitude of the two sexes. The traditional cultural stereotypes which are prejudiced against women have a lasting and profound influence on the feminine problem for the simple reason that their continued acceptance by the majority in fact produces the sort of phenomena which make them self-justifying and self-perpetuating.

Even in Socialist countries, whose official Marxist ideology completely accepts the principle of the equality of the sexes, in actual practice traditional notions, according to which the chief and basic function of woman is linked to bearing and raising children and to ensuring a harmonious family life, still retain their sway, on both the ideological and public-opinion levels.

True enough, schools give the same education to boys and girls, but the approval of the traditional division of labour between the sexes is implied in the value system transmitted by the education.

The persistance and domination of the cultural stereotypes is illustrated by the results of one of our investigations, made with the top class of an elementary school in a Budapest working-class district. The students queried were around 14 years of age. This investigation showed that 87 per cent of the girls mentioned marriage and family as one of their main aims in life. The boys, on the other hand, named material success as their primary goal in life, something the girls hardly mentioned. Only 18 per cent of the boys mentioned forming a family as a primary objective. No wonder, then, that it is most noticeable that the intellectual curiosity of the majority of girls lessens beginning at early adolescence, for their interests are moving in other directions.

NEW MEASURES

The organism of women serves human reproduction. However, the only thing that follows from this is that women have the human right to bear children, and that since this coincides with the interests of society, the latter must help women to exercise this right.

One possible form of help is to offer a number of concessions which will help working women, similar to those mentioned above. Yet, however magnanimous such arrangements may be, their final benefit appears to be doubtful since they firmly codify a situation where women are not a work-force of equal value.

That is why, in my opinion, society ought not to direct its efforts merely towards establishing 'compensatory' privileges for working women. What it ought primarily to do is to create the general conditions which will make it possible for large masses of women to take an equal part in all aspects of the life of society. This of course demands a continuing struggle against the prejudices that hinder

a more even distribution of the burdens of homemaking—but it also demands much more.

First of all, a major financial effort must be made, regardless of the problems that stand in the way, to provide an extensive range and network of service organizations and establishments to take over a large share of the household work. The cost of these services should be so low that all women, regardless of income, can take advantage of them. Their existence depends only on the degree to which society as a whole is willing to concentrate its resources to establish, maintain and expand them.

At the same time, it may be well possible to 'socialize' certain aspects of housework in a different way. The dullness of housework today, with the consequent low efficiency and low prestige, no doubt largely derives from the fact that it is an untrained and unskilled activity. Might it not be possible to provide training which will turn homemaking activities—or at least some of them, such as looking after children—into trades or professions? Then certain people would simultaneously look after their own homes and do the appropriate work of a few other families. This would create realistic alternatives both for women who prefer activity within a family environment, and for those who want to escape from it.

These are most limited proposals and even if successfully applied would lead to no more than that women would finally become equal partners in a world which is itself a long way from being an emancipated one. It is this fact which decisively determines how far the true emancipation of women can go.

As long as a significant part of the work done by all people is physically onerous, uninteresting and monotonous, as long as impersonal social mechanisms regulate the distribution of people to the various fields and kinds of work in a manner that is independent both of their wishes and individuality, women cannot be truly emancipated, for no one is. To paraphrase Marx, feminine emancipation is not possible without human emancipation, that is, without creating the circumstances under which every man and woman has the possibility to chose an activity that best suits his or her personality, interests and abilities.

Women and work (II): Social attitudes and women's careers

by Riita Auvinen

Equality of opportunity for women in education and employment is legally a fact and factually a fiction—because social attitudes are more constraining than law. Attitudes about woman's role and marriage not only constrain a girl throughout her entire education towards 'feminine' fields and away from 'masculine' fields—such as science and engineering—but strongly inhibit her aspirations towards high achievement in her chosen career and towards positions of leadership in competition with men. Woman's traditional burden of housework and child care, though she may be employed or studying, puts her at a further unfair disadvantage, so the husband and society itself should take over some of the domestic load.

A thoroughly reliable study on the features of a society developing scientifically and technically has just been completed in Finland. According to this study, one particular feature that stamps such a society and underlies all its activities is the striving for efficiency; this striving for efficiency becomes a central value and goal. And efficiency calls for a sophisticated utilization of the labour resources of the society, taking full advantage of all those available.

Because of the constraints of the sex role which has been assigned them, women represent a considerable reserve oftalent—a 'minority group', though a majority in absolute numbers—which has not been fully placed at the service of society. An industrial society aiming at efficiency and valuing ability is unlikely to leave this reserve untapped. Thus, it is understandable that in Finland, as elsewhere in the world, efforts are being made to place men and women on a fully equal footing in education and employment and to offer men and women the same opportunities in the life of society.

Women's right to have the same training and enter the same professions as men is, in fact, to a large extent a formal national objective. From a legal point of view, they have already attained this right; legislation between 1864 and 1929 has given Finnish women almost complete equality with men, and with industrialization women's involvement in education has increased.

In fact, however, in Finland, as in every country in the world, women have far from equality in employment. They are largely under-represented in many fields, particularly scientific and engineering fields, and find themselves holding lower-level positions, on the average, in almost every field by comparison with their male colleagues of comparable training.

While the legal barriers to the full and equal participation of women in every field of education and every field of work have largely disappeared, other major obstacles still remain, and these are perhaps even more effective than the legal ones. These obstacles are based on social attitudes about the work of women—attitudes, I hasten to add, of women as much as of men—all centred around existing and archaic conceptions of the sex role of women. This article will examine these particular obstacles.

SOCIAL ENVIRONMENT AND CHOICE OF CAREER

In spite of all efforts toward equality, environmental influences today still determine to a considerable extent the opportunities of the individual, both in choice of profession and in subsequent advancement in his chosen field. The revisions in educational policy which have been drawn up in Finland are directed toward democratization of the school system and increased effectiveness of teaching. However, since choice of career is a long-term process, often beginning long before the individual enters on training leading to his actual profession, educational policy can affect this process of selection only in part.

The fact is that individuals from different social environments encounter varying obstacles and receive varying incentives which affect both their application to their studies and their choice of occupation. Thus, in addition to dealing with economic factors which affect choice of a career, such as low family income, an effort should be made to eliminate what we may call 'the social distance', which equally affects educational and vocational choice, in order to make opportunities in these areas more equally available to all. This latter is a problem above all of attitudes and of how they can be influenced.

In the individual's choice of a programme of study or in his vocational choice, personal preferences can be considered primary. These preferences in turn are based on the individual's own values, and are generally dependent on his own personal make-up, background, experiences and the options he considers available to him. While sharp social norms which definitely prohibit or compel certain individual preferences are rare, none the less norms which favour or restrain the choice of a given field of education or work as appropriate or inappropriate to a given social group, sex or class may be very common. Since personal values are acquired from the social environment, they

are necessarily affected by the norms prevailing in the environment.

Clearly, then, while social and educational policy can play a major role in determining what opportunities an individual perceives as open to him or her, this is but one aspect of the issue. In addition, an effort should be made to change the social and individual values and norms on the basis of which the individual makes his educational and vocational choices, giving full recognition to the fact that these norms and values may affect educational choice at a very early stage and sharply restrict the range of occupational options that later remain available.

While stated in general terms, these are the factors which inhibit women's academic and professional advancement in the broad sense. They contribute to the fact that the proportion of women particularly in science and engineering is small, for these fields are, by the norms of society, male-designated and female contra-designated.

In what follows, I wish to examine in more detail the social norms which affect educational and career choice, relate them to woman's sex role and make suggestions as to some steps which should be taken to bring women into more widespread and equal participation in the work life of society, particularly in scientific and technical careers, in order to give society the full benefit of the largely untapped talent resources that they represent.

THE MARRIAGE CAREER

Perhaps the factor which most contributes to the low participation of women in professional careers as well as to the lesser success of women in their studies and in their professions, once chosen, is that of women's own attitudes. Marriage is still considered by women to be a woman's career, and girls often spend their time daydreaming about a good husband instead of studying in order to enter a good profession. As long as the idea continues to prevail that a woman's main life sphere is the home and the family, and that professional skills are important only as insurance against spinsterhood or widowhood, we can hardly expect women to be as interested as men in obtaining academic and professional qualifications, still less in competing with men in such fields as science and engineering.

Such attitudes not only affect choice, but affect level of aspiration. It seems to be characteristic—certainly of Finnish women and probably of women in all countries—that they avoid positions of leadership or responsibility.

There is no longer any difference between the sexes in level of education, and in the younger university age-groups women are even in the majority; therefore neither lack of adequate training nor lack of ability can be considered as an explanation of women's lack of success. Entrance into high positions now depends to a great extent on the woman herself, on her desire to lead, to take responsibility and to participate in decision-making. For this, confidence in one's own abilities is needed, a confidence which women seem to lack in spite of their high level of education. In order to eliminate this lack, it has been proposed in Finland to give women training in leadership together with men in the future.

DISCRIMINATORY VOCATIONAL GUIDANCE

The attitudes of women about marriage and suitable feminine careers of course reflect those of society as a whole. These attitudes make themselves strongly felt in the vocational guidance which helps orient a young girl's educational and professional choice.

On the basis of the data available about the mental capabilities of men and women, there are no differences in abilities significant enough to justify vocational placement according to sex. In spite of this, according to the attitudes prevalent nowadays even in official vocational guidance work, a large number of jobs and professions are classified as either men's or women's. Such a rigid basis of vocational placement, tied to sex, restricts the individual's opportunities of developing his talents and inclinations, and causes economic loss to society.

In particular, women's technical and mathematical abilities today are largely unutilized and undeveloped. This is particularly regrettable when we recognize that in the automated and programmed society of the future, the physical differences between the sexes—strength, for example—will be of no importance, and even today are not a major factor. On the other hand, special talents and abilities are becoming more and more necessary in order to carry out highly skilled jobs requiring an advanced level of education, especially in mathematics and technology.

Vocational guidance has been offered in Finland for about twenty years and is today an official government activity. Such guidance is given in two ways. One of these consists of vocational guidance courses which are given in the schools; these provide basic information about various occupations and about working life in general. They also provide some basic education designed to change the students' attitudes towards work. The other way is by individual vocational guidance.

The purpose of the education in basic attitudes is to try to enhance freedom of vocational choice by modifying stereotyped and inappropriate attitudes and values concerning professional and working life. How well teachers are able to provide this kind of instruction is an important question. It can be assumed that in many cases they are, in fact, not qualified, since many teachers' own concepts are out of date in this respect.

The vocational guidance textbooks used in the schools aroused some criticism in the past. They perpetuated outdated conceptions of sex roles, indiscriminately labelling certain occupations as being either men's or women's, and they placed women's vocational training in an inferior position relative to that of men. For this reason, these textbooks were largely revised in 1968.

The problems of vocational choice, however, are not always resolved by means of class-room instruction on the subject. Personal guidance by a professional counsellor is necessary. The point of departure for such guidance is to preserve as far as possible the individual's freedom of choice, so the personal preferences of the individual must form the basis of guidance.

These preferences on the part of the girls continue to be limited to a particularly narrow range, due mainly to traditionally conceived sex roles. Thus, one

study on vocational guidance showed that the counsellor was able to suggest to about one-third of his students occupational possibilities which they had not previously considered, but that this happened significantly more often with girls than with boys, indicating that the aspirations of girls are less realistic than those of boys.

SEX-ROLE ORIENTED EDUCATION

Traditional attitudes towards the respective roles of the sexes strongly permeate the entire educational system, reinforcing a false division of labour between men and women.

The Finnish basic school system, compulsory for all, was created in 1921 in order to give boys and girls the factual knowledge and skills necessary in everyday life. Academic instruction has been identical for boys and girls during the entire existence of the school system. Practical instruction, on the other hand, was conceived on the basis of a division of labour between the sexes which was appropriate in an agrarian society. The girls learned housekeeping, home economics and textile crafts; the boys learned wood crafts. This division between boys and girls has remained unchanged up to the present time.

Such a difference in practical instruction helps to maintain the idea, already shown to be false, that it is sensible to divide work tasks into those suitable for men and those more appropriate for women. Furthermore, the lack of practical information, contact and experience in the basic schools has prevented girls from becoming interested in technical occupations such as those connected with the wood or metal industries or with electronics, and this in turn has handicapped them in applying to vocational training schools in these fields.

The first prerequisite for giving boys and girls equal educational opportunities is to give them the same basic education, in practical aspects as well as academic aspects. The concept of 'masculine' and 'feminine' fields of work should not be allowed to appear in the schools. On the contrary, pupils should be educated by telling them that individual differences in aptitude are greater than any over-all differences between the sexes. The school system should try to eliminate discrimination between the sexes by giving as far as possible the same instruction in practical subjects to boys and girls, and by postponing special courses affecting occupational choice until the pupils are mature enough to consider their own personal aptitude for a given field.

The period of vocational and professional training is from the point of view of life work more important than basic education. Women's professional training has not been given the same degree of attention in Finland as has that of men. Furthermore, women have been primarily guided into and trained for 'women's' fields, following conceptions of men's and women's work which survives in homes, among employers and in those parts of the administrative hierarchy concerned with vocational training. As a result, women acquire less-adequate professional training than do men, and are relegated to the status of a manpower reserve which is tapped only in case of need.

In 1966, two-thirds of all Finnish

youth over the age of 16 continued their education after basic school. Boys enter actual vocational training more often than girls and spend a somewhat longer time acquiring their vocational training, but the girls form a higher proportion of the population of academic high schools.

Just as in the professional fields, the vocational school system is characterized by a division of males and females into different lines of study. In 1967, 73 per cent of the boys in vocational schools were studying technical subjects or metal and wood crafts; of the girls, 31 per cent were in commercial and office work courses, 24 per cent in various health-care courses and 18 per cent in cooking and home-economics courses. The proportion of girls is at least 90 per cent in the following fields: nursing and health care, typing, textile crafts, cutting and sewing.

Clearly, although the courses in vocational schools proper are theoretically equally open to both girls and boys, in practice the two sexes follow different lines of study. Apart from personal attitudes, this is due to the fact that in the crafts and home economics courses in the primary and extended primary schools boys and girls are in a different position. This differential training, spanning several years, places the sexes in a different position when it later comes to vocational or educational choice. A re-evaluation of sex-linked criteria of choice would make it possible to pay greater attention in vocational training to considerations of actual aptitude, which would be beneficial for the individuals concerned—and to society as well.

Now let us see what happens in Finnish academic high schools. First, however, it should be noted that boys applying to high school receive extra entrance points not given to girls in order to ensure equal numbers of the two sexes at secondary level. This is due to the fact that, on the average, boys score somewhat lower in the final report from primary school, which is assigned a certain number of points and which has a considerable effect on acceptance or rejection by the high school. (Later, in applying for university admission, boys are also given extra points if they have performed their military obligations. Girls cannot receive such points, since they do not serve in the armed forces. Nor do female university applicants receive such points for having borne a child, though child-bearing is as important to society as military service, and restricts opportunities of study and the accumulation of points to the same extent. There has never been any suggestion in Finland of granting women such 'childbirth points' towards university entrance.)

The academic high schools included 57 per cent of the age-class in 1967, with 56 per cent of the students being girls. The students in these schools have to choose between two and sometimes three lines of specialization: languages, mathematics and the humanities. In making this choice, they are guided by their experience with these subjects acquired in middle school (age 11-16). In 1967, a majority of girls (62 per cent) chose the language course, a majority of boys (64 per cent) the mathematics course.

The line of specialization has far-reaching consequences in determining the programmes of study one can follow at the university, thus in choosing a professional career. Yet it is very rare for the students

to have explained to them, before making their decision at the high-school level, the respective advantages and disadvantages of the various fields of study at university level.

Since the 1940s girls have completed the university matriculation examination more often than boys. The proportion of girls in university education has also grown continuously, and they now constitute half of all the students. Thus, women who have completed their secondary education do not continue on to university education as often as men. None the less, international comparisons indicate that the proportion of women university students in Finlands is higher than in any other European country.

Interruption and determination of higher education used to be more common among women than among men in Finland. Since the mid-1950s, however, the proportion of women among university students and among those completing their academic studies has been about the same, indicating that women and men complete their studies equally often.

Different social attitudes towards the two sexes, then, no longer affect academic study quantitatively, but still do qualitatively. Choice of field of study according to sex is still very common among university students, although in the 1960s there have been signs of a lessening of this tendency.

An examination of Table 1 reveals these points clearly. It is manifest that home economics and nursing are entirely women's fields. Women formed the vast majority (80 per cent) of those in the humanities, where many of them qualify as language teachers. However, for many others the humanities represent simply a kind of general university course taken when one

TABLE 1. Distribution of Finnish university students according to course of study (1965)

Faculty or course of study	Total students	Female students	Percentage of female students
Home economics	287	287	100.0
Nursing	476	476	100.0
Humanities	10 764	8 646	80.3
Commercial design	286	186	65.0
Primary-school teacher training	961	489	50.9
Theology	1 147	572	49.9
Physical training	379	187	49.3
Commercial subjects	3 451	1 627	47.1
Social sciences	4 964	2 138	43.1
Mathematics and science	6 307	2 671	42.3
Medicine	2 211	856	38.7
Agriculture and forestry	823	267	32.4
Veterinary subjects	100	32	32.0
Law	2 042	539	26.4
Engineering and technical subjects	3 864	284	7.3
TOTAL	38 062	19 257	50.6

has no specific career in mind. This point is particularly emphasized when we note that whereas 45 per cent of all the women at university level were in the humanities, only 11 per cent of the men were.

There is no sexual label on such fields as primary teacher training, physical training, theology and commercial subjects, where women and men were about equally represented in 1965. What is particularly interesting, however, is that women formed about 40 per cent of the total studying mathematics and science, as well as of those in medicine and the social sciences. In the first two of these three fields, particularly, this is quite a high proportion of females by comparison with the situation in the universities of other countries of Western Europe and North America.

By contrast, engineering and technical subjects have been only slightly penetrated by women and still remain largely a masculine domain, with women constituting only 7 per cent of the student population at the Institute of Technology and Engineering, where these subjects are taught. And even these few women students tend to concentrate in textile engineering and architecture. One reason so few women can be found in the institute is that for the most part they lack mathematical training, which prevents them from applying for admission—this is in addition, of course, to the social attitudes that steer women away from such 'unfeminine' fields.

When we come to the doctoral level of studies, what we may call the level of definite professional commitment, two significant observations can immediately be made.

The first of these is that here, just as at all other levels of education, sex-role orientation is strongly manifested. Thus, most doctoral dissertations defended by women are in fields that are connected with the traditional feminine role or are otherwise considered more appropriate to women. However, the many dissertations by women which are not in such fields indicate that women are quite capable of doing research in non-sex-role-oriented fields as well, and the confinement of the majority of women to the 'feminine' fields is due for the most part to social prejudice.

The second significant observation is that while the percentage of women taking their doctorates has increased over the number of years, it has increased far less, proportionately, than the increase in the number of women students at the university level. Figure 1 shows this fact clearly: whereas, by 1964, women made up slightly more than 50 per cent of the total student population, and, at that time, represented something over 40 per cent of all those graduating, women winners of doctorates still remained somewhere around 10 per cent.

Most women take their doctorates in some field of the humanities or else in medicine. Up to 1964 there had been altogether 70 dissertations by women in the humanities and 68 in medical science. On the other hand, during the same period, there were only 22 dissertations by women in the natural sciences or mathematics, and only 2 in engineering.

On the average, according to the statistics of the University of Helsinki, in the period 1920-63 there were, in all faculties together, six times as many dissertations defended by men as by women. The ratio of feminine to total Ph.D.s reached a peak during the period 1950-55 of around 11 per

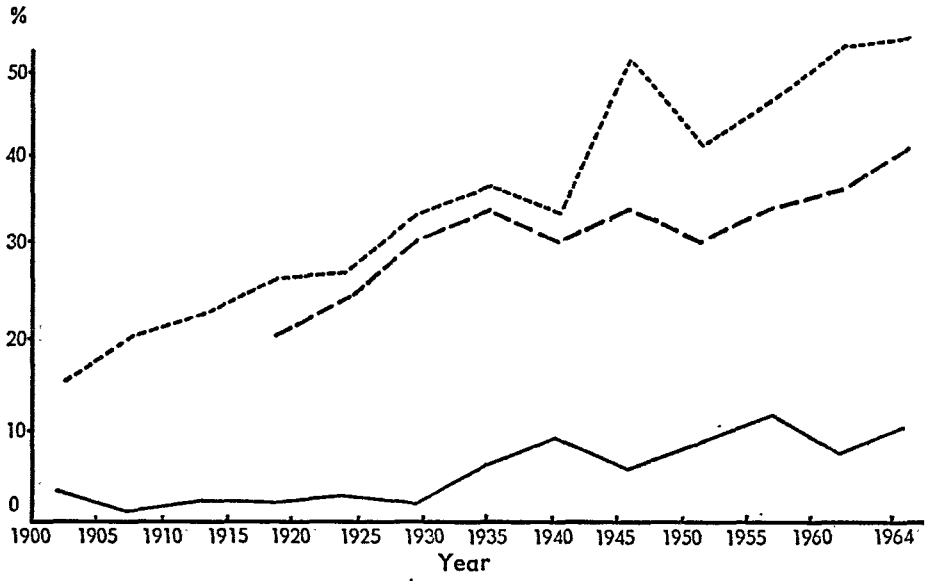

FIG. 1. Proportion of women at different levels at the University of Helsinki (---- among graduates; ---- among those graduating; —— among winners of doctorates). Figures used are averages for five-year periods.

cent (average); this can be explained by the large proportion of women students during the Second World War period (1939-44). The percentage of feminine Ph.D.s then dropped to a low of 7 per cent for the 1955-60 period, but has been climbing back since, reaching a level of around 12 per cent by 1966.

In sum, therefore, the commitment of women to careers other than marriage —scholarly and professional careers— remains much lower than that of men, despite women's full access to and equal enjoyment of the advantages of university education. Yet, accepting that marriage is the natural and desired stage for women —and for men—should marriage be so great a block to high-level attainments? I believe not and I believe certain measures would greatly reduce this block. These I wish to discuss next.

REVISING THE TRADITIONAL DOMESTIC PATTERN

Marriage restricts the opportunities of women to participate in both the labour force and education, regardless of educational level. Table 2 clearly shows that the employment rate for married women is much lower than for single women and is consistently about two-thirds that of men, whatever the degree of education.

With the lengthening of the educational process and the lowering of the average age of marriage, it is no longer

TABLE 2. The employment rate of men and women in Finland in 1960

	Married women (%)	Unmarried women (%)	Men (%)
Those with an academic degree	67	83	92
Those with at least six month's vocational training	60	86	93
All over age 15	45	53	84

uncommon for a woman to continue studying after marriage. Simultaneously, it is becoming more common for women to continue working after marriage. However, the amount of time available to a woman either to work or to study is greatly dependent upon the division of labour within the family. In fact, how domestic tasks are divided up to a considerable degree determines the possibility of a woman's advancement in her profession.

In order for a woman to study or work effectively outside the home, it is necessary for the husband to participate to a relatively large extent in the household and child-care tasks, so that the pressures that generally fall heavily on the mother of the family may be redistributed more evenly. Yet, the narrowing of the gap between men and women as far as the division of domestic tasks is concerned has not kept pace with the external division of labour in society. Here we have a case of cultural lag. Technical and organizational development has been more rapid than the evolution of the attitudes of society.

Housework in Finnish society continues to remain the woman's job, despite the fact that women participate more actively here than in any other western European country both in the labour force and in education. The burden of household and child-care tasks means that working or studying women have less free time than any other group in our society. This affects not only the woman's career advancement and her educational opportunities, but even the profession or field of study that she will choose for herself. As we saw above, the level of a person's aspiration is affected by the possibilities the individual himself feels he has of achieving a given objective.

Not only is the family institution insufficiently flexible to adapt itself to the difficulties involved in women's employment or study outside the home, but the services offered by society to the family are equally traditional and are inadequate to the needs of today. Women, upon whom the domestic load falls so heavily, are unable—because of unavailability or high price—to buy the social services which will free them from their domestic burden and provide them with the additional time needed to attain success in their studies or careers. Men, who traditionally are more or less exempt from the family work-load, are more successful than women and outdo them in career promotion and in academic achievement. In order to compensate for this inequality and in order to guarantee the study opportunities of student mothers, the student union of the University of Helsinki began a day-care programme for the children of student families, on an experimental basis, in the autumn of 1968.

In order to achieve equality between men and women in the labour market, as well as in education, a more equitable division of household and child-care tasks between men, women and society is neces-

sary. The fair division of these tasks means that education in home economics must be extended. In contrast to the present system, such training must be given to boys as well as to girls, so that they, too, can acquire the information and skills necessary to do domestic work and child care. But at the same time, all child care and homemaking benefits now granted to female employees must be granted equally to men.

Women and work (III): The effects of technological change

by Madeleine Guilbert

Have the past fifty years of industrialization helped much to change woman's condition? Yes, in general. No, when it comes to employment. For, while industrialization has provided numerous new job openings for women, the work is still essentially of the same menial and poorly paid calibre as they have done since long before the spread of technology.

Will the new technology of automation change this picture? Not much, if present evidences can be accepted. Thus far, the introduction of automation in a plant has tended to wipe out low-skill jobs filled by women, creating either unemployment or else displacing the holders to other jobs still requiring the poorly paid feminine qualities of patience and manual dexterity.

INDUSTRIALIZATION AND EMPLOYMENT

Women have been taking employment outside the home since long before the development of modern labour-saving home appliances, which presumably freed them so they could do so. In France, women have been engaged in outside work since the Middle Ages; there were even guilds for women workers—kept under fairly strict supervision, it is true. In the eighteenth century, however, the number of working women increased considerably as the textile industry spread over the countryside and provided employment for peasant families in their own homes. Subsequently, as major industries came into being, from the first half of the nineteenth century onwards, ever-increasing numbers of workers began to flock to their factories—not only men, but women and children too, already conditioned by the textile industry and prepared to accept extremely low wages. The same sort of thing had occurred in England a century earlier.

By 1866, 34 per cent of the non-agricultural working population in France were women (2,775,000). This movement continued and, between 1866 and 1906, the number of women in non-agricultural occupations grew by 1,600,000, almost one million of whom were in industry. Thereafter, the number of working women remained more or less stable, though there were considerable modifications in the way in which they were distributed. In the traditional branches of production—the textile or clothing industries, for example—the number of working women decreased, as did the number of men. On the other hand, women played a greater part, both in actual numbers and in percentage, in growing industries such as the metal and chemical industries, where advances in mechanization facilitated their employment. At the same time there was a marked increase in the number and percentage of women in the tertiary sector,[1] an increase directly related to the progress made in the education of women. From then on, women who went out to work came from all social spheres; the diversification of the work available opened it up to new layers of society.

The changes brought about by the growth of industrialization were accompanied by deep-seated psychological alterations. The industrial era transformed people's views about work, and this was bound to lead to such changes. Work came to be regarded as an activity proper to the nature of man, something necessary for the harmonious development of his personality. Nowadays it is an exception —indeed almost scandalous—for a man not to work. Admittedly, this is not true of women; if they do not work outside the home, it is accepted that it is because they are doing housekeeping.

Nevertheless, employment outside the home has now become an important part of life for many women, even when combined with home duties. Indeed, their participation in working life is at the root of the problems relating to their participation in social and political life. In any case, it can be said that the development of industry, by making it possible for women to enter an increasing range of employment, has opened up to them ever-widening spheres of social activity and has brought about important changes in their status. At the same time, certain changes have taken place in family life, where women are increasingly taking over responsibilities which were once considered exclusively masculine.

It should also be noted that the development of communications technology —which in its turn is related to industrial development—has brought into the home the means of extending the range of women's interests. Women, who used to be almost completely ignored, have now become a very important audience for the mass communication media, particularly the press.

OUTSIDE THE HOME, THE SECONDARY SEX

However, the changes in the status of women that have accompanied the devel-

1. The three sectors of the economy are: *primary:* agriculture and mining; *secondary:* industry and manufacturing; *tertiary:* services.—Ed.

opment of industry are far from being all for the good. All industrial societies are faced with problems concerning the status of women which are nothing other than signs of resistance to these changes. These problems take different forms in different types of society.

In some countries, anti-female discrimination is reflected in their institutions and in political, legal or professional matters. In others, while discrimination is not always apparent, yet there are many anomalies. Many examples could be given: inequality of access to education; inequality of access to vocational training; inequality in promotion; less pay for equal work; and less participation in political and trade-union activities. Even in the Socialist countries, which hold as a principle that there should be no discrimination against women, there are discrepancies in the allocation of political responsibilities, of work based on qualifications, and of professional responsibilities.

What are the elements involved in this state of affairs? First of all, there is the weight of tradition. It is a fact that, in all industrial societies, many women do not work outside the home, even in circumstances where economic necessity would seem to demand it. Some of these prefer to remain at home, even if their family obligations no longer take all their time. Others are more or less constrained to do so by social or family pressure.

The weight of tradition—the belief that most of the housework should be done by women—is still felt, even if they go out to work. A recent time-budget survey of families where women have outside jobs (Table 1) showed that on working days and even more so on Sundays women still spend much more time on domestic work than do their husbands.

TABLE 1. Average hours daily allotted to housework and child care (one or two children)[1]

	Wednesday	Sunday
Women		
Factory workers	3.87	7.12
Office workers	3.34	6.87
Professional workers	2.92	6.62
AVERAGE	3.37	6.87
Men		
Husbands of factory workers	0.38	1.37
Husbands of office workers	0.92	1.81
Husbands of professional workers	0.43	1.46
AVERAGE	0.49	1.65

1. M. Guilbert, N. Lowit, and J. Creusen, 'Enquête Comparative de Budgets-Temps', *Revue Française de Sociologie*, October-December 1965, p. 487-512.

The effects of the evolution of industry in the last fifty years upon women's work must also be carefully considered. The growth previously mentioned in the number and percentage of women working in certain branches of industry is related to the move towards mass production and the more efficient use of labour after the First World War. This move, which began before 1914 in the United States, spread to other industrial countries; it led to an increase in the number of unskilled jobs as various tasks were redistributed and simplified. Many such jobs—the most simple, piecemeal and monotonous ones to which no responsibility was attached—were given to women.

In present-day France, the latest stat-

istics available (April 1964) clearly show that the proportion of skilled workers is much higher for men (44.2 per cent) than for women (12 per cent). More women than men are semi-skilled workers, 48.7 per cent of them falling into this classification as compared to 32.8 per cent of the men. Only 1.1 per cent of women hold positions of responsibility and 1.8 per cent are technicians or supervisors, whereas 8.6 per cent of men hold positions of responsibility and 10.9 per cent are technicians or supervisors.[1]

In addition to such discrepancies in employment there are differences in vocational training. Amongst the industrialized countries, the most pronounced discrepancies are to be found in those countries which first underwent industrialization. In the Soviet Union, where statistics about vocational training make no distinction between young men and young women, it would seem that such training is in almost all cases provided for both sexes. In France, public establishments for vocational training do not, in theory, discriminate against women. In fact, although a circular has been sent from the Ministry of Education reaffirming this principle, young women generally continue to be refused admission to establishments preparing young people for types of employment regarded as a masculine, though lack of space and equipment is usually given as the reason. As a result, most vocational training for women in France is in office work and dressmaking, despite the fact that the number of women working in the dressmaking trade is steadily decreasing.

The situation is somewhat better at the professional level, but problems arise when it comes to finding employment. Women holding the same professional qualifications as men are rarely offered posts of like standing. Women are, for the most part, given less responsible jobs, which means different relations with other personnel. However, it is in the employment of women in senior posts in industry that differences between countries seem the greatest.

Such differences in the work done by men and women are often paralleled by differences in salary. This is so in France, Italy and Belgium, as well as in other industrialized countries. It is true that the discrepancies which were so marked at the end of the last century have diminished. Certain international conventions (for instance, Convention No. 100 adopted in 1951 by the International Labour Conference and Article 119 of the Treaty of Rome, which set up the European Economic Community) have laid down the principle of equal pay for equal work. But there are still discrepancies, especially in some of the Common Market countries. In France, the quarterly survey of the Ministry of Labour for 1 April 1969 showed that on the average women are paid 7.4 per cent less per hour, relative to the wages of men, for work requiring the same qualifications or of the same nature.

The industrial jobs that women generally obtain are those in which it pays to employ female labour, because of their special aptitude for simple, repetitive tasks, often acquired through their experience in domestic work. This discrepancy, as a

1. Figures taken from a quarterly survey of the Ministry of Labour, given in *Revue Française du Travail*, October-December 1966, p. 92-3.

result of which women are apt to specialize in certain types of work, obviously has profound economic implications.

The other side of the coin is that the weight of tradition has not been all-dominant. In some fields of employment, women are now obtaining jobs hitherto closed to them. The number of women in the liberal professions has increased. Women may compete for entry into certain of the specialized higher educational institutions, and there is a slight increase in the number of women holding senior posts or working as engineers or technicians, though there are very few comparable examples in the workshop.

In sum, therefore, the growth of technology, in so far as it has increased the part played by women in the working world and in society, has been a major factor in improving the status of women. This evolution still continues to meet with opposition, an opposition expressed with varying degrees of intensity, but perceptible in all industrial societies.

HOW WILL AUTOMATION AFFECT WOMEN?

We may now well ask: will the profound technological changes taking place around us—especially those related to the development of automation—be likely to speed up the changes taking place in the status of women?

It is at once obvious that technological changes promise increased mechanization and simplification of household work. Obviously, too, such changes could transform working conditions—shorter working hours, for instance, would be a logical consequence of the development of automation. Moreover, automation tends to change the nature of the work carried out. The possible effects of these three aspects of automation will be considered in turn.

The mechanization of housework in itself can hardly be said to have had a decisive influence upon the status of women in the past. As has already been pointed out, the entry of large numbers of women into employment took place before the technological developments which have simplified domestic chores. Moreover, the women who work are not always those who can afford to have efficient home appliances. In addition, the time-budget studies already quoted show that in many homes where women work they still do most of the housework. Therefore, technical means of simplifying housework, however important they may be, do not of themselves appear to be determining factors for changing the condition of women.

A substantial reduction in working hours as a result of the development of automation would probably affect the situation much more, and might help to overcome some of the difficulties which working women encounter. For instance, working women would have more time to undertake further training.

Now, will the changes brought about by automation in the nature of work itself enlarge the work possibilities for women and enable them to obtain posts presently generally refused them? This is the most important question. If we look closely at the present situation, however, we shall see that no definitive answer can be given. Automation is more developed in some

sectors of industry than in others, and still affects only a few industries, even in the most industrialized countries. Furthermore, it is rare for an industrial firm to be fully automated; usually only one sector of a firm is automated, or else only some of the machinery installed is automatic or semi-automatic. Finally the industries using automated methods of production are rarely those where women workers are in the majority.

Why are industries employing a majority of women less automated than those employing a majority of men? Do the so-called female tasks in industry have certain characteristics which make them more difficult to automate? Or are there economic reasons—particularly the relatively low cost of female labour, which may minimize the savings to be achieved by automating a process—that help to brake the extension of automation to industrial sectors employing a large percentage of women? This may indeed be true of industry, but it does not apply to banking and insurance, where the work force is largely feminine and where computers are now in widespread use.

The effects of automation upon the working conditions of women have not been sufficiently investigated. The observations I have been able to make in this area concern one particular industry, the metal-working industry.[1] These observations showed that long-term effects on the work of women, which are very difficult to prognosticate, must be carefully distinguished from immediately observable effects which can, however, serve as an indicator. As for the latter, two distinct types of cases occur.

The first set of cases relate to work hitherto carried out by women where women are still employed after the introduction of automation. Here, I observed the replacement of production lines for manual spray-gun painting by a chamber for automatic electrostatic painting and by an automatic conveyor belt for lacquering and printing flexible tubes. In these cases women were given the work of doing by hand what the automated process does not do, such as putting workpieces on the conveyor and removing them. The main requirements for such work are manual rapidity and precision and the ability to repeat exactly the same set of movements. This technological advance, therefore, has not really changed the nature of the labour done by women. Indeed, it has tended to emphasize its piecemeal, repetitive nature.

The second set of cases observed in the metal-working industry showed that when a process is automated female employees are partially or totally eliminated and replaced by male workers. When, for example, foundries installed sand-blowing machines to pack sand automatically into moulds to make cores for castings—a task which used to be done by hand by women —the result was a partial cut-down of female labour; the machines are operated by men, but women are still employed to remove the cores from the moulds, a delicate manual operation.

On the other hand, when automatic presses are installed, the women employees are gradually eliminated by stages. I observed this process in a bearing factory

1. M. Guilbert, *Les Fonctions des Femmes dans l'Industrie*, The Hague, Mouton, 1966, p. 222 ff.

being automated. In this particular factory, three types of machines were concurrently in use to polish bushings. Only women were employed to operate the oldest machines, in which the workpieces were fed in separately by hand. Both men and women were employed on the second type of machine, which was more modern and bulk-fed, but the women were there because they were old employees and only men were being taken on as new operators. The third type of machine, which was just being installed, was fully automatic; it needed no more than maintenance and supervision, and only men were employed for this.

Such examples appear to indicate that when automation is introduced the proportion of women workers is reduced. This is not to say that the installation of automatic equipment always leads to an over-all reduction of female employment. In fact, since automation particularly takes place in growing firms, women are often simply transferred to non-automated departments, especially those where rapidity and manual precision are still the main requirements. The same sort of thing occurs in office employment: a chain of stores, for instance, which has automated its accounting department, employs male programmers and operators for this work and offers jobs as saleswomen to women hitherto employed there. It would seem, therefore, that in many cases the introduction of automation accentuates the tendency for women to be employed only on repetitive or unskilled work.

One cannot, however, be categorical about the possible effects of technological change, and the consequences at present observable should not be considered definitive. They are not irreversible, and it may be that the wider spread of automation will favourably affect the condition of women by opening up new fields of work for them. We cannot over-emphasize the importance of providing vocational training for women at a high standard and in a wide range of subjects, so that they can obtain the new jobs that are too often closed to them at present.

By pointing out the great changes which industrial development has brought about in the condition of women, by underlining the complex nature of the obstacles which still continue, in this era of science and technology, to block improvements in the status of women in industrial societies, I hope to have made it clear that many complex and far-reaching changes yet remain to be made.

Women and technology in developing countries

by Barbara E. Ward

The tide of technological change—represented by labour-saving household devices, employment in factories, the conveniences of the towns into which people are migrating, increased education, and medical advances, particularly the Pill—is increasingly emancipating women in the developing countries from ancient ways of life which were characterized by heavy feminine burdens of toil. Yet, paradoxically, these instruments of liberation are at the same time causing many women to be chained more tightly than ever to their domestic duties.

At one level of argument the title of this article embodies a fallacy. Technological developments do not necessarily discriminate between the sexes any more than between colours, creeds or social classes. Changes in methods of transport and communication, increased control over epidemic diseases, availability of mass-produced goods, etc., are not intrinsically sexually selective. Already one cosmonaut has been a woman, and women are everywhere drivers of automobiles and aeroplanes, surgeons, precision workers of all kinds, computer operators and so on. Thus, even in its most dramatic aspects, the technological revolution is not an exclusively male preserve. We are all in it together.

Nevertheless, the prevailing division of labour between males and females inevitably brings it about that in most parts of the world there are certain aspects of technological change which, potentially at least, are of more direct significance for women than for men. Domestic organization is everywhere primarily a female responsibility. While changes in it certainly do affect men, too—and may indeed draw men into domestic chores more frequently than has been customary in the past—their effect upon women is always direct and often profound. Though less spectacular than flights to the moon or organ transplants, the developments in everyday matters (such as transport) and the

invention of new domestic appliances (such as refrigerators, rice-cookers, electric irons and the like—not to mention the Pill and other contraceptives) have had, or will have, a far more revolutionary impact upon domestic life and relationships and so, in the long run, upon the attitudes and values of both men and women almost everywhere.

THE EFFECTS OF TRANSPORTATION

A study of the changing roles of women in Asia, published by Unesco in 1963,[1] gives some vivid illustrations of the impacts of modern transportation on the lives of women in developing countries. A Thai woman gave a graphic description of the ways in which ordinary travel has changed since the end of the nineteenth century. A journey which took her grandfather two months on elephant-back and her father two weeks by train and on foot could now be accomplished in a few hours by fast car. An Indian writer in the same volume pointed out that modern means of transport have been one of the most liberating influences even upon women in full *purdah* (seclusion). And two women from countries as far apart as the Philippines and Ceylon explained in almost identical words how driving their own motorcars made it possible for each of them to combine successfully the roles of housewife, mother and professionnal educationist.

These writers were all highly educated representatives of their countries, and relatively well-to-do. However, the revolution in transport has affected less privileged women almost as much. For one thing it makes emigration possible, and is a kind of 'enabling clause' for urbanization. Where in the past the migration of workers, as in southern Africa for example, was mainly a man's affair, and women were left behind often for years at a time to carry on the home as best they could (with all the hard labour necessary for mere subsistence in a tribal society), the coming of relatively cheap and convenient mechanical transport makes the movement of whole families a fairly simple matter.

Recent migratory movements, like those from the Caribbean or the Indian sub-continent to the United Kingdom, though spear-headed by men, have very quickly included women and children as well. Here is a sphere in which 'modernization', which in its earlier stages was often entirely disruptive of family life, is proving far less so as it develops further.

At the same time, of course, more women than ever before are 'seeing the world'. It is still true that women travel away from their homes less frequently than men. Even today, my own village in south-western England contains several women who have never visited London and two who have never even been as far as the county town thirty miles away. None of the men has been so stationary. But these stay-at-home women are all over 60 years old. The younger ones have all travelled, some of them very far afield indeed. For good or ill they have made new personal contacts, seized new opportunities for education and employment, and have married men who in their grandmothers' days

1. Barbara E. Ward, *Women in the New Asia*, Paris, Unesco, 1963.

would have been considered 'foreigners'. Similar changes are taking place all over the world.

THE SPREAD OF EDUCATION

But travel is only one part of the modern system of communications. Not only people, but goods and ideas too, are being distributed more and more freely. The spread of books, newspapers and the telephone, radio, cinema and television marks a whole series of social revolutions. In education, the arts and entertainment, their influence is obvious, producing new knowledge, new concepts, new and modified social attitudes, new ways of passing time and new openings for employment. The volume already referred to points out that the husbands who refused to countenance the education of women because their wives might learn to send and receive love letters from other men foresaw only a very restricted few of the complex transformations that improved communications would bring.

One of the most striking accompaniments of that side of technological change which is connected with the spread of modern education has frequently been a widening of the intellectual gap between women and men, and—even more damaging for those it affects—between parents, especially mothers, and their sons. At its most drastic this latter gap may involve an almost complete breakdown in communication. The tragedy implicit in such a situation probably never affected very many families, and will in any case affect fewer and fewer as the numbers of educated girls increase, but there are still some women in Africa and Asia whose sons were sent to school in Europe so young that they find it almost impossible to talk with their mothers in their native tongue when they return home.

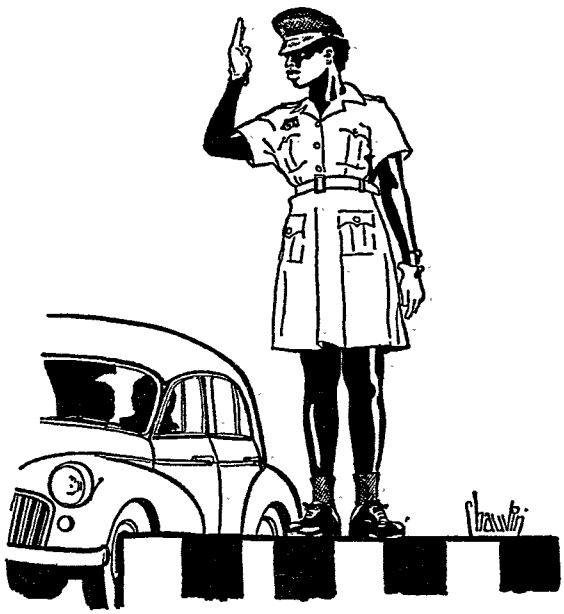

FIG. 1. As this policewoman of Lagos (Nigeria) illustrates, with the gradual emancipation of women in developing countries, jobs traditionally considered to be masculine are opening up to them.

Although the generation gap is seldom as wide as this, nevertheless during the years in which modern schooling is just becoming universal it is inevitably very great. Moreover, because the education of girls lags everywhere behind that of boys, women are likely to remain the greater sufferers for at least a long time to come.

The educational discrimination be-

tween the sexes affects relationships within the same generation, too. Marriages which break down because of incompatibility in this sense are not few. Any discussion of modernization which ignores problems of this nature (and they are many) would be seriously incomplete.

Even though it continues to lag behind, however, the education of women has probably been by far the most important factor in bringing about changes in their role and status all over the world in the last fifty years. It is education, moreover, that helps make it possible for women to take advantage of the many technological developments that can provide them with better material goods and save them from hard and time-consuming physical labour. Women who cannot read or keep accounts cannot successfully cope with urban life, public transport and modern kinds of shopping; nor can they understand the printed instructions which accompany so much of modern merchandise. Literacy gives them access not only to books and newspapers and letter-writing, but also—and much more important—to bus and train services, modern shops, and a whole new range of goods and services.

THE PRODUCTS OF TECHNOLOGY

The goods and household equipment that are now available are contributing to other aspects of the domestic revolution. Cloth, which in many places and until very recently had to be hand-woven (even, as in much of South-East Asia, hand spun) can now be bought by the yard; sewing machines speed the making up into garments, and even provide a source of income; mass-produced enamel, aluminium and plastic pots and pans are to be found all over the world; soap, cosmetics, medicaments, surgical plaster, even comfortable and hygienic sanitary towels, are on sale almost everywhere. For people who live in towns foodstuffs, once all laboriously planted, weeded, harvested and processed by family hand labour—largely female—are now available, ready-wrapped in the stores. Even in villages the preparation of food has in many places been made much easier by the introduction of electricity and piped water.

These things do not by any means exist everywhere in the world as yet, but they are surprisingly widespread, and where they do exist their effect upon women's lives can hardly be exaggerated. For example, there is a fishing village in Hong Kong (typical of many others), which I first visited in 1950. At that time all the fishing-boats were wind-driven, slow and at the mercy of the very uncertain weather of the South China Sea. All the fisher families lived entirely on their boats, owning no property whatsoever ashore. The village contained no radio, no piped water, no electricity, no latrine. Only two of the fishermen's children went to school and both of them were boys.

By 1966, all but one of the boats had been mechanized, and each had a radio. Many fishing families had moved their older members, most of their women and all their younger children into newly built houses on the land. There was a new school, with three trained teachers and more than a hundred fisher-pupils,

including all the girls between the ages of 7 and 15. There were also a splendid latrine and three stand-pipes with a never-failing supply of sweet water. In addition, there was a new maternity and child welfare clinic in the nearby market town, at which all the babies for the last five years had been born (previously all births had taken place on the boats, at sea).

In 1968 the generosity of a charitable trust in New Zealand made it possible for the villagers to purchase a small but adequate generator which gave them their electric light. Within six months every house had an electric iron, an automatic rice-cooker, and at least two electric fans to set beside its radio. One enterprising shopkeeper was selling iced drinks from his electric refrigerator, and there was talk of installing television.

In less than twenty years the women of this village have experienced a technological revolution which has improved their and their children's health, increased their expectation of life and given their children the chance of a good education. It has also improved their personal income, for now, for the first time, they have a good deal of leisure which most of them use to earn extra cash by making plastic flowers at home for a Hong Kong factory.

The women themselves say that the changes they value most are those which have brought better health and the chance of an education for their children. They also mention their appreciation of having more leisure and less everlasting hard work. They are quite well aware of the advantages technological change has brought to their own lives, discuss it clear-mindedly and often, and are busily looking forward to opportunities of buying still more electrical equipment.

On the other side of the world, in Mexico, changes almost as far-reaching have taken place in the same period. The key technological innovation in the villages there was a very simple one: the introduction, about fifteen years ago, of a mechanical method of grinding maize.

Maize, as used for making the flat, pancake-like *tortillas* which are the staple food, must first be soaked in water and then ground daily. Up till about 1950 most village women had to rise every day before dawn and trudge off to the natural rocks which were their grinding places. Grinding was done by rolling the maize between an upper stone held in the hands and the living rock. For an average household this took two or three hours—sometimes longer—and it was tiring work. Today the housewife simply takes her bucket of soaked maize along to the local mill, usually situated in a small shop. There she joins her neighbours in a friendly gossip until her turn comes round, and then the job is done for her—quickly, cleanly and cheaply.

The housewife also has piped water in her village now. She probably owns a sewing machine and—like her counterparts in the Hong Kong village—an electric iron, a radio and often a television set. She is still a very busy person and many aspects of the material conditions of her life would appear intolerable to a contemporary villager in a fully industrialized country. Nevertheless, her life is already vastly different from her mother's. Her daughters will undoubtedly see further changes, too.

THE SURGE TO THE TOWNS

The examples of change cited above—which stand for many—involve villages. However, it is obvious that the effects of technological change are still more apparent in towns, especially in the great metropolitan cities which have been developing at an unprecedented rate on every continent during the present century. It is here that the full impact of modern technology upon everyday living is experienced. Here are the centres of manufacture and distribution of material goods, and here are such large concentrations of population as to make at least some supply of services essential.

The surge to the towns, which is one of the major characteristics of our time, is to be explained as much by the 'pull' exerted by all these attractions as by the 'push' from an overpopulated countryside, for even where the countryside is not overpopulated (in Thailand, for example, or many parts of Africa) the towns continue to attract an apparently endless stream of rural emigrants. The reasons for this are made clear in the following true cases.

Two girls from the Hong Kong fishing village described above have married townsmen. One of them lives with her husband and three children in a small one-room apartment, measuring about 12 feet square, in a recently built block on an estate containing several thousand identical apartments. The family shares communal lavatory and washing facilities, but does all its cooking, ironing, mating, homework, sewing and sheer living in the one room, surrounded in the building by others with whom the family had no previous acquaintance and enveloped always by a volume of noise that has to be heard to be believed.

This woman has asserted over and over again, both spontaneously and in answer to direct questioning, how happy she is to have escaped from village life. Here, she says, everything is convenient. She and her husband own a refrigerator, two rice-cookers, an electric iron, a small electric heater (Hong Kong can be cold in the winter) and a television set. The water taps and flush toilets, though shared with others, are only a few yards away. A street market, shops and a small restaurant are at her door. The apartment block also houses a primary school, a clinic, a welfare officer and a social club. The rent is very cheap.

The other girl is less lucky. She lives in a squatter's hut half-way up one of Hong Kong's steep hillsides. Made of wood and beaten-out kerosene tins, the hut is far from weatherproof, and in the rains the earthen floor becomes a pool of mud. There is no toilet. The nearest stand-pipe for water is half a mile away, and except in the dry season it is easier to fetch water from a near-by (very doubtfully clean) stream. The three children are well dressed but dirty. So far she has managed to find a school place for only one of them. Her husband is intermittently unemployed.

Despite all this, this woman, too, frequently declares her firm conviction that she is far better off here than in the village. Pressed for a reason, she points to her electricity supply (probably illegally installed), her two rice-cookers, electric iron, fan and heater, and the sewing machine with which she makes a

little extra money. On being informed that she could also have all these amenities in the village now-a-days, she explains that life here in town is far less hard work than it ever was in the village, that town shopping is convenient, public transport useful, and the local welfare clinic on the spot. Finally she adds that she has far more leisure in town.

These two case histories are included in order to draw attention to the fact that modern technological innovations make it possible even for people living in what by most standards would be considered insupportable conditions of squalor and overcrowding to consider themselves much better off than they would have been in traditional circumstances. That there are enormous numbers living in towns (and villages) today who do not have access to the goods which would make them feel like this is true. The brutalities of acute poverty and actual hunger are still real enough. None the less, it remains true that more people, in absolute terms, have more goods than ever before, and that many of these goods liberate women in particular from at least some of the back-breaking work that has been their usual lot, and that more of the people so affected live in urban than in rural areas. Women to whom goods of this kind mean not just prestige but also less fatigue, better health and greater leisure are usually quite clear in their minds on this point. Generally speaking they want to live in town.

It is in towns, moreover, that women are more likely to find employment, though it seems likely that unlike men, who go to the towns to seek work, most of the migrant women who take employment in the cities of the world do so rather as a response to the economic necessity they find pressing upon them after they have arrived. And when wage-earning in town takes places, its effects are far-reaching, for it is likely to be in a non-traditional occupation, will probably be connected with modern technology and will bring with it far-reaching changes in domestic roles and in outlooks. Women working in modern textile mills, for example, or in a big store, business office or educational establishment, have to keep to fixed hours and their pay is usually based on hours worked. Because they have prior obligations to housework, catering, cooking and, above all, children, most women find this both difficult and tiring.

It is sometimes argued that the organizational problems that outside work poses for women are more easily dealt with in countries where the large, extended family exists, or where domestic servants are still easily available. This is probably true, but it does little to help the majority of working women who in any country come from the poorer sections of the population among whom both extended families and domestic servants are rare or non-existent.

Even among the upper classes in such countries the problems are becoming fairly large. With more and more varied employment available and wages rising, the attractions of factory work prevail easily over the few perquisites of domestic service. At the same time, the move towards 'going separate', that is setting up independent simple (nuclear) family households is very marked.

I have heard highly educated Asian women debating in worried tones the

same problem that worries their Western counterparts: now that at last we are educated and emancipated we find ourselves chained more securely than before by the sheer demands of domesticity. For such women one can predict an increasing resort to modern domestic gadgets.

The technological revolution, with its educational and other 'modernizing' corollaries, first frees some women from total immersion in the domestic sphere, then in freeing others begins to confine the first group again. Finally by producing still more technological equipment of a domestic nature, it may help to redress the balance it has itself destroyed.

THE NEGATIVE ASPECTS OF TECHNOLOGICAL CHANGE

Sometimes the impact of technological change has been unmitigatedly depressing to standards of living. This was very frequently the case in nineteenth-century Europe, for example. It was the basis of Dickens's attacks upon English society, and of much of the work of Engels and Marx, to mention only three of the most influential writers.

Relatively secure in their Western welfare states, with their remarkable new washing machines, detergents and deep freezes, bourgeois Western writers try to believe that such things cannot happen any longer. The world is supposed to have learnt its lesson; industrialization is expected to proceed in an orderly fashion, taking due care of the human relationships and the human wants of the workers. Yet in every continent there are back streets and shanty towns which, despite everything said above about the ways in which they can be made supportable, are a disgrace to civilization. A very large proportion of the hundreds of thousands who flock into towns live there below the poverty level. How can one decide whether or not they would have been better off if they had stayed in their villages? Put very simply, industrialization and urbanization still can, and very frequently do, depress as well as elevate standards of living.

Modern technological developments can have their Luddite effects too. Cottage industries (in which women are able to take a full part mainly because they involve work at home) are especially vulnerable. The story of the nineteenth century English hand-loom weavers is well-known: how, under their possibly imaginary 'General Ludd', they fought against their displacement by power looms, resulting in widespread unemployment, lower wages and shoddier goods. Exactly similar reactions have occurred all over the Orient.

It does not take the full force of large-scale foreign competition to drive small peasant industry out of business. The impact of local technological change can be just as dramatic, as the following illustrates.

Until about fifteen years ago the Melanau women of Sarawak, in East Malaysia, enjoyed a somewhat unusual economic and social independence because their individual contribution to the processing of the Melanau's single export crop, sago, brought them in a regular cash income. Then, about 1955, an enterprising Chinese invented a mechanical means of refining sago. Within a very few years the need for women's

employment had almost entirely disappeared—and there was nothing to take its place. The Melanau women gained enforced leisure, and lost their incomes; relief from toil meant also loss of independence.

The facile optimism which sees nothing but good in the increasing pace of technological advance is as obviously ill-founded as the equally facile pessimism which sees nothing but bad. Their circumstances being so different, Melanau and Hong Kong village women would be hardly likely to see eye to eye on this matter.

MEDICAL ADVANCES AND BIRTH CONTROL

There is, however, one field where the impact of modern technology upon the lives of women appears, on the face of it, if not unmitigatedly good, at least very widely welcome. This is the field of health, where medical advances have brought many improvements. Probably the most important of all medical advances is birth control, which is undoubtedly one of the crucial factors to be considered in any assessment of the effects of modern technology upon women. For the first time in human history there is the possibility of freedom from the physiological and social effects of the more-or-less continuous round of pregnancy, parturition and lactation which, with numerous miscarriages and the ever-present chance of death in childbirth, has been the lot of the vast majority of women between the ages of 15 and 50 since the human race began.

Moreover, the babies that are born are likely to survive. This, too, is crucial. A modern Westerner reads the pathetic inscriptions on the numerous tiny graves of past centuries which are scattered throughout the old burial grounds of Europe and North America with pity; most Asian, African and South American women would read them with a sympathy born of experience. One of the most striking differences between conversations with women in most of the so-called developed countries and most of the so-called developing countries today is that in the former one can ask: 'And how many children have you had?' whereas in the latter you ask: 'How many have you raised?' Increasingly as the former question becomes safer to ask in the developing countries—and this is happening—the roles of wives and mothers there will be marked by a new freedom from fear.

These are matters of peculiar personal concern to women. Their impact upon the structure of domestic relationships and thence upon the whole fabric of society itself is barely to be seen as yet. All that can be said at this stage is that the effects when they do become apparent are likely to be very considerable, unprecedented and, because of differing domestic circumstances in different parts of the world, various. And they will not be confined to women.

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Research group leader at the CNRS, which she entered in 1950, and senior lecturer in sociology at the Faculty of Letters and the Human Sciences of Tours. Member of the Study and Co-ordinating Committee on the Problems of Feminine Employment and of the Employment Committee of the General Planning Commission for Equipment and Productivity. Born 1910 in the Allier Department (France). Awarded doctorate *(Docteur ès lettres)* by the University of Paris in 1966. Married. Formerly (1945-48) special projects officer at the French Ministry of Labour. Field of interest is the sociology of employment, particularly relating to women and work. Author of some thirty papers in her field and the books, *Travail Féminin et Travail à Domicile* (1956), *Les Fonctions des Femmes dans l'Industrie* (1966), and *Les Femmes et l'Organisation Syndicale avant 1914* (1967).

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Valentina Tereshkova-Nikolayeva
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Chairman of the Soviet Women's Committee. First woman to fly in earth orbit. Born 6 March 1937, near Yaroslavl, U.S.S.R., daughter of a tractor driver. Worked in a tyre plant and then a textile plant in Yaroslavl, while continuing her studies by correspondence at a textile technical school. Made 126 parachute jumps as a member of the air club of Yaroslavl. On 16-19 June 1963, piloted the Vostok 6 for forty-eight revolutions about the earth, in a paired flight with Valery Bykovsky in another Vostok. Later in 1963, married cosmonaut Andrian Nikolayev and is now the mother of a daughter, Alyonka.

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Associate Professor of Anthropology at Livingston College. Born in 1937 at Montreal (Canada). Educated at McGill University and the London School of Economics (Ph.D., 1963, in political sociology). From 1963 to 1968, was Assistant Professor of Sociology at the University of British Columbia (Canada). Formerly Visiting Lecturer at Western Washington State College (United States) (1963) and at the University of Ghana (1961). Author of numerous papers in biological and social anthropology and the books, *Discipline and Discovery* (1966) (co-author) and *Men in Groups* (1969). Has two books, *Man to Man* and *The Biology of Social Relations* (provisional title), in preparation.

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