Theoretical issues in the study of automation

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M.A. THESIS 1968

CONTENTS

PREFACE

This essay is concerned with the principal theoretical issues which arise in the sociological study of automation. No attempt has been made to assess cromprehensively the social political and economic consequences of automation. I have taken the view that at the present time it is far more important to try and state the terms in which automation must be understood than to enter into the uncertain field of sociological prediction.

There are several reasons underlying the choice of my approach. The most important of these is that despite some twenty years of direct academic concern we have failed to state clearly what the sociological problems of automation are. This failure is due, in a large part, to the methodological inadequacy of a great number important studies. My claim is that it is a reflection, even a direct outcome, of the failure of sociological theory to state precisely what the relationship is between technological change and changes in the structure of social systems. It can be seen equally in those studies which examine the phenomenon of technical change in its consequences for society as it can in those studies with the

much narrower focus on the effects of technical change on the structure of industrial organisations. It is with studies of the second type with which this essay is primarily, though not exclusively, concerned.

My intention has been to describe, classify and evaluate a series of empirical sociological studies carried out in both Britain and America on the industrial consequences of automation. I have been particularly concerned with the theoretical soundness of these studies but I have also tried to assess what implications their findings have for some general accounts of the consequences of automation for society. In the last two chapters I have set out a theoretical model of the industrial organisation and the forces which underly its operation to see how far we can account for the effects of automation on the structure of organisations and to see how far we can understand the problem of the resistance to technological change.

In writing this thesis I have drawn freely on the patience, knowledge and experience of a number of people. Professor John Rex has been of more direct help than he could conceivably imagine. I have tried to meet his strict

standards of writing clearly and thinking sociologically. I would like to take this opportunity of thanking him for his patience and encouragement especially at those times when I was convinced that the whole exercise could come to nothing. I should also like to record my gratitude to Richard Brown both for his helpful suggestions and his support throughout the most critical stage of the writing of my thesis. Peter Bowen of Rutherford College of Technology read my manuscript and made a number of critical comments all of which I have attempted to meet or incorporate in the final text. To put it this way, however, is to give the impression of a very short intellectual transaction. In fact, my long conversations with Peter Bowen have been extremely valuable to me in my attempts to understand the dimensions of Industrial Sociology: in this respect they have had a very direct influence on the writing of this thesis. Of course, the responsibility for the basic approach with all its weaknesses is mine alone.

W. Williamson.

August 1968.

I

THE CONCEPT OF AUTOMATION

Section One

The Importance of Definition

The logical starting point for an essay on the industrial consequences of a technological development and the practical and theoretical problems involved in studying it must be the clarification of central concepts. The purpose of this chapter is to review how automation has been defined and to consider the appropriateness of such definitions for its analysis in social scientific terms.

The starting point is a conviction that before the social implications of automation can be understood we must be clearly aware of what it is we are talking about. The point is not so trite as it might first appear. Many students of automation have drawn attention to the fact that automation is frequently confused with other forms of technology. Crossman has written for instance that:

> *"Published discussions of the impact of automation on the labour force and on society at large frequently suffer confusion through failing to draw a distinction between automation proper and the wider field of general technical progress. Therefore we need to gain a clear conception of what automation is before proceeding to discuss its effects. If it can be achieved this will also provide a better focus for future empirical studies and analysis of job and skill changes." (1)*

We shall return later to Crossman's own definition of automation but in the meantime we can add further weight to our conviction by referring to the report of the Clark Committee on Manpower Policy. This committee, attempting as part of its brief to assess the effects of technical change on future manpower policy in the United States, concluded that one of the reasons why no one was clear about the impact of technical change on manpower policy was because there existed a '*confusion of tongues - a failure to define terms and a tendency to link all technological developments under one increasingly meaningless term: automation.*' (2) The problem of definition is thus clearly an acute one.

Since the first coining of the word there has been a sustained interest in the possible effects of this new technology both on the structure of industrial organisations and on society at large but it is as true now as it then was that the student of automation is severely handicapped by the ambiguity of the terms he must use (3) To what, we may ask, does the word specifically refer? But more than this, can we find a classification of all the technical applications encapsulated in the idea of automation. There are still many unsolved

difficulties in questions of this order.

A situation such as this is particularly disconcerting since the ways in which we define automation are of considerable importance in their consequences for the types of problems we select out for research. The generality or specificity of our definitions will ultimately determine the range of problems which we associate with automation: the point being that "systems of definition are inextricably linked to research methodology and, equally, to the kinds of problems being analysed." (4) It is for this reason above all others that the definitional problem is such a pressing one. In this chapter a classification of the major technologies subsumed under the term automation will be outlined.

Recognition of the importance of precise definitions in framing research problems raises the problem of whether or not such precision is demanded for all types of analysis. Sultan and Prasow raise the possibility that for certain types of analysis rigid definitions of automation are not required. For an appraisal of the effects of automation on the economy and, say, for estimates of the rate at which automation is being introduced - both considerations being of strategic importance in the great debate which surrounds the subject -

- they suggest that a much more meaningful analysis could be carried out using rates of productivity change as the key indicators rather than categories of technology. (5) What they are saying here is that the factors which are likely to produce unemployment, higher productivity (or whatever other measure we employ to quantify our conception of progress and which, at the same time, are the hypothesised consequences of automation) are legion and automation is only one of them. But the problems to which the sociology of automation has been addressed, unlike some problems of economics, would seem to require a well worked out set of precise definitions.

Sociologists have for a long while been concerned with the effects of automation on the nature of jobs, attempting to find out whether or not the diffusion of automation will result in skill upgradings or else with the elimination of industrial skills as we presently know them. (6) They have been concerned with the consequences of automation for the worker as a person - for his self identity. Does automation tend to increase or decrease the feelings of alientation associated with current production conditions? (7) Do automated machines and the contingencies of their supervision result in an increase in mental strain and general fatigue? (8)

What problems does automation present for the end of the line supervisors? (9) Will the behaviour of work groups differ significantly with automated conditions? (10) How does automation affect the managerial problems of controlling and coordinating work flow? (11) What kinds of organisational structures are appropriate for automated production processes? (12) When will technical change be resisted? (13)

These, and many other problems fall within the interests of sociologists. It is for this reason, that for sociological purposes, there is a need for a set of definitions which (a) relate technical changes to the experience of those doing work and thus, ultimately, to the structure of the industrial social system and (b) form the basis of any generalisations we might make about the possible consequences of automation throughout industry as a whole.

Since we are interested in the effects of technical change on the nature of work roles and on the ways in which work roles are related to one another in a system it is important that we know precisely the performance capability of the machinery itself. It is wrong to generalise too freely because different types of automation may have different consequences for the nature of work and the structure of work roles.

Sociologists do, of course, concern themselves with the much wider societal consequences of technical change and have increasingly devoted their attention to the problems of automation at this level. Michael, to anticipate our subsequent discussion in the next chapter, sees in automation a potential threat to democratic political institutions in that it will, amongst other things, promote a kind of computerised technocracy - a society based on the specialist knowledge of a specially trained technological elite. (14) Similarly, Daniel Bell envisages sweeping and fundamental changes in the system of social stratification in modern societies. He envisages the industrial proletariat metamorhosing with all the certainty of technical progress into a new 'salariat'. (15)

These accounts, although based on a wide range of evidence, depend also on a particular view of what automation is and how extensive it is likely to become. If their view of automation is suspect in some significant sense then we can rightly dismiss their claim that automation will produce these changes. What we would not be saying is that their predictions will not be confirmed. Clearly there is a

possibility that the future will be moulded by technocrats or that the proletariat will disappear. What is not so clear is the argument that these changes can be attributed solely to automation.

Section Two

Three Paths to a Definition

An adequate appraisal of the research evidence must depend in part, therefore, on the availability of a relatively precise taxonomy of automated systems constructed in such a way that the social effects of these systems can be clearly identified. The task of developing such a taxonomy for specific sociological purposes is not so simple as it might first appear: within the literature there are at least three ways of approaching this problem.

Firstly, attempts are made to discuss automation as a rather special philosophy of production: stress is laid on the fact that automation implies a new way of looking at production systems and work in general. The second method is to rely purely on engineering descriptions of automation. This has the advantage of being precise but a situation can ensue when a taxonomy based purely on the number of known applications of automated systems would yield so many categories that it would be almost impossible to generalise about them. The third method is to try and develop systems of classification based primarily upon the demands which automated systems make upon those who have to operate them. For social scientific

purposes this would appear to be the most valuable but as I shall show it can place strict limits on the range of problems one can legitimately analyse.

In this section I shall discuss these classifications. It is important that we do this for as the T.U.C. report pointed out it is 'obvious that "automation" possesses more than one meaning and that the controversies surrounding it arise, partly at least, because the same term is employed with different connotations.' (16)

Automation as an Industrial Philosophy

D. S. Harder, the man who first introduced the term into the English language described automation as 'a philosophy of manufacturing - a new way of thinking about work'. (17) Similarly, Drucker has argued that if automation is anything at all it is 'a concept of the structure and order of economic life.' Writing in Harpers magazine he said:

> *"Above all there can be little doubt that automation is not technocracy under another name and that the push button factory is not its symbol. Automation is not gadgeteering. It is not even engineering! It is a concept of the structure and order of economic life, the design of its basic patterns integrated into an harmonious, balanced and organic whole." (18)*

In another context Drucker has attempted to characterise automation as *'a concept of the organisation of work'*. (19)

Common to these two attempts is the implicit suggestion that to try and describe automation is engineering terms would be to strip it of some of its more essential connotations. Automation, so the argument seems to be is not merely a set of machines, however infinite the variety of tasks they might perform; rather it is a way of thinking about machinery. John Diebold has summed this position up succinctly:

> *"It is no longer necessary to think in terms of individual machines or even in terms of groups of machines; instead, for the first time it is practical to look at an entire production or information handling process as an integraed system and not a series of individual steps ... Automation is more than a series of new machines and more basic than any particular hardware. It is a way of thinking as much as a way of doing."* (20) *(my emphasis W.W.)*

The term 'automation' would seem therefore to have acquired the same kind of meaning which a term like 'mass production' acquired in the first quarter of the twentieth century, namely, a special orientation to the processes of work.

How far this way of thinking about automation has contributed to the general confusion which surround the subject is difficult to tell. Certainly, by obscuring the fact that there are different types of automation having different

performance capacities and quite likely, having a different effects on industry, these definitions do not facilitate a scientific appraisal of its implication. For scientific work we must be much more precise than this.

Some Engineering Classifications

One way in which we might be expected to do this is to rely on engineering classifications. These show the wide range of machinery to be found within automation and illustrate clearly the range of tasks these machines can perform. It should be immediately pointed out, however, that even on this level it is extremely difficult to be precise. The reason for this is that amongst technical experts themselves there is considerable disagreement on what can be properly described as automation. Let me give an example of this. To my suggestion that automation could be usefully thought of as (a) all forms of computer technology (b) automatic transfer machinery (c) process technology, Mr. J. Geddes of Eliot Automation Ltd. replied:

> *"There is, however, one main point which I should like to take up with you namely, the meaning of the word 'automation'. It has, we maintain, one single and easily defined meaning and that is that it describes systems in which equipment is endowed with the duty of taking decisions between alternative course of action within the content of the operational role of the system. That is to say systems of advanced mechanisation, such as automatic transfer lines, are not automation.*

The use of computers to perform simple clerical tasks is not automation. In fact, although computers can be frequently used in automated systems, computers and automation are very far from being in any sense synonymous ... Automation is the extension of man's ability to make logical decisions". (Private communication)

The advanced mechanisation which Mr. Geddes refers to has elsewhere been called 'detroit automation' after its origins in the motor industry. Similarly, even if we have to exclude higher mechnisation from our definition of automation we might still have to recognise that such mechanisation and even mass production techniques are in fact entailed in it. (21) It is the line of argument which I want to follow up now.

It has been pointed out that automation possesses more than one meaning and this is part of the reason why we are not sure what to expect of it. At the same time as the T.U.C. report argued 'Automation, however defined, is only one form of technological change and is rarely met in isolation from other forms'. (22) This adds to our difficulties but there is also the observation, often forgotten, that 'Automation ... is a continuation of what has gone before. It has long historical roots.' The meaning of automation is clarified if it is looked at historically. The outline to follow

draws almost entirely on the work of Buckingham who has suggested that:

> *"For purposes of analysis automation can be best defined as any continuous and integrated operation of a production system that uses electronic or other equipment to regulate and coordinate the quantity and quality of production. In its broadest usage it includes both manufacturing and administrative processes of a firm. These processes can be distilled into four fundamental principles: mechanisation, continuous process, automatic control and rationalisation. Each of these four elements has evolved separately. The novelty of automation as a distinct technology is that it is a synthesis of all four emerging since world war two from a unique combination of scientific break through and economic conditions." (23)*

In Buckingham's analysis these four different principles represent different phases in the evolution of technology since the eighteenth century.

First in the line was mechanisation. In itself 'a fusion of several new concepts' mechanisation replaced muscle power; in fact mechanisation was based securely on 'forms of application of power'. In the beginning of the twentieth century mechanisation is superceded by mass production based upon a continuous process technology. The symbol of this new technology of work is the assembly line. The second world war produced a series of innovations which extended the logic of mass production. These were innovations in transfer machinery 'which integrated

the various stages of production so that a continuous flow or process could be secured without the intervention of human labour.' (24) Developing rapidly in the motor industry it is the form of technology which has come to be known as Detroit automation.

The principle which is peculiar to automation is the principle of 'feed back'. Essentially this is the method whereby the output of a machine or process is geared to its input. Controlled in this way suitably programmed machines can start and stop automatically, check mistakes, rectify error, choose alternative courses of action and generally perform decision making functions once though peculiar to man.

The fourth principle which for Buckingham "ties the engineering aspects of automation to the economic, social and managerial aspects" is that of rationalisation. He writes: *'In a production system it means that the entire process from raw material to the final product is carefully analysed so that every operation can be designed to contribute in the most efficient way to the achievement of clearly enunciated goals of the enterprise.' (25)*

There are several very useful features of Buckingham's discussion. He has shown clearly that we must avoid the

tendency to regard automation as an entirely revolutionary development. He has also shown how attitudes towards work - industrial philosophies - can be theoretically linked to different types of technology and thereby improve the descriptive capacity of our definitions. Finally by showing how technologies give birth to a special kind of social organisation - an aspect of his account which, for reasons of economy I have left out here - he has shown us the road along which we might be able to discover a much more satisfactory account of the relationship between systems of technology and the social systems which have evolved in their use.

The underlying reason for emphasising the historical roots of automation is to show, as Ted Silvey has put it, how ' ... old things become new in the new relationships' and to high light the engineering diversity which exists within automation.

One way in which we can begin to simplify the many engineering classification which are available is to make a broad distinction between factory automation and office automation. Under factory automation Buckingham suggests we shall find the following kinds of machinery. (a) Automatic production machines such as milling machines and lathes; (b) automatic process control

machines used in oil refineries and chemical plants; (c) automatic material handling equipment that transports finished or semi-finished products from one machine to another. Almost inveriably computers are used in offices since a great deal of information requires processing.

Buckingham's list of the types of factory automation is not exhaustive. Forster has classified nine automation systems based upon the degree of 'feedback control' involved in the system. In industry he argues these nine basic types are usually found to be grouped together. To illustrate some of the principal groupings he isolates three 'modes of automation'. They are (a) Command automation for stable industrial processes. This type is best exemplified in machinery which can operate on programmed instructions. (b) Feedback automation for unstable processes where the relay of information back and forth is an essential prerequisite for the successful operation of the system and (c) Sorting automation which is appropriate for those systems with random input (e.g. post office sorting) and which require classification and allocation. (26)

One limitation of these classifications is that they do not tell us to which major industrial sectors most of these devices are applicable and nor do they immediately suggest what

implications each has for the work of the operator. A classification does exist however, which comes close to these requirements. It is that developed by the D.S.I.R. in 1956 which recognises three principle types of automation. The first type is identified as 'transfer machinery and automatic handling. This is essentially an advanced form of mechanisation and is particularly applicable to mass production industries. It means in practice that a series of manufacturing operations can be carried out without the intervention of an operator. One can find examples of this in the motor industry and machine tools. The second type is referred to as 'automatic process control' - directly useful in those industries which process liquids or chemicals or electricity. This type relies upon highly precise 'sensing devices' which control strategic system variables such as temperature and pressure etc etc. Any deviation from what is required is immediately corrected through complex feedback mechanisms. Lastly there is 'computers in offices' performing either decision making functions or else concerned with the more mundane aspects of data processing. (27) Silvey has described automation in similar terms pointing out that it is not often remembered

that automation is a 'three-legged stool'. A report of the research department of the A.E.U. adopted a similar three fold classification of the types of automation. (28)

There are two immediate implications of these engineering classifications. The first is that it is quite wrong to generalise in an unqualified way about automation; it refers to at least three different types of technological system. Secondly, although the symbol of the automation revolution is commonly thought to be the computer, computers are not in fact integral to some types of automation. For sociological purposes, it is important to bear these distinctions in mind for the social consequences of each type are different.

Automation: Information Processing: The Mechanisation Profile

Although we find engineering diversity within automation these are common elements. The most notable element and the one which has most understandably received most attention is the progressive movement, clearly visible within each type, towards self regulating work processes. In fact, automation has been defined by Dr. Allen Astin as 'the process of rendering automatic'. (29)

Concern with this generic attribute of higher forms of technology has resulted in yet another attempt to classify

automation in such a way that it can be systematically studied. I am referring here to the work of Crossman who has attempted to construct a taxonomy of automation based upon the degree to which it removes the need for human skills - especially information processing skills - and the work of Bright who has, with similar interests, constructed the so-called 'mechanisation profile'. (30) (31) Both of these writers see the most important aspect of automation the inexorable tendency to replace human skills with the skills of the machine.

The first report we turn to is the earlier report by Crossman written under the auspices of the D.S.I.R. (32) It was an attempt to describe and analyse the changes in skill requirements which accompany automation. Written in 1960 the report accepted as its basic framework the classification of automated systems produced by the D.S.I.R. in 1956 (see above). It became clear, however, that the classification was not sufficiently precise to be of great use in predicting skill requirements. To overcome this deficiency he proposed at that time a further threefold classification based upon the demands each system made upon the operator. It was as follows: (a) Continuous flow production (with sub types)

(b) Programme machines and computers (c) Centralised remote control. Several illustrations of each principal type are given accompanied by a precise description of skill changes. Generally, the conclusion seems to be that as automation extends throughout different processes less is demanded of the operative in terms of physical effort and more in terms of 'monitoring ability' or dial watching. However, whereas automated operatives rely more upon their ability to carry out a constant surveillance of many variables the other group of traditional tasks concerned with maintenance remain substantially the same.

In his second report delivered to the North Americal Joint Conference on the requirements of automated jobs held in Washington in 1964 Crossman is more explicit in his definition of automation as *"the replacement of human information-processes by mechanical ones." (33)* Automation is seen as the 'second phase of the industrial revolution' this being the ' historical process of replacing human labour by machinery.' The first phase dispensed with muscle power; the 'second replacement process' of automation is the removal of 'human information processing' or evaluative skills from the productive process. He takes it as axiomatic that these

secondary replacement processes will result in 'severe structural unemployment."

It is not essential nor practical at this point to discuss Crossmans classification further. He himself lists ten different types of automation though he claims, on the basis of his typology, to be able to identify a further 422 types and 'that practical examples could be given for all of them.'

Drawing upon his taxonomy which, on his own admission he considers incomplete, Crossman draws six conclusions about the consequences of automation. (a) "The outstanding effect of automation has been to remove a large number of low-level information processing tasks from the scene altogether." He instances the changeover from manual process control in chemicals, oil and steel to automatic process control. (b) "In complete automation with remote but not automatic control leads to an increase in operating stress." In this he gives the example of the changeover from hand fed methods in steel rolling to partially automatic control. (c) Complete automation appears to increase the general skill level since the proportion of operators engaged on maintenance functions increases. (d) Work teams become more cohesive. (e) Greater job security is one result of automation (f) There will be an

increase in the demand for junior scientists and technologists.

One of the principal difficulties of Crossman's scheme is that although the changes he summarises may be correctly predicted as the changes likely to come from automation he cannot properly account for these changes by merely pointing to different skill requirements. The idea of skill is by no means unambiguous; it refers to much more than the task content of the role; it also refers to the social status of a role. Furthermore, skills need not necessarily depend upon the nature of the technology; they may derive their particular distinctiveness from an occupational association such as a Trades Union. Being this the case it almost certain that trades unionists will resist any action which might undermine their particular skills. To assume, therefore, with Crossman that skill levels are purely a function of the system of technical apparatus is to rely on a very mechanical conception of the nature of industrial organisations. There is always some degree of 'orgnisational choice' in determining skill levels; so tasks could be regrouped; certain roles expanded to take on more responsibility etc etc. (34) By concentrating merely on the ergonomic aspects of industrial roles and their associated skills Crossman has failed to take fully into account the social and cultural matrix within which skills are defined

and evaluated. This omission is inevitable with a theoretical framework which does not recognise the degree to which social systems exert strict cybernetic controls over systems of technology. (35)

Similar difficulties can be seen in Bright's mechanisation profile. (36) The mechanisation profile is a device expressly designed to measure changes in skill with higher forms of technology. It measures the degree to which any production system approximates full automation. Mechanisations is understood to have three principal dimensions. The first of these is the span of mechanisation or the extent to which in any one plant formerly discrete production operations are mechanised. The second of these is the level of mechanisation - the level of mechanical accomplishment achieved with the machines. Finally there is the penetration of mechanisation - the extent to which secondary productive operations are mechanised.

Bright suggests in relation to these three measures that:

> *"Span seems simple enough to identify. Penetration is not quite so obvious but it can be appreciated simply by examining the need for manual contribution to the system. Level of mechanisation is a more unqualified notion ... (but) ... It seems quite possible to examine the characteristics ... by a systematic analysis of the way in which man uses tools and refines them as he creates a more automatic production sequence." (37)*

Following his own prescriptions he identifies seventeen levels of mechanisation based on the degree to which tool refinement replaces human intervention in the process. Used in conjunction with the other two measures of mechanisation production systems can be analysed and graphic profiles constructed which illustrate clearly the degree of automaticity achieved with the system and also the kinds of skills which would seem to be required with the system.

The use of this profile involves a tacit recognition that automation is a relative condition and not an absolute one; that there is considerable justification in the common use of the term when these are associated with 'a significant advance in automaticity'. Bright is therefore denying that as we move up the mechanisation profile we shall reach firm cut-off points between higher mechanisation and automation. In his scheme automation is a matter of degree. We might find, for example, that in a firm the level of mechanisation is very high but Bright contends that we would not be justified in talking about automation if the span of this mechanisation was restricted or the penetration quite low.

On the empirical level Bright goes on to show that at least one of the implications of the use to which he puts his

mechanisation profile is to illustrate quite clearly that automation is not so extensive as some commentators assume. Secondly, although the level of mechanisation increases the skill required of the operator need not necessarily increase; nor is it certain that skill levels in general will rise. This particular findings of Bright's study - carried out as it was in 13 different plants - is probably very important for it explodes some of the more enthusiastic accounts of what is likely to happen with automation.

The work of Crossman and the work of Bright show some striking similarities. Their differences in detail are far less important. Both writers are concerned with skills; both assume that one can understand changes in skill solely by reference to the technical requirements of the machine. This ergonomic emphasis leaves a series of critical questions unasked. We can learn little of the nature of the changes which might occur in work roles - not merely the task content of these roles but also changes in the amount of responsibility and power invested in them. But for the purposes of this essay what is more important is that a mechanical ergonomicist emphasis can tell us very little of changes in the social structure of

industry itself. Admittedly it was not the purpose of either Crossman or Bright to analyse systematically changes in the structure of industrial social systems although both of them have comments to make about this. Our purpose in looking at their work has not been, however, to show it to be wrong. Rather I have been concerned to show the limitations which exist even in the most sophisticated conceptions of automation.

As I shall show in chapter four of this study there are other technical variables in industry than the level of mechanisation which are of decisive importance in understanding what changes in the social structure of industry are likely to follow technical innovation. Their work illustrates all too clearly the difficulties in assuming that technology imposes its own logic on industry. As I have suggested there is no necessity that skill levels will rise or fall just because a technical system would seem to require changes in the task content of occupational roles; the level of skill required at any one point in time depends just as much on managerial practice and trades union practice, as it does on technology. In a word, both Crossman and Bright have not taken into account the reciprocal nature of technology and social structure.

Summary and Conclusion

In this chapter an attempt has been made to show the importance of carefully defining our terms. In the first section it was argued that the types of problems which we associate with automation will depend very largely on how narrowly we conceive of it. Thus if we assume that automation is synonymous with technical progress then it is clear that almost everything - affluence, unemployment, the leisure society, alienation or whatever - will be directly associated with automation. As the Clark Committee suggested this broad conception of automation was, in fact, producing a great deal of confusion. It was important, therefore to narrow it down and to define it precisely. This in itself was not easy especially when there is a clear need to have operational definitions.

Three types of definitions were distinguished, each having their own special difficulties. There were (a) automation as an industrial philosophy (b) automation defined in engineering terms and (c) automation defined in terms of the demands which it makes on the operator.

Although it is helpful to think of automation as

something qualitatively different from anything which has preceded it and to regard it primarily as a new orientation to work we were able to show that (a) this was neither appropriate from the historical point of view and (b) that for social-scientific purposes we have to be more precise since the social consequences of automation will vary with the type of automation we were talking about.

Turning to engineering descriptions of automation it became clear that even these were not free from ambiguity. On the other hand it was possible to separate out three principal types - transfer automation, process automation and computers in offices.

This threefold classification will be adopted in the main body of this study although it has certain inadequacies. Specifically it does not help us in predicting changes in skill levels or changes in social structure. It can, however, act as a framework around which we can 'hang' specific studies.

What is properly required for the sociology of automation is a definition or set of definitions which relate systems of automated technology to the social system of industry. In other words a classification including both technical and social

variables. The closest approximation which we have to such a classification is to be found in the work of Bright and in the work of Crossman. However, a certain ergonomical bias precludes the wholesale adoption of these for sociology.

We are left, therefore, with the classification evolved in 1956 by the D.S.I.R. The reasons for accepting this classification are on the whole pragmatic: it is precise and widely accepted and it can act as a framework around which we can group some of the more important empirical studies of automation. It is this basic classification which is employed to organise my discussion of these studies in chapter three.

The main points in this chapter can perhaps be represented with a diagram.

Definitions of Automation

Type of Definition	Exponents mentioned	Limitations mentioned	Advantages mentioned
Automation as an Industrial Philosophy	D. S. Harder John Diebold Peter Drucker	Imprecision: not readily operational	None
Automation as a System of Engineering	D.S.I.R. Forster Buckingham A.E.U.	No immediate use for Sociology. Limited for some problems e.g. skills	Offsets unitary view of automation. Useful for grouping work.
Automation as Information Processing. The Profile of Mechanisation	Bright Crossman	Limited for some problems e.g. skills Ergonomic bias Often cannot be used. Little operational potential	Offsets unitary view of automation. Links machines to experience of work.

Notes to Chapter One

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29. Dr. Astin — quoted Buckingham op cit note (17)

30. E.R.F.W. — Crossman op cit note (1)

31. James Bright — op cit note (6)

32. E.R.F.W. Crossman — "Automation and Skill"
D.S.I.R. 1960 Problems of Progress in Industry series no
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33. E.R.F.W. Crossman — op cit note (1) pp. 161

34. For a discussion of the notion of "Organisation Choice" see Trist et.al.
"Organisational Choice"
Tavistock 1964
also Daniel Bell — op cit note (15)

35. The reference here is to Talcott Parsons and the argument is developed more fully in chapter four of this study where a theoretical model is developed based upon the notion of a socio-technical system.

36. James Bright — op cit note (6)

37. James Bright — op cit note (6) p.41.

II

AUTOMATION AND SOCIETY

Section One

Contrasting Positions in the Public Debate

In the last chapter an attempt was made to fee the term 'automation' from some of the ambiguity which has come to surround it. The main justification for carrying out such an exercise was that if we are ever likely to understand its social consequences we had to be clearly aware of what it was and what it was not. The threefold distinction which we made between the types of automation is an essential preliminary for the much more important task of tracing the relationship between automation and social change. We turn in this chapter to the discussions of this relationship which exist within the literature. Our concern is to delimit as far as possible the sociological problems of automation and suggest the terms in which they can be legitimately analysed.

A first glance at the growing literature on the consequences of automation at this level i.e. at the level of the social system, would immediately suggest that it is impossible to discuss this topic in a neutral atmosphere. At the same time unless a note of objectivity is introduced into the discussion

then we are never likely to understand what effects automation will have on the structure of social systems.

Few technological developments of the last few decades have aroused so much concern as automation save, perhaps, for the frightening developments in the technology of war. Even here, of course, modern weapons systems depend upon automation techniques for their operational efficiency. It is quite impossible to envisage the defence systems of either Russia or America without at the same time thinking of the complex control devices built into these systems and which depend upon the extensive use of computers.

President Kennedy saw automation as the 'greatest domestic challenge of the sixties' pointing out that to maintain full employment at a time when automation was replacing men 'we have to find over a ten year period 25,000 new jobs every week to take care of these displaced by machines and those who are coming into the labour market.' (1) Furthermore, as an A.E.U. report has pointed out automation has come to be associated with an H. G. Wells world 'with man as subordinate babysitter to a machine' or else with a pervasive machine madness portrayed in Chaplin's film, 'Modern Times'. (2) It is seen at one and the same time as the technological embodiment of the imperatives

of progress and rationality diffusing rapidly throughout modern economies and the creator of all manner of social pathologies insofar as it destroys one of man's most meaningful relationships to his society - his employment.

One is tempted at the outset to enquire why it is that automation produces this reaction: to be concerned, in fact, with why it is we are now beginning to question our faith in the infinite adaptability of modern social systems to 'environmental threats'. It may well be as Crozier and Friedmann have suggested that the general public, sensitive as it is to new developments may have "detected a vital turning point in the history of our societies" (3) The reason on the other hand may be much more fundamental. It is almost a truism to suggest that automation may not be of equal benefit to everyone. Howard Coughlin of the A.F.L. - C.I.O. has stressed this point. He pressed us to conclude that unless something radical is done automation may result in an unemployment which by its very nature is cumulative and residual and that under current conditions, and contrary to what some would have us assume, automation, represents 'an overwhelming burden on the American worker'. He writes:

> *"The aimless, unplanned, explosive and destructive introduction of automation - under whatever name it comes - is reaching a point where it is no longer tolerable.*

We can solve it, as we will, temporarily, by unemployment insurance, retraining, the shorter working week, charity, but none of these can do more than allay the overwhelming burden which automation has placed on the American worker. We may have to restructure our economy, replan our society, ask over and over again, what is the role of man in such a society, what is the purpose of technical change, can we afford to have millions of educated men and women wandering about in a society which has no use for them. These are the questions which we have avoided asking. These are the questions which cry for an answer if, indeed, there is an answer." (4)

The central question in Coughlin's opinion is 'why automate?' especially, if as seems likely, the extension of automation will merely induce an extension of unemployment so that the ability to consume will no longer have to be dependent on the ability to produce.

If this analysis is correct then it is clear that automation poses a serious threat to the distributive mechanisms of capitalist societies; it will break the traditional link between work and income. The question arises therefore as to whether or not automation should be a planned development; that if necessary its development should be retarded until such times as we can rethink our pre-automation attitudes concerning the relationship between working and eating. Coughlin represents the Trades Union position on automation or what some people would consider the pessimist position.

The pessimist view, however, is being constantly qualified. B. Buckingham has suggested that 'Spring comes when it is most needed' and that this maxim is particularly applicable to automation. He writes:

> *"Automation has proved to be as great an improvement over the standard methods of business operation as the mechanical factories of the industrial revolution proved over the craftsmen of the middle ages. Even to the skeptic automation offers the opportunity for greater output, shorter working hours, the creation of a host of skilled jobs in maintenance, design and engineering, safer working conditions and the production of new and better goods of standardised quality with more efficient use of raw materials."* (p.13)

Buckingham's book can be read with satisfaction as the work of a liberal humanist who is sufficiently realistic to be aware of the immense problems which will have to be overcome if the potential benefits of automation are to be properly realised. He goes on:

> *"... public policies should be designed to protect workers against the most acute personal hardships that result from the economic dislocations; and ... the Government must maintain a high and stable level of production and employment."* (5)

In this passage Buckingham is sensitive to the dilemma which we mentioned earlier, namely that the ability to produce remain commensurate with the ability to consume else automation will create more problems than it can, in fact, solve.

In a similar vein Sir Leon Bagrit in the B.B.C. Reith lectures in 1965 extolled the virtues of automation as an extension of rather than as a replacement to man. (6) He sees in automation the possibility of more leisure and the possibility that man will be able to fulfill himself freed from the relentless dehumanising pressure of an earlier technology. Automation does not diminish creativity and usefulness, quite the opposite, it extends it. Given an adequate education for leisure and a responsible attitude to one's fellow men then automation portends not only to increase the material standard of living but also the quality of living in those societies which can successfully exploit it.

One more example will suffice to illustrate what we have called the optimist position. Speaking in 1961 at a conference on automation Mr. Quintin Hogg, then Lord Hailsham, had the following to say:

> *"... the essence of the matter is not the subsitution of machinery for skill. It is the development of more skill in the use of machinery. The end will be, not less opportunities for skilled employment, but more, not a threat to albour but an enhancement of its status. This, oddly enough is the end result of all labour saving devices... A new army of maintenance technicians will be substituted for the army of operators."* (7)

It is not necessary to prolong a discussion of the kinds of issues being debated. I have said sufficient to illustrate the ambivalence which exists within the literature.

In this context the need for more social research into these problems is clearly apparent not merely to account for the differences between the two sides of the debate but, of far greater importance, to spell out what adaptations might have to be made so that we shall be in a position to control technical change.

Section Two

Some Theoretical Issues

Regrettably, some of the confusion which has come to surround our thinking about automation has been reflected on the social scientific work on the subject. Peter Drucker has characterised the situation in the following way:

> *"Aware that we are living in the midst of a technological revolution we are becoming increasingly concerned with its meaning for the individual and its impact on freedom, on society, and on our political institutions. Side by side with messianic promises of utopia to be ushered in by technology there are the most dire warnings of man's enslavement by technology, his alienation from himself and from society and the destruction of all human and political values."* (8)

Norbert Weiner, often thought of as the father of automation because it was he who pioneered the science of cybernetics, was one of the first to raise his voice in an attempt to show that the successful exploitation of automation required serious adjustments. He pointed out that although automation brought with it remedous improvements in industrial efficiency, in rational decision-making and in productivity, we were now reaching a point where it was necessary to pay more attention to the 'Human Use of Human Beings' and that in the modern world it would become increasingly necessary to plan for technical change. He offered a forbidding warning:

> *"Let us remember that the automatic machine ... is the precise economic equivalent of slave labour. Any labour which competes with slave labour must accept the economic conditions of slave labour. It is perfectly clear that this will produce an unemployment situation, in comparison with which the present recession and even the depression of the thirties will seem a pleasant joke."* (9)

He went on to question the morality of allowing men to use machines which only allowed them to use a small fraction of their abilities claiming that; 'It is a degradation to a human being to chain him to an oar ... but it is almost an equal degradation to assign to purely repetitive tasks in a factory, which demand less than a millionth of his brain power.'

It would be wrong to over emphasise the importance of Weiner in the debate over automation but he did lay bare some of the problems with which we are still occupied. It is the purpose of this chapter to review and evaluate some of this thinking concerning the relationship between automation and social change. Automation is only one aspect of technical change; it is rarely to be found on its own. Presumably, therefore, it ought to be analysed from within a much more general framework concerning technological change generally and its relationship to social - structural change in the society at large. The carrying out of such an analysis would presuppose the availability of a theoretical

model which takes systematically into account the multifarious ways in which systems of technology articulate with social systems. The fact that such a model is not readily at hand goes a long way to accounting for the ambiguity which beset most discussions of automation at this level.

Heilbroner has suggested that one of the reasons why such a model is not available is because in the history of thought on these matters there has been a split between economic thinking and social theory. More precisely he suggests that economic theorists have lacked 'a conception of the technological process sufficiently broad to comprehend its long range and its short range impacts, alive to its secular rearrangements of society as well as to its mixed creative and disruptive effects on the economy.' (10) What has been lacking in social theory 'is not overall vision or profound intuition, but systematic and scientific analysis - which is to say, the only kind of analysis which will allow vision and intuition to be translated into fruitful action.' (11)

From Adam Smith, Ricardo and Marx there is a continuing economic emphasis on the consequences of technical change on output and the level of output. Although this grossly oversimplifies the situation there is a certain justification in regarding economics even up to and including Keynes as being primarily

concerned with the effects of innovation on the economic system. Little attention is paid to the wider institutional matrix of technical change.

Heilbroner does not attempt a chronological account of the social theories of technical change but concentrates his attention on two key themes which to him pervade the literature. One theme concerns the consequences of the machine on the worker: the other the consequences of the machine on the institutions of society. With the former the history of social thought has been concerned with the dehumanising effects of technology. From Adam Smith's view that those who spend their time performing simple industrial operations and having no time to exert their 'understandings' generally become 'as stupid and ignorant as it is possible for a human creature to become' through to Marx's analysis of alienation and Durkheim's 'anomie' there has been a constant moral abhorrence, with, of course, some exceptions, of the consequences of a machine culture on the integrity of the individual. With the second emphasis, perhaps best exemplified in Veblen, there is the view that the machine affects all aspects of our culture. The machine, he argued in "The Theory of Business Cycles", *'throws out anthropomorhic*

habits of thought ... It inclulcates thinking in terms of opaque cause and effect ... Thus in the nature of the case the cultural growth dominated by the machine industry is of a skeptical matter of fact complexion, materialistic, unmoral, unpatriotic, undevout.' (quoted Heilbroner).

In Marx there is the most systematic analysis to date of the consequences of technical change on the institutions of society. A dynamic theory of dialectical change based on the contradictions between the social forces of production (technology) and the social relatinns of production (classes) is developed which, when applied to the movements in western capitalism leads inevitably to the conclusion that the whole system will be destroyed by revolutionary change. The Marxian model regards the institutions of society - social legal and political - as being firmly rooted in a technological matrix which is of decisive importance in exerting pressures for change. For Marx the most important institutional facts concerned property relationships and the social classes based on these. Technical changes come into conflict with these; the class struggle intensifies and the property relations are transformed. - (12)

The attributes of capitalism and the theory of dialectical change which are at the heart of the Marxian analysis of social systems are too well known to require recounting here. What is clear that within this framework automation would necessarily be seen as a major technological development which would almost certainly bring chaos to the capitalist system. In fact, automation can be conveniently thought of within the Marxian system. But the model itself may be too simple; it neglected to take into account the many ways in which capitalism has been able to overcome these potential threats: it understates the importance of labour movements as agents of controlled institutional change rather than revolutionary instruments. Whatever is the case the intense miserisation of the proletariat which he could confidently predict from the framework of his political economy has not occurred. This must lead us to question the theoretical utility of the Marxian model in a society which, although still capitalist in the legal and political sense, is not the capitalism of independent producers driven by greed and competition but, as Galbraith has reminded us, the capitalism of monopolistic organisation. (13)

The technical change has social consequences is something we are no longer required to prove. But the precise

relationship between the two is entirely problematic. Sociological theory has largely failed in developing a framework within which this relationship can be systematically explored. This applies not merely to the classical authors but also to modern theories of change.

The model of structural differentiation developed by Parsons and Smelser, (14) has little to say about technological factors. Their basic focus of interest is on the strain which can occur between the functional needs of the system and the needs and abilities of the individual. Similarly in Moore's theory of social change little recognition is given to the importance of technical change for social change more generally. For him social change is a function of certain 'flexibilities' in the system. The fact of partial and differential socialisation is one such flexibility - the fact, that is to say, that one generation can never fully succeed in imparting its own culture onto the next. (15)

What would seem to be required in these circumstances is a model of change which relates technical changes to the group structure of society and which attempts to predict the likely reaction of various groups to technical changes.

To economists a major aspect of technical change and of automation in particular is its consequence for the level of employment and for the level of output and investment. Another important aspect concerns the way in which this output and the returns on this output are to be distributed throughout the population. This problem of distribution is likely to be particularly acute with automation since the traditional link between work and income, between effort and reward could be modified considerably. A change of such importance has obvious implications for the market position of various groups in society. It also has important implications for the 'master symbols of legitimation' as these apply to the power and status of different groups. Technical change, therefore, could have serious implications for the distribution of power in society.

At the same time, by bringing into existence new types of work roles demanding new types of knowledge and skills technical change imposes new requirements upon the educational and training facilities which exist in modern social systems. The ' points of articulation and impact' could be extended and infinitum. What is clear in the circumstances is that we are not likely to understand the consequences of change if we merely pay attention to the immediate economic consequences of changing technology. Such change must also be related to structure of social systems.

Section Three

Automation and the Social System

At the most general level automation is seen having important implications for all aspects of our culture, for our conception of democracy, of property, and of the role of the individual. In some publications the continuation of the western ideal of political democracy is seen to depend upon the close supervision of automation. In this respect two reports deserve special mention. The first report by Donald N. Michael was produced under the auspices of the Centre for the Study of Democratic Institutions, Santa Barbara and is impressively titled "Cybernation: The Silent Conquest" (16) In this report Michael sets out to describe some of the more 'sombre and complex difficulties which are already beginning to plague some aspects of our society and economy (and which) are only beginning to be recognised.' The second report by Rex Hopper extends Michael's discussion to examine the effects of automation on the processes of revolutionary change. (17)

Michael's starting point is the observation that automation, despite other opinions, represents a qualitative change in the evolution of technology:

"Both optimists and pessimists often claim that automation is simply the latest stage in the evolution of technical means for removing the burden of work. The assertion is misleading. There is a very good possibility that automation is so different in degree to be a profound difference in kind and that it will pose unique problems for society, challenging our basic values and the ways in which we express and enforce them." (18)

He identifies two principal types of automation which can be combined to produce mixed systems. One type is exemplified in devices which improve human capacities; the other is epitomised in the electronic computer. However, there are common elements. *"The capabilities and potentialities of these devices are unlimited. They contain extraordinary implications for the emancipation and enslavement of mankind."* Michael sees a disquieting feature of this situation in the fact the automation is a necessary development because modern economies are under considerable duress to be even more productive to create even higher levels of affluence at a time when this is becoming even more difficult:

"In recent years deterioration sales prospects, rising production costs, increased foreign competition and lower profits have led business management to turn to out national talent for technological inovation as the most plausible means of reducing costs and increasing productivity..."

In the face of these demands cybernation (Michael's word for automation and computer technology) becomes necessary although there are some paradoxical aspects in that' ... *as cybernation*

advances new and profound problems will arise ... Cybernation presages changes in the social system so vast and so different from those with which we have traditionally wrestled that it will challenge to their roots our current perceptions about the viability of our way of life. (p.13-14) He points out forebodingly that, 'If our democratic system has a chance to survive at all we shall need far more understanding of the consequences of cybernation. (p.14)

Predictably the most important consequence of cybernation relates to the level of employment and the distribution of employment. He takes it as axiomatic that irremedial structural unemployment is inevitable. One implication of this is that the Government might be faced 'in the indefinite future' to support through public works a large part of the population. Potentially this could undermine the American doctrine of competitive individualism - a major value in the American, if not capitalist, society. The situation is paradoxical for as Michael points out, those who would resist such an extension in the role of the state should realise that '*encouraging the extension of cybernation in the interests of free enterprise and better profits, may be self defeating.*' (p.27)

To those of us who might think that his alarming prognosis is not in the least in keeping with current experience he maintains that by its very nature cybernation will be introduced selectively 'by organisation, industry and locality'. Because of this the problems associated with it will not be immediately seen as national problems. Furthermore, since the principle of attritition will be operative in the labour market the consequences of cybernation may be delayed, but only for a short period. He writes:

> *"By the time the adverse effects of cybernation are sufficiently noticeable to be ascribed to cybernation, the equipment will be in and operating."* (p.28)

Michael then goes on to discuss the relationship between automation and leisure but some of his more interesting points deal with the relationship between cybernation and changes in the political system.

His argument entails the following steps. Firstly, efficient Government in the future will presuppose the exploitation of cybernation (a) for relatively mundane data processing and (b) for the making of rational decisions. This in itself is neither profound nor startling. What is startling is his suggestion that 'privileged access to information at the

time it is needed is a sufficient if not always necessary condition for attaining and maintaining power.' One consequence of this in Michael's opinion is that as computer systems become integrated into the administration of affairs of state and policy decisions increasingly to be based on the use of these systems, a gap emerges between the state and public opinion. Only the really sophisticated voter will be in a position to discriminate between alternative policies. He suggests also that there may be a tendency for the major public positions to be occupied by 'authoritatian personalities' intolerant of ambiguity and emotionalism - two of the commest features of the democratic process.

Similarly, since the computer deals more efficiently with mass problems there may be a tendency on the part of planners to regard the public at large in mass terms and that the 'individual may be completely swallowed up in statistics.' In such a situation the alientation of the individual and the start will reach unheralded proportions. Cybernation will thus consummate the emergence of mass society.*

*It is interesting to note certain parallels here with the work of Max Weber. In Weber's conceptualisation of bureaucracy and legal-rational authority the idea of precise calculability

plays an important part as a necessary consequence of the rule of law. This calculability which is appropriate, even essential to capitalism.

> *"is the more fully realised the more the bureacracy "depersonalises" itself i.e. the more completely it succeeds in achieving the exclusion of love hatred, and every purely personal, especially irrational and incalculable feeling from the execution of official tasks. In the place of the old type ruler who is moved by sympathy, favour, grace and gratitude, modern culture requires for its sustaining external apparatus the emotionally detached, and hence rigorously "professional" expert."*

From Max Weber in 'Max Weber on Law in Economy and Society' edited by Max Rheinstein and Edward Shils.
quoted by Bendix 'Max Weber; An Intellectual Portrait'
Could we have legitimately expected Max Weber to have anticipated that his perfectly professional expert would have turned out to be a computing machine?!

There are many issues upon which we could question Michael's analysis. Two sets of considerations are of particular importance and we shall deal with them presently; they concern his view of the relationship between innovation and social structure and also his assessment of the extent to which automation will develop.

Before we take up these issues we shall turn to Hopper's report, "Cybernation, Marginality and Revolution" (19) The purpose of Hopper's report is to ascertain whether or not with cybernation the possibility exists for the emergence in American of '*numerically significant group of economically*

powerful and intellectually informed people who will themselves marginal to the structure of political power and social prestige'. His hypothesis is that where these conditions are found there is a clear possibility that revolution is immanent. Such conditions, therefore, represent the structural prerequisites for revolution. (20) His thesis is that the 'population displacement' resulting from cybernation will create the necessary marginality and *'work such changes in our social structure as to develop the kind of socio-psychological seed bed in which revolutionary behaviour typically has been nurtured.'* (p.314)

Hopper contends that automation and the cybercultural revolution result in three principal forms of population displacement. Predictably the first and most important population displacement is that associated with unemployment. Secondly, there will be 'displacement through obselescence' i.e. the replacement of human brain power by machines. Finally there will be cultural displacement a term which for Hopper sums up the fact that no longer will our central conceptions of 'property' and 'work' be applicable as key components in our value system. He questions whether profit can still be the measuring rod of progress and whether or not work can be equally subjected to productivity measurement. Since the virtues of hard work and

profit are rooted in scarcity the problems of the economy of abundance are acute indeed. His argument is that 'the old cultural values are no longer functional ... '. (p.320) Relating these three displacement processes to marginality Hopper speculates that:

> *"... if large scale unemployment and cultural confusion are virtually certain in the immediate future, it is highly probable that the future also holds an enormous increase in the number of people who will be thrown into a marginal position."* (p.321)

Not only will large numbers of people be marginal to economic processes they may also be marginal to the processes of political decision-making and thus to political power. This section of his argument draws heavily on Michael's report and the latter's view that cyberneticians might ultimately constitute a power elite.

Hopper is of the opinion that his revolutionary hypothesis could well be confirmed. The displaced population will be numerically significant; it will have economic power because of its potential as a mass consumer market and it will be intellectually informed since a large part of it will have been recuited from displaced people from the middle and higher social strata. He does not conclude that revolution is inevitable and he also points

out that even if it were it would be difficult to predict its political texture. He forewards the personal view that ' ... we shall move toward a militarised and cybernatised totalitatianism of the right'., and he ends with a quotation from Norbert Weiner 'The hour is very late and the choice of good and evil knocks on our door.'

Both reports have presented a forboding picture of the likely consequences of cybernation on the structure of American and, indeed, Western capitalist society. It would be wrong merely to dismiss them as futuristic or sensational although they do have these qualities. Furthermore, even if we disagree in important respects with their predictions we cannot disagree with them in the importance they attach to the problems they have discussed. It is necessary to consider the likelihood of extreme unemployment; it is equally necessary to consider the implications of the Governmental use of computers. In both cases it cannot be denied that changes of the order of magnitude which they predict would have powerful ramifications on the major values - the major symbols of legitimacy - which control the functioning of a capitalist social system. To discuss these issues properly much more rigorous thinking than has so far been outlined is absolutely necessary.

Three sets of considerations seem to be of strategic importance if we are properly and systematically to evaluate the work of Michael and Hopper and, indeed, the work of anyone else who writes about automation or technical change at this level. The first two considerations are pragmatic, the third theoretical. The first is that before we can begin to discus automation we ought to be clearly aware of what it is we are talking about. The reasons for saying this have been dealt with more fully in the preceding chapter. On this level one would have to recognise that automation can mean different things and certainly computers and automation are not synonymous. One would also point out that the immediate social consequences of the different types of automation vary considerably. (see Chapter 3) This makes it difficult to generalise too freely about automation.

The second issue, directly related to the first, concerns the extent of automation both on the macro level and the micro level i.e. within the economy as a whole and within specific industries and industrial organisations. Here one would stress that although automation systems, by their very nature, could produce extensive change in the level of employment, and in the nature of work itself, it does not logically follow from this that these changes will come about. There are two reasons for

saying this. Firstly, in the use of machinery there is considerable room for human engineering; just because certain types of automatic transfer machinery could conceivably be operated or monitored by merely semi-skilled workers it does not follow that this will be the case. In the design of work and in the setting of skill levels management has considerable room for manoevre. One ought to avoid therefore the anthropomorphic fallacy of assuming that machines will somehow imprint their own requirements on the social structure of industry. Secondly, since a great many higher level predictions of the sort we have been discussing depend upon some quantitative notice of the extent of automation and the rate at which the cybercultural revolution is occurring it becomes very necessary to be sensitive to those factors which govern the rate of change and to the important practical difficulties involved in measuring the extent of change.

The third principal issue concerns the way in which writers attempt to relate technical change to social change and the importance of having theoretical models to assist in this very complex operation. Bearing these points in mind the conclusion necessarily emerges that both Michael and Hopper have probably grossly exaggerated the consequences of automation.

In relation to the first point out argument can be stated very simply and briefly. Whereas both Michael and Hopper assume that automation systems are applicable to a whole range of human mechanical and conceptual operations and that 'the potentialities of these devices (automated machines and computers) are unlimited' we can legitimately point out that these assumptions are suspect. The differences which exist within automation between types of systems and the performance capacity of the different systems are extremely significant in themselves; their potentialities are limited and their social consequences within industry will be different. The importance of this argument is taken up more fully in the next chapter.

The second major issue is directly related to this and is of much greater importance. Briefly it is that Michael has over emphasised the magnitude of the automation revolution within industry and under emphasised those factors which in any economic and social system tend to slow down the rate of technical change. The work of Bright makes clear that measuring the extent of automation in industry is a much more complex operation that some have previously assumed. (21) Just because automation systems can take over many tasks which

were previously carried out and completed by operators it does not follow that in all instances they will be used in this way. One needs to take into account the range of application of automated systems. What this means in practice is that in any one organisation not all production operations will be subject to automatic control and, therefore, despite a possible high level of automation we would not be justified in talking about full automation. Furthermore, there is the third measure employed by Bright - the depth of penetration of the systems in question.

Given, therefore, that there are at least three measures to be taken into account in describing the extensiveness of automation it is clear that the consequences of automation on the structure and functioning of an industrial organisation will be in part a function of its span, level and penetration in that organisation. Michael has not taken these considerations into account. Had he done so then his assumptions about the future extent of automation would have been different and, this being the case, his assessment of the social consequences of automation a little less dramatic.

These considerations apply more appropriately to estimates of the extent of automation in an individual firm. It is also important to take into account systematically those factors which govern the rate at which automation is likely to extend throughout

the economy as a whole.

At this point Michael accepts that cybernation is necessary in a modern economy, that there are certain processes occurring e.g. external competition, demands for higher levels of affluence etc, which underly the modern imperative to innovate. The logic of his account is as follows; since those factors in a modern economy which would seem to impel technical change along are likely to remain continuous in their operation then the automation revolution must accelerate. Furthermore, since the need to innovate is not confined to just manufacturing sectors but even in the realm of information processing and decision - making it is perfectly possible for the cybercultural revolution to gather an even greater momentum.

One of the difficulties with this claim apart from the obvious one that the cybercultural revolution does not often live up to its potentials in practice, is that it fails to take into account those variables which would seem to govern the rate of technical change, especially those which would retard it. Whether change occurs at all depends more upon the cost of automated equipments in relation to the cost of more conventional equipment than on the intrinsic capabilities of the machinery itself. As the T.U.C. report put it

"The comparative cost under alternative systems are one of the vital factors which any firm must take into account when contemplating the use of some new method of production." (22)

Similarly, an I.L.O. report laid down twelve factors which, taken together, influence the extent and rate of introduction of new technologies. (23) They range from 'the extent in which the existing plant conditions are lagging in regard to the best technology available (the existence of a large gap may lead to the speedier introduction of the newest technology)'and' the prevailing and expected capital-labour price ratio' to such less tangible conditions as the 'political situation' and the 'attitudes of Government towards business'.

Other factors need also to be taken into account. The T.U.C. report suggests that, 'The type of material used in an industry is an important factor in the spread of automated systems of production.' Where materials can be easily subject to automotive controls as is the case with fluids and electricity then automated systems can be expected to spread more quickly. Other industries cannot use automated systems. The T.U.C. offers an example - the garment industry. In this case the market demand for its products is likely to fluctuate widely and in these circumstances it would not be economically rational to use automated techniques which invariably impose quite a high degree

of rigidity on the productive process which naturally militates against frequent changes in product.

These points have been mentioned in order to illustrate that Michael has probably overestimated the extent to which automation is likely to develop. There are obviously many more factors influencing the rate of technical change which we have not mentioned. Enough has been said, however, to suggest that the diffusion of automation is likely to be (a) much slower than Michael assumes and (b) much more unevenly throughout industry than his account would imply. Such considerations are a sober corrective to those who anticipate the automatic factory fully functioning just over the horizons of the next decade. The third and final set of difficulties are theoretical. How are we to describe and predict the social consequences of technical change? What ought to be our basic point of reference? In the past as we argued earlier there has been a split between the economic analysis of technical change and the sociological analysis of change. To some extent these are combined in the two reports we have discussed. Both writers take pains to relate economic change to social and especially cultural change. It is for this reasons that any theoretical criticisms which might be made against them cannot be made independently from

any substantive or empirical criticisms of the sort we have just been discussing.

In both cases automation is regarded as changing the labour market in drastic ways both quantitatively on the level of employment and qualitatively on the nature of the employment or division of labour. These changes have important consequences for select industrial groups. Hopper is concerned about middle executives - ambitious, hard working and committed to the American ideal - who might find themselves both marginal to economic processes i.e. displaced by computers and marginal to political processes. Michael is concerned with the way in which unemployment will affect the distributive mechanism of capitalist society and especially the values which govern this mechanisms. At the same time, by looking at what might happen in the division of labour Hopper and Michael predict an important development in the emergence of an elite of computer programmers - an occupation which the computer produces. They have then attempted to spell out the implications of these changes.

Undoubtedly it is in this way that we ought to approach the problem. The mistake Michael and Hopper make, however, is to underemphasise the extent to which social systems will resist those changes they see as inevitably deriving from automation.

Put differently they have failed to take into account the possibility the social changes will be carefully supervised and made to fit within pre-existing patterns of social arrangements. They have neglected, in short, the whole problem of 'system inertia' - the tendency on the part of all social systems to seek to maintain themselves within the framework of their existing value systems.

In this respect their work is fateful, and pessimistically so. The dynamics of the process whereby social systems seek to maintain their integrity are by no mean clearly understood. Within functionalist literature and exemplified in the work of Parsons the problem is seen as one of the group seeking to resuscitate group solidarity, to apply normative sanctions to deviant behaviour. This applies either to the small face-to-face group as it does to the society at large. Alternatively we can regard existing social relations being held together by coercion and the application of force. Whatever the case there is always the implicit suggestion that the status quo will be resistant to fundamental change. If one sees society as a coalition of conflicting interests - as a pluralistic system - it would be quite legitimate to suggest that say, Trades Unionists, by articulating their grievances and fears about automation, may

institute actions which will retard the applications of automated systems.

Alternatively one might suggest that the state, especially, the modern state, will attempt to control automation on the political level, possibly to retard it until such times as the appropriate social adjustments can take place. Processes such as this are entailed in this notion of 'system inertia' and by adopting a view of society which under emphasises the degree to which such processes are amenable to rational control Michael and Hopper have overstated the gravity of technical change. In summary they have assumed that technical and social change is a one way process, that technical change itself is sufficiently important to account for social changes. They have neglected to take into account the multifarious ways in which the social system itself can exert a degree of control over change at least sufficient to ensure that its basic structure and values are not fundamentally threatened.

This notion of system inertia is neglected just as much in lower level work i.e. at the level of the firm or organisation. It is to lower level studies which we now turn.

Section Four

Automation and the structure of organisation

Concern with the effects of automation and computers on management and administration is the second main theme in the sociology of automation. It is a complex area in its own right but it should not be assumed that this lower level work is entirely divorced from higher level work. Quite the contrary, the former is an integral part of the latter; it is on the basis of social change either observed or anticipated in industry itself which underly many of the higher level studies of automation. It is important, therefore, to be critically aware of what these changes are.

Just in the same way as we can detect in higher level work an underlying vision of the wholescale transformation of western capitalism so it is with lower level work that we find sweeping predictions about the role of management in the computer age. More than one commentator has suggested that with automation 'middle management' is likely to disappear, to become redundant. (24) Hopper sees this as inevitable and one of the implications of this displacement process for him is that the highly ambitious group of middle executives might become so frustrated at the shrinkage in mobility opportunities that they might be impelled

into new forms of political radicalism. (25)

Added to this possibility it has also been suggested that automation may effectively precipitate the downgrading of a great deal of management and staff work with quite novel implications for the nature of social stratification. It has been suggested that there will emerge a 'white collar proletariat' barred by the limits of their education to higher administrative positions which will entail a functional knowledge of computers and their operation. The implications of such a process would be far reaching; even greater pressure would be exerted upon and more prestige attached to those agencies which were seen to promote social mobility.

Some of the consequences of computer systems on management have been predicted upon some assessment of their effects on two main areas; (1) in their impact on decision-making and on information processing generally and (2) on the division of labour in management and administration. We shall discuss these in turn.

Automation, decision-making and information processing

Developments within cybernetics - literally the science of control - have made rational decision-making strategies available to the manager especially in those areas where a high degree of uncertainty existed and where hunches rather than reason were at the root of most decisions. It is the implications of computerised

decision-making which is at the root of a great deal of speculation concerning the changing structure of management.

A report which deals in a reasoned way with these developments and casts some light on the sociology of management change is Herbert Simon's "The New Science of Management Decision". (26) In this book Simon gives an account of the many new techniques available to management especially decision taking techniques.

It appears that computers can handle 'programmed decisions' in a revolutionary way i.e. all those decisions which are based on formally defined rules or precedent and the implimentation of which is entirely mechanical; they can also introduce a great deal of control and predictability into formerly 'non-programmed decisions' i.e. hunches and intuitions. In this way a great deal of management forecasting and preplanning can be subject to rational control. To summarise what is a very complex argument Simon suggests that these technological changes will have three main consequences for the structure of management. one negative, two positive.

On the negative side the basic hierarchical structure of industrial administration will remain intact although the relationship between the parts of the organisation may become

more explicit. (Simon sees the organisation as having parts. In the "bottom layer" there are the basic work processes e.g. manufacturing. In the "middle layer" there are the programmed decision-making processes which govern the day to day operation of the firm. On the "top layer" there are the non programmed decision-making processes. On this level policy decisions are taken.) The reason he adduces for this assertion is rather unfamiliar. Far from claiming with the classical school of organisational theorists that the principles of hierarchy are the most efficient to apply in the design of industrial structures, he suggests that, 'Hierarchy is the adaptive form for finite intelligence to assume in the face of complexity.'

We shall have cause to question this assumption later in this study but to briefly anticipate, one of the most important findings in industrial sociology over the last few years is that hierarchy may not be the most efficient form of organisation. Some firms, especially those who operate on the frontiers of innovation would seem to be best served by an 'organic management structure - one in which roles are not hierarchically organised or explicitly related to one another. (27)

To say that the principles of hierarchy will still apply is not to say that organisations will not change. Simon selects

out two main areas for consideration - changes in centralisation or decentralisation and changes in the authority and responsibility of managers themselves. He sees automation as having important implications for both these dimensions of organisational functioning. With respect to the first problem his thesis is that the automation of important parts of business data processing will 'radically alter the balance of advantage between centralisation and decentralisation' (i.e. of decision-making functions and thus of power.)

Two technological facts of information technology provide the framework within which management reorganisation must take place and both favour centralisation. The first stems from the opportunity automation offers for planning the work of the organisation as a whole - integrating into a more complex planning process the various plans of separate departments. The exploitation of this possibility would seem to favour a central system of management control which will remove some of the decision making functions of 'middle management'. (This group would include department heads up to an including factory managers.)

The second technological fact 'pushing in the direction of

centralisation' is the speed at which data can be processed and decisions taken. For the successful exploitation of this potential the organisation and its work processes must again be seen as a system and the computer programmed on this basis. Once this is done there is little room for spontaneous modification of plans by overzealous managers keen to ensure departmental autonomy. Thus the possibility of individual discretion is severely curtailed by centralisation. The changes which shall take place in the manager's authority and responsibility are implied in what has been said. Simon writes of these changes:

> *"If a couple of terms are desired to characterise the direction of change we may expect in the managers job, I would propose rationalisation and impersonalisation. In terms of subjective feel the manager will find himself dealing more than in the past with a well structured system whose problems have to be diagnosed and corrected objectively and analytically, and less with unpredictable and sometime recalcitrant people who have to be persuaded, prodded, rewarded and cajoled. For some managers important satisfactions deriving in the past from interpersonal relations with others will be lost. For other managers, important satisfactions from a feeling of the adequacy of professional skills will be gained."* (28)

Thus in the future a premium will be placed upon technical rather than social skills in management yet Simon is of the opinion that work experiences will be more intrinsically satisfying - 'less frustrating and more wholesome' - for "Man does not generally work well with his fellow men in relations

saturated with authority and dependence, with control and subordination, even though these have been the predominant human relations in the past." (p.49) Automation obviates the need for control mechanisms or relationships of this nature. Little can be said against Simon other than that his predictions depend upon the rational use of these modern methods in management and since this cannot be guaranteed it is not certain that the changes he predicts will occur. The value of his book, however, lies in its exposition of the potentialities of automation.

Automation and the division of management labour

The rationalisation of management has its counterpart in the rationalisation of clerical work generally. Much of clerical work is merely of a routine nature - processing information, filing, following well-worked out procedures. This type of work can be easily transferred to a computer with obvious consequences for the clerical labour force especially the status of clerical work.

C. Wright Mills has pointed out that a great deal of clerical procedure has been mechanised and that with the absolute growth in the size of office units more and more aspects of office work are coming to bear the same characteristics of factory work. (29) Office mechanisation has further eroded two aspects of the white

collar work situation - its security and the extent of promotion opportunities - two features which in the past separated the white collar worker from the proletarian.

In this process, not to be exclusively explained by mechanisation alone, the social status of clerical work is being re-evaluated with adverse consequences. It is in the context of these changes that arguments about the emergence of a 'white collar prolotariat' become particularly significant. However, as I shall show in the next chapter computers are not, as yet, having such far reaching consequences and, since at this level clerical positions are taken in the main by young women, the consequences of these changes, affecting as they do career lines and individual aspiration, may not be quite so dramatic as some writers have assumed. Women clerical workers apparently do not have such a high level of commitment to career lines which, if frustrated, might lead to newer kinds of radicalism e.g. trades unionism on the part of clerks. (30)

A more important change in the office division of labour must now be mentioned for this one portends to have far reaching consequences for the social system at large. Leavitt and Whisler predict that automation will tend to decrease the important of traditional 'middle management' - a view we have already met with

from other quarters - creating a greater demand for staff programmers, research analysts computer specialists and the like. (31)

A similar view has been put foreward by two English researchers - Enid Mumford and Tow Ward. (32) Not only do they attempt to describe the pattern of change in the office division of labour but they attempt to describe how these changes will affect the distribution of power in the organisation. They write:

> *"One consequence (of integrated data processing) is a flattening out of the hierarchy pyramid now typical of most management organisation and which is largely a consequence of the traditional pattern of information flow. The number of top management are likely to increase while the elimination or reduced size of departments less need for middle supervisory management."* (33)

The implications for the structure of power within the organisation is such that "It is now possible for a small elite of senior managers, supplied with the necessary information by the computer, to be responsible for most major decision-making." (p.8)

Furthermore, since the computerisation of management will have necessarily redefined organisational functions a great deal of power will have been transferred to new groups of technical experts. Such a situation has serious sociological implications besides those relating to the potential chaos which could ensue were these groups to withdraw their labour. Mumford and Ward suggest that

these groups are "irresponsible" and identified with computer technology rather than with the aims of business. Their loyalty to the firm is therefore in some doubt.

These developments in electronic data processing herald, therefore, the emegence of a new kind of salaried employee who is indifferent to the organisation save for his instrumental involvements yet who has a great deal of effective power. Management would seem, therefore, to require in the forseeable future a staff of professional experts upon whom considerable power and responsibility will be attached rather than general managers without specific technical skills. For Britain, at least, this will entail fundamental changes in the selection and training of managers.

Upon such hypothetical changes on the internal structure of organisations - predicted as they are on the knowncapacity of computers - much wider claims are made about the effects automation is likely to have on the society at large. We have already mentioned some of these claims. It is important, therefore, that we be clear on the ways in which such claims can be evaluated. Once again there are broadly two sets of factors to be taken into account - the empirical and the theoretical.

On the empirical level much more needs to be known about the number of electronic data processing installation; also much more needs to be known of the ways in which these installations are being used. To anticipate our argument in the next chapter it is clear that in Britain at least computers are not being used to their full potential. This must lead us to the conclusion that the cybercultural revolution with all it entails for rational decision-making, the disappearance of middle management is far from being with us.

In fact, however, this empirical point is not the most important for on the assumption that the momentum of technical change in the office is likely to be maintained then it is almost certain that in the future computers etc will be used to their full potential.

The most important contribution which can be made to the understanding of the social consequences of automation must be on a theoretical level. This is not to say that empirical considerations are not important; clearly the level, span and penetration of these systems in offices will be just as significant a measuring rod as it is for factories and unless they are taken into account we are likely to be presented with a distorted picture of the extent of office automation.

Consider, however, the supposed relationship between frustration, political radicalism and blocked opportunities for upward social mobility. Although Hopper's account of this relationship is creditable it is still nontheless lop-sided. He has assumed that technology will impose its own logic on the structure of social systems; he has failed to discuss as systematically as he might the extent to which social systems will modify and control such technical change. Were it true that social mobility, defined as occupational mobility, will inevitably become restricted then there are at least two further modes of adaptation other than that suggested by Hopper. Firstly their may be a redefinition of personal mobility goals; the prize jobs may be perceived as being so far out of one's reach that it is not worth fretting about them.

Or, in a similar manner there may be a tendency to dissociate social mobility from occupational mobility and one's social status will come to depend less upon work than upon some other feature of one's life. In any case, most social mobility takes place between ranks which are relatively close to one another, the ' height of social mobility' being relatively 'low' in modern western societies. (34, 35)

What is far more important than 'height' is the amount

of mobility which takes place; Hopper has not taken this into account. What these points, limited though they are, suggest it is that the relationship between technical change and, in this case, social mobility has not been clearly worked out. One of the reasons why this may be the case is that there is still a tendency to assume a position of technological determinism and to underemphasise the extent to which technical change will be 'controlled'; in short, attendency to underemphasise the institutional matrix of technical change.

Even at the level of the organisation itself these difficulties become apparent. Just because computers can modify and improve upon decision-making processes it does not logically follow that they will be used in this way. Just because new groups will emerge in the office division of labour - groups of technical experts oriented more to their machinery than to the goals of the enterprise - it does not necessarily follow that effective power will be freely given over to this 'irresponsible group'. This same mistake of assuming that technology carries with it its own pattern of social organisation, is being made even at this lower level where the possibility of 'organisational choice' should be clearly recognised.

These brief points serve to re-emphasise what is an underlying theme of this study, namely, the need to have adequate models of the relationship between technical and social changes which explicitly recognise that although technology can be an important agent of change, the changes which do take place are not to be explained exclusively as the outcome of technical change. One must recognise that the 'social' has a degree of autonomy; that social factors can modify the direction of change that would seem to be implied in a technology.

Section Five

Automation, work and the social system

The third and final area in which sociologists expect automation to produce significant changes is in the nature of work itself. As Crozier and Friedmann have put it; *"The impact of automation is most striking at first sight in the profound changes which it works in the position of the man on the job and in the actual nature of his work."* (36)

Once again there is a double reference; automation changes the nature of work and work tasks and in so doing begins to change other important aspects of the social system. In the next chapter we shall be more concerned with the effects of automation on jobs and the organisational context of work. In this section, we can briefly mention some of the changes which are expected in the society at large as a consequence of the changes which have taken place at the level of work.

In modern society social status is derived primarily from the status attached to a man's work. No less important, probably even more so, the values which we attach to work and the virtues of work are an integral part of the value system of modern societies. Given changes in the nature of work and also in the meaning which work has as a central component in

man's existence and in his experience of himself it is clear that a transformation in work is a major aspect of a much more comprehensive transformation of society itself.

The importance of this view is nowhere more fully established if we think of the classical authors both in economics and in sociology. Adam Smith saw changes in work primarily occuring in consequence of the extensive division of labour. With Emile Durkheim changes in the division of labour had important consequences for the integration of social systems. Occupational specialisation he noticed served to exaccerbate the 'destructuration' of the moral order. The situation was paradoxical since by alienating men from one another on the normative level, the division of labour in a modern economy monetheless ensured that men were more dependent upon one another on the economic level.

Durkheim's pessimistic and conservative account of amonie; is complemented with suggestions as Heilbroner has put it 'to flesh out work with meaning' so that the worker will see his specialised task as part of a much more comprehensive whole. (37) It is only through work that the individual can be reintegrated within the group and it is only through the development of a strong sense of occupational soldarity that modern societies can hope to overcome the cancer of amonie.

Marx's analysis of the nature of work under capitalism and, in his earlier work his account of the nature of work and human development is probably the most comprehensive account to date of the importance of work as a major aspect of the life of the society generally. His account of alienation - the inexorable processes whereby the worker loses both his sense of identity and the feel of his work - is complemented with a self actualising theme which underlies in part Marx's view that the prolotariat will rise up to throw off the chains of capitalism.

Whatever the type of theoretical system in question work has always been thought of as an integral part of the social system. In modern sociology this concern with the nature and experience of work has taken a new turn. We tend now not to generalise about work as such but to make detailed empirical studies about different occupations. (38)

Unfortunately studies of this type which deal with the nature of occupations under automation are noticeable by their absence. And, given that automation is not an homogenous development it becomes difficult to fully realise the extent of change in the nature of work roles which it most certainly will bring about. Nonetheless certain things can be, and have been said, and these can be grouped under two main headings

(a) changes in the nature of work and the experience of work, and (b) changes in the ideology of work. Changes on both levels are seen as having important wider implications.

Crozier and Friedmann suggest that "Like all important technical changes automation results first in the transformation of the corresponding human tasks and the qualifications required for these tasks..." (39). Despite the range of variation in the performance capabilities of automated machinery there is a common feature - the progressive replacement of human skills, both physical and social and intellectual, from the productive process. In certain industries this means in practice that work becomes 'lighter' - less materials handling - but labour gains in this respect would seem to be offset in other industries where the drudge of physical work is replaced by the intensely monotonous concentration in dial watching. (40) Despite such variation Daniel Bell has maintained that *"Just as factory work impressed its rhythm on society, so the rhythms of automation will give a new character to work living and leisure".* (41)

He goes on to explain that

> *"Automation will change the basic composition of the labour force, creating a new salariat (his emphasis W.W.) instead of a proletariat as automated processes reduce the number of workers required in production."* (p.268)

This conclusion follows inevitably from one of his initial assumptions that: "... *the vast developments of automatic controls and of continuous flow creates the possibility of eliminating the workers from production completely.*"

However, for those still in employment there will be extensive changes in the organisation of work. The need always to ensure the continuous operation of the plant could conceivably result in a reorganisation of life rhythms primarily because of shift work with all its attendant social, psychological and sexual problems. Moreover, "*For the individual worker automation may bring a new concept of self.*" He will have lost the 'feel' of work - the experience of the conscious modification of things. Under automation control of work is shattered there being instead the 'endless concentration' and 'mental tension' of dial watching.

Bell does not see the implications of these changes as entirely negative:

> "*Yet there is a gain for the worker in these new processes. Automation requires workers who can think of the plant as a whole. If there is less craft, less specialisation, there is the need to know more than one job, to link boiler and turbine, to know the press and the borer and to relate their jobs to each other.*" (p. 270)

For Bell, however, what is probably the most important change

is in one of the core 'technologics' of earlier industrialism - work measurement. This now becomes redundant for under automation the worker's work can no longer be measured by his productivity for the latter is entirely dependent on the machine.

In an interesting last section Bell raises a question which he does not answer. What will happen to the protestant conception of work i.e. that work is in itself endowed with virtue, "when not only the worker but work itself is displaced by the machine?" What is being implied here is that automations impact on work and society is to understood not merely in its consequences for the instrumental aspect of work, but through them in its consequences for the ideology of work.

This theme that there is a basic disjunction between the nature of work and the ideology of work in a modern society is quite common. Berger has commented on the fact that withyet further intensifications in the division of labour and with the further emptying of work of any meaning, there still 'persists an ideology of work that continues to present the idividual with the expectation that he find work meaningful and that he find satisfaction in it.(42) This ideology he claims is institutionalised in the educational system (see for instance vocational counselling)

in the media of mass communication and last but not least, in the various occupational and professional organisations.' (43) Change in the ideology of work is directly related to change in the distributive mechanism of capitalist societies. If we cannot equate reward and success with the virtues of diligence and hard work then with what are we to equate it with? We have already in the first section of this chapter illustrated some of the thinking about this aspect of our problem.

Less precisely defined than the other two levels of analysis of automation which we have already discussed it is still nevertheless true that observing what changes which occur in the nature of work will tell us a great deal about the types of changes which we can expect in the society as a whole. An account of automation from this point of view suffers from the paucity of available empirical material. Moreover in the discussions of the issues which are at hand e.g. that by Daniel Bell or Bernard Karsh (44) there is not sufficient attention paid to the different types of automation. This leads to rather loose generalisation which cannot be accepted as legitimate comment on the sociology of automation. In the next chapter some of the available studies are discussed an attempt is made to assess how far these studies refute or confirm some of the higher level thinking and generalisation which is made about the effects of automation on the nature of work.

Conclusions

A central theme of this chapter has been the insistance that what is now required if we are to understand the sociological problems of automation properly is a theoretical model which can relate types of technical change to change in the structure of social systems. The lack of such a model underlies the current confusion and lack of precision which characterised the literature on this topic.

One of the main reasons why such a model has not been available has been that neither economics nor sociology in the course of their development have paid much attention to each other. At the same time the need to relate economic change and social change has always been a pressing one. Because of this theoretical failure the knowledge vacuum has come to be filled with a great many views on automation, some of a fatally pessimistic nature and some entirely optimistic; unfortunately some of these views have come to stultify sociolical thinking on these matters.

Within the sociological literature on the subject there is no clear picture of what are the precise problems associated with automation. Problems are seen at three levels of complexity - on the society and culture, on the structure of industrial organisations and in the nature of work. That automation has

important implications for each of these 'areas' is something which we would not deny. What is at issue is the way in which these three 'areas' have been examined. Not only is it the case that much of the sociological work suffers on a theoretical level but it also has empirical or substantive deficiencies. Most of the writers discussed above have failed completely in grasping the actual complexity of the problems of measurement. On the theoretical level the main difficulty lies in too ready an acceptance of technological determinism with the corrollary that adaptive facilities of the social system itself were underemphasised. This criticism applies to all three levels of analysis.

What now seems to be required is a model which relates technical change to the experience of the group most directly affected by the change. Given that we can identify these groups, their major values and the extent of their power, we might be able to predict how they may react to change. Furthermore we must recognise that technical change can be modified, held up, accelerated or whatever by the actions of men. We must avoid therefore too rigid an adherence to technological determinism.

Notes to Chapter Two

1. President J. Kennedy quoted W. Francois "Automation: Industrialisation Comes to Age"
Collier Books New York 1964

2. A.E.U. research report "Automation" 30.9.66.
Unpublished.

3. Crozier and Friedman "Introduction to the Social Consequences of Automation"
International Soc. Science Bulletin 1958.

4. Howard Coughlin "What Automation Does"
New Society 23.5.63. No. 34 p.8.

5. Walter Buckingham "Automation: Its Impact on Business and People"
Mentor Executive Library 1963

6. Sir Leon Bagrit "The Age of Automation"
B.B.C. Reith Lectures published Wiedenfield and Nicholson 1964.

7. Quintin Hogg Conference address quoted A.E.U. report op cit

8. Peter Drucker article in Technology and Culture April 1966 vol. 7 p.143

9. Norbert Weiner "Cybernetics or Control and Communications in the Animal and the
N.Y. John Wiley 1948 p.189

10. Robert L. Heilbroner "The Impact of Technology:
The Historic Debate paper in "Automation and Technological Change"
edited by J. T. Dunlop. The American Assembly Prentice Hall 1962 p.21

11. Robert L. Heilbroner op cit note (10) p.21

12. See T. Bottomore and Rubel "Karl Marx"
Penquin 1963

13. J. K. Galbraith "American Capitalism"
London Hamilton 1957

14. See T. Parsons "The Social System": Neil Smelser "Social Change in the Industrial Revolution"

15. W. E. Moore "Social Change"
Prentice-Hall 1965

16. Donald N. Michael "Cybernation: The Silent Conquest"
a report to the Centre for the Study of Democratic Institutions
Santa Barbara 1962 p.5.

17. Rex Hopper "Cybernation Marginality and Revolution"

article in Horrowitz "The New Sociology"
O.U.P. 1964

18. D. N. Michael op cit note (16u) p.5

19. Rex Hopper op cit note (17)

20. Hopper's hypothesis was derived from an earlier study of revolutionary change in South America; he is thus claiming that it has a general validity.

21. See James Bright "Automation and Management"
op cit chapter one see note (6)

22. T.U.C. report "Automation and Technological Change"

1965 p.5

23. I.L.O. report "Automation and Other Technological Developments"

Geneva 1957

24. The most well-known advocation of this argument is to be found in

Harold Leavitt and Thomas Whisler "Management in the 1980's" Harvard Business Review November-December 1958
See also Foster 'Modern Automation'. Other studies dealing with this issue will be more fully discussed in chapter three of this study.

25. Rex Hopper op cit see note (17)

26. Herbert Simon. "The New Science of Management Decision"
The Ford Distinguished Lectures ... vol. 3
American Book - Stratford Press, Inc. 1960

27. See T. Burns and G. Stalker "The Management of Innovation" Tavistock 1961 for a discussion of the notions of 'mechanistic' and 'organic' authority systems and the conditions under which they are appropriate.
See also Joan Woodward "Industrial Organisation: Theory and Practice"
O.U.P. 1965 where the innaplicability of much management theory is demonstrated.
For a fuller discussion of these points see chapter four of this study.

28. Herbert Simon op cit see note (26) p.48

29. C. Wright Mills "White Collar"

30. See for example E. Mumford and O. Banks "The Computer and the Clerk"
Routledge 1966

31. H. Leavitt and T. Whisler op cit see note (24)

32. E. Mumford and Tom Ward "How the Computer Changes Management"
New Society 23.9.65.

33. Mumford and Ward op cit see note (32) p.7

34. Bendix and Lipset "Social Mobility in Industrial Society"
Heinemann also Current Sociology vol 9. A good discussion of this material is to be found in T. Bottomore "Classes in Modern Societies"

Allen and Unwin

35. Current Sociology Vo. 9 Unesco

36. Crozier and Friedmann op cit see note (3)

37. R. L. Heilbroner op cit see note (10)

38. There is a growing literature in this field of Occupational Sociology although there are few comprehensive texts. A useful book is edited by Peter Berger "The Human Shape of Work" see note (42) and there is also a very useful discussion of the field in S. Cotgrove "The Science of Society" Allen and Unwin.
It is particularly regrettable that so few of these studies deal with the occupations of automation. Blauner's "Alienation and Freedom" is, however, a useful and important contribution. See also E. Mumford and Tom Ward "Computer Technologists" Journal of Management Studies Vol 3 No. 3 October 1966. As I hope to show in chapter three of this study a great deal is becoming known about the types of work systems which automation can sustain but little is known about the experience of work under automation nor about work orientations. Future research will have to correct these omissions.

39. Crozier and Friedmann op cit see note (3)

40. See chapter three for a discussion in greater detail.

41. Daniel Bell "Work and Its Discontents"
in his "End of Ideology"
paperback Free Press 1963 p. 268

42. Peter L. Berger (Ed) "The Human Shape of Work: Studies in the Sociology of Occupations"

see the article "Some General Observations on the Problem of Work"

by P. L. Berger
Collier Macmillan 1964

43. Berger op cit note (42) p.221

44. Bernard Karsh "Work and Automation" in Jacobsen and Rouček op cit

see note (23) Chapter One

III

THE SOCIOLOGY OF AUTOMATION

Section One

Aims and Discussion Framework

In the last chapter some theories of the social consequences of automation were discussed. The general conclusion was that the sociological problems of automation were yet to be clearly stated. In part, the reason for the persistence of this situation must be, as Schultz and Weber have pointed out, that there is a paucity of 'structured sociological research' against which some of the more general accounts can be evaluated. (1)

This chapter is directed at research of this nature and it pursues three principal aims. Firstly, to set out the findings of sociological case studies of automation in a systematic way. Secondly, it attempts to examine what limitations there are to these studies. Finally, its aim is to see how far the findings of these studies lend confirmation to some of the more general theories of automation discussed in the last chapter.

Over the last few years quite a considerable number of studies which fall into the category of 'structured research' have appeared although not all of it has been specifically sociological research. William Faunce has pointed out, for example that:

> *"To the extent that social scientists have become concerned with the problem (automation) at all, their attention has been focused primarily upon the possibility of technological displacement of workers and its attendant problems. The questions of individual and organisational adjustments to the changes in production techniques has received much less attention."* (2)

Despite this the situation is changing; there is a renewed interest in the sociological consequences of technical change although there is little concensus on the most appropriate ways in which to approach this problem. One consequence of this is that the significance of the findings of a growing number of case studies is not entirely clear. Furthermore, since this growing research effort is not systematically coordinated around a determinate range of key problems the importance of which emerges naturally from a common theoretical framework, it is difficult to regard our growing knowledge as being in any sense cumulative. In the light of this it is proposed in this chapter to set out and discuss the findings of important case studies under the headings of the three main types of automation which were discussed in chapter one; these were (a) process technology (b) automatic handling devices and machine tools (c) computers in offices.

Section Two

Process Technology

There are several reasons why it is appropriate to begin with a discussion of process technology. W. H. Scott has pointed out that although the concern with the problems presented by process technology seems to be declining in the face of a much greater interest in the implications of various forms of computer technology it was process technology which first captured the public imagination during the 1950's. (3) It was in this period, that the scene was set for subsequent discussion of automation. In the public imagination, process technology has come to examplify all that is entailed in the idea of automation. Thus when one finds far reaching social and industrial changes being proclaimed for automation it is more than likely that it is from the experience of process technology that such claims are being made.

Joan Woodward and her team of researchers in South East Essex have suggested that manufacturing methods in an industry can be seen as passing through three stages of technical advance:- from small batch and 'one-off' or unit production through to large batch or 'mass production' through finally to continuous flow or process production. (4) Similarly, in a recent study

of alienation in modern industry Robert Blauner has claimed that process technology is the latest stage in the technical evolution of manufacturing employing the latest control devices which modern electronics have developed.(5) In short, process technology represents the spearhead of technical evolution in manufacturing methods and it is for this reason that process plants have attracted a great deal of interest in recent years.

There is, however, a curious ambivalence in our attitudes to this type of automation, an ambivalence which is reflected in the wider literature about automation. There is first of all the obvious tendency as we have just noted to conceive of process technology at the forefront of the technological revolution. Associated with this is the suggestion that not only is process technology progressive in a purely technical sense but also in a social or human sense. Adam Abbruzzie has written of 'new horizons of labour dignity' as more and more sections of industry come to resemble and embody the operating conditions found in process plants. Similarly, in his essay, 'Work and Its Discontents' Daniell Bell writes of workers attaining a new conception of the self - a new conception of their relationship with work and with society generally. (6) Finally, though by no means exhausting the list of possible references, Blauner has argued that under process technology there is a shift away from a commodity concept of employment to a welfare concept. Because of the challenging

nature of work, a new found responsibility, a high degree of job security, in short, because of a non alienated work environment, workers come to anticipate spending their whole working lives with the same organisation. Similarly, for reasons which are both human and strategic management in these circumstances tends to look after the welfare of the employee. In this situation worker-managment relations are entirely harmonious. (7)

However, it is not to be supposed that the quality of human relations in process plants is to be explained entirely by the existence of highly trained, progressive managements for process technology itself seems to call forth these qualities. Management can afford to be magnanimous for productivity no longer depends upon the worker but upon the machine and is, therefore, usually high. In these circumstances, a Blauner argues, there is a premium placed upon management to employ responsible employees rather than merely skilled men for a responsible workforce (i.e. one which can diligently and without supervision ensure the continuous operation of extremely complex machinery) is absolutely essential in this kind of plant. In circumstances such as this it is not hard to understand the supposed transition from a commodity concept of labour to a welfare concept of labour.

We shall discuss Blauner's work in greater detail in a moment our purpose so far having been merely to illustrate one set of arguments which are applied to process technology. Writers at the opposite pole tend to stress the severity of the employment consequences of process technology pointing to the great gains made in labour saving with this type of automation.

The gains made for labour dignity, or alienation, or whatever are completely offset by the absolute decrease in employment opportunities which process technology produces. (8) One can, of course, quite easily provide evidence on the level of employment in process plants which would sensibly support these views. At the same time, however, it must not be forgotten that the industrial sectors which can utilise process control are few in number i.e. those industries having a flow technology often dealing with liquids or, for example, electricity generation, which is particularly suitable for the introduction of automated techniques. Given this it is unlikely that the proportion of the labour force affected in any way by process technology will exceed more than 8 per cent of the total. (9)

To appreciate the significance of these arguments which on the whole would suggest that process technology is a welcome development, it is important to appreciate what features -

structural and behavioural - of industry this technology is likely to modify. This is particularly important since one's evaluation of the past will temper one's evaluation of the present.

The Context of the Debate

One of the constantly recurring lines of criticism directed against the industrial structure of Capitalism both in the nineteenth and twentieth centuries concerns the way in which the worker has been systematically and inexorably deprived on the fruits of his labour, both in a quantitative economic sense and in a qualitative experential sense. The former is economic exploitation the latter alienation. (10) From Marx to George Friedmann it has been a commonly held belief that the mechanism principally involved in this dehumanising process has been the extensive division of labour.

Bell has suggested that specialisation is one of three of the most important "technologics" of Capitalism, the other two being the principles of measurement and hierarchy. (11) Given an extensive division of labour it is possible, Bell suggests, to measure meticulously every work operation and to transfer the control of work - an important factor in work satisfaction - from the worker himself to an appointed management functionary.

Alain Tourraine, a French sociologist, has summed up this process as a movement from the 'craft system of work' to the 'technical system' of work. In the former the essential productive unit is the worker, in the latter it is the factory. (12) The process of specialisation results in a diminuition of skill levels but probably more important than this, at least for the critics of industrialism, a loss of responsibility on the part of the worker. The end product of all this is that work is no longer intrinsically satisfying in its own right; that it is sought after for reasons which are predominently instrumental. Dubin has suggested that work is no longer a central life interst for a great number of industrial workers. (13)

Within this context social scientists have assumed that workers act in one of two ways there being little agreement on which is the most likely response. Either the worker seeks to re-establish his occupational autonomy by various 'strategies of independence' (14) or else his expectations for a satisfying work experience are displaced onto new expectations of his life within the home. Durand has written for example that:

> *'In the phase of the downgrading of skilled work, the craft's work is broken down into fragmentary and repetitive tasks, of which that of the semi-skilled worker is typical. Confronted with this fragmentation of work, the worker's response is to maintain his occupational autonomy'.* (15)

and that in the face of a scientific work organisation the production line worker, a man whose work role exemplifies all the dehumanising characteristics of industrialism, is 'engaged in sureptitious battle against pace'. The so-called 'strategies of independence' - strikes, absenteeism, restriction of output, 'bucking the line', 'gold bricking' work to rule, in short, the whole range of labour action-are seen in this analysis as an attempt to regain work, to recreate a work environment in which work becomes a 'self actualising experience'. (16)

Peter Berger, on the other hand, has argued that the worker has reacted by retreating into the home and by devaluing the importance of work as an aspect of his total experience. He refers to this type of adaptation as 'privatism' and suggests that it is to be explained because of the persistence of an outmoded, Protestant work ideology which stresses that man ought to fulfill himself in work where this is plainly no longer possible. (17) Privatism is one way of reconciling these contradictory pressures.

It is not my intention at this point to discuss the relative merits of either analysis for this is an extremely complex sub-topic in its own right. My purpose has been to illustrate briefly the kind of situation which automation - and especially

process automation - is expected to change and to suggest the evaluative backcloth against which process technology is being regarded with so much enthusiasm. It has been necessary to do this for the situation now is that most students expect automation to reverse those dehumanising tendencies in industry which once seemed so inevitable. Durand has written:

> *"As the technical organisation of work is further developed to the point of automation, the reintegration of work takes place."* (p.30)

and that:

> *"The technical concept of automated production processes is, indeed, one of integrated groups of work processes. The individual job is no longer isolated; it owes its new significance to the part it plays in a complex whole".* (18)

If the discussion so far suggests that process automation seems to reverse certain consequences of assembly line production, notably the tendencies towards an even greater division of labour, it should not be assumed that in this transformation the worker regains lost skills. This is quite obviously not the case; rather he aquires a qualitatively new skill. Robert Blauner has suggested that an essential component of this new skill is responsibility:

> *"The development of machine and assembly line technologies greatly reduced the number of traditional craft skills necessary for manufacturing production; with the emergence of automated continuous process technology, traditional*

> *craft skill has been completely eliminated from the productive process. ... In the place of physical effort and skill in the traditional, manual sense, the major job requirement for production workers in continuous process technology is responsibility. As the French sociologist Alain Touraine phrases it, 'Their responsibility defines their professional skill'".* (19)

Certain skills do remain intact and these are usually the ones concerned with maintenance.

The Evidence from Case Studies: The Worker's Role

Process technology then seems to be reversing both the tendency toward a greater division of labour and the tendency for the worker to loose all control over his work. These observations are in the main substantiated by other case literature. Four studies are of particular value in the study of process automation.

There is first of all the study we have quoted from by Blauner which is a study of alienation amongst factory workers. This study of alienation amongst factory workers. This study seeks operationally to define the concept of alienation and apply the analysis to a series of different work environments. His thesis is that the degree of alienation experienced by the factory worker is a function of the type of industry in which he works; that contrary to crude Marxian suppositions not all work environments produce the same degree of alienation.

He analyses four work environments which for him illustrate the ways in which industrial production methods have progressed throughout the industrial revolution. These are (a) printers (b) textile workers (c) automobile workers and (d) chemical operators. Using four dimensions of alienation - powerlessness, meaninglessness, isolation and self estrangement - all of which are entailed in the Marxian notion of alienation and all of which are experienced to some degree by most industrial workers, and relating these dimensions to different work environments, especially technological environments, Blauner postulates his thesis of the U-curve of alienation.

Essentially this states that the evolution of manufacturing methods in modern industry has served to accentuate and intensify the degree of alienation experienced by the industrial worker; that alienation is at its peak with the assembly line workers in the automobile industry and hardly exists at all in the traditional craft industries of which printing is a fine example. With the chemical operator the situation changes for, as we have seen, a reitegration of work takes place and alienation decreases. Thus in Blauner's analysis process technology will decrease the level and intensity of alienation experienced by the factory worker. Hence the so-called 'U-curve of alienation'.

A second important study in this context is that of Mann and Hoffman, 'Automation and the Worker' which is a study of social change in power plants contingent upon the introduction of automated equipment to the process of electricity generation.(20) An empirical study formally designated as 'an investigation of the social and psychological effects of a new form of technology, automation.' This is a case study which compares two power plants at different stages of technological complexity. Thoroughly empirical in its orientation this study attempts not merely to describe what changes occurred in the structural morphology of the power plant but to relate these changes to the attitudes and perceptions of the workers involved in these changes. Despite a commendable attempt to try to treat the organisation as a total social system this study succeeds only in providing a great deal of very useful empirical information. However the study does not suffer too much for that since the authors themselves consider it an exploratory study. We shall have something to say later of the theoretical assumptions which the authors bring to their work, namely, a human relations framework of analysis, but for the moment we shall be interested only in their principal empirical findings.

A third study which is directly useful here is that by Joan Woodward 'Industrial Organisation; Theory and Practice'. This is a study of management organisation in British industry based upon a sample of firms in South East Essex.(21) Initially concerned to find out 'whether the principles of organisation laid down by an expanding body of management theory correlate with business success when put into practice' this study widened considerably into a much more comprehensive enquiry into what variables affected the structure of management. The initial finding of the study was that few firms seem to adopt the kind of management organisation which is prescribed by the classical organisational theorists and that in some cases a rigid adherence to these rules would be positive damaging. It emerged later in the analysis of the data accumulated from a number of detailed case studies that a decisive variable determining the formal organisation of management was the level of technical complexity reached by the organisation in its production methods. This study which is both empirical and analytical is of considerable value in throwing light on the problems of management organisation in process technology.

Finally, in the group of studies we shall be concerned with in this essay there is the study by Emergy and Marek reported in

Human Relations 1962 'Some Sociol-Technical Aspects of Automation'. (22) This is a study currently being carried out by the Tavistock Institute of Human Relations of the social psychological problems which exist in an highly automated power plant installed in a large organisation. This is another example of process technology and information is given on the problems of the change from one set of operating conditions to another and to the ways in which the new technology and its special operating characteristics affected the structure of the management system in the power plant. Part of the difficulty involved in regarding the findings of these studies as contributing to a cumulative body of knowledge about process automation stems from the limitations of the case study technique itself. As Emery and Marek have pointed out a case study in a particular plant tells only of one possible way in which the introduction of automation can affect the structure of an organisation and for this reason may not be readily generalisable. (23) However, even accepting this limitation the studies we have briefly mentioned lend support to the view that process automation brings with it beneficial consequences and that workers and managers themselves seem to derive a great deal of satisfaction from their work under the special conditions imposed by this technology.

In all of these studies attempts are made with varying degrees of success to relate technical changes to social and psychological changes in the operating conditions of process plants. As such these studies can be seen as attempts to illustrate and discuss some of the main variables which need to be taken into account when we examine technical change.

Process technology is modern; the successful exploitation of the latest methods of production often means that completely new plant has to be set up. As Mann and Hoffman show one of the immediately appreciated aspects of automated process plants is their cleanliness, spaciousness and safety. (24) They also suggest that these physical characteristics of process plants contribute in part to the higher levels of work satisfaction found in them.

By far the most important characteristic of process plants, however, is the absolute reduction in operating personnel which is achieved in them. A consideration of this aspect reveals some of the most important characteristics of process technology. In their study of the power plant Mann and Hoffman point out:

> *"Visitors to Advance (The automated plant - W.W.) were impressed by the large amount of gigantic, expensive machinery and the few men apparently responsible for its operation. (p.52)*

and go on to say that' ... the personal requirements of the new plant, relative to its production capacity, were a little less then half what they were in the older plants.' (25) (p.52) Blauner suggests on the basis of comparative employment data that the low level of employment in process plants is a general feature of process technology pointing out that "despite the size of the major companies, individual plants do not employ as many workers, on the average, as in the automobile industry". (26)

This low level of employment is achieved primarily through changes in the occupational structure of these plants - notably changes towards the reintegration of skills, and, contrary to what might be expected, job security is increased and so is the work satisfaction of process workers. Synonymously, change occurs in the structure of supervision. In fact, all these changes are strategically interrelated with one another.

In the Mann and Hoffman study it was observed that in the new process plant - the one they refer to as Advance - a policy of job enlargement was effectively executed. Three of the previous operative roles were combined under the direct control of the maintenance engineer. Whereas previously there were three craft functions dealing respectively with the boiler operations, turbine and condenser functions and general electrical

work a new role was evolved in which the three functions were fused.

Training for this role was carried out rather unsystematically - operatives merely rotating from one job to another - but the overall effect was to raise the level of job satisfaction and break down the degree of physical separation which is usually found between workers in older electrical plants. In the new plant there is a shift in the main orientation of operative roles from direct intervention in the productive process to one of 'servicing' the technical system i.e. a move towards maintenance. Mann and Hoffman point out that in circumstances such as this where it is imperative that the plant remain functioning - the consequences of 'downtime' being to shut of the electricity supply of a whole area - it is important for workers to have an overall understanding of the operation of the plant and to be able to predict accurately the consequences of their actions on the whole system. It was of course for these reasons that a policty of job enlargement was accepted but it should be pointed out that process technology affords clear opportunities for the successful adoption of such a policy.

These shifts place new demands upon the operative's skills. In the Mann and Hoffman study it was reported that although the new work situation allowed for a greater degree of work satisfaction

the operatives nevertheless experienced greater tension and nervousness. Similar findings are reported in the study by Emergy and Marek; in both cases an expansion in the skill requirements of the operative's role produces a new level of work satisfaction. They note that with progress to automation the operative is increasingly separated from the productive process for the higher output achieved under automated conditions could not be achieved by manual intervention. Automatic control devices have to be introduced. They write that " ... at most points in the productive process the operator is one step removed from what is going on". (p.21) Further

> *"With centralised panels of indicators in each of the three main locations it is now possible for an operator to have conceptual contact with many more steps in the process than previously. And hence to have greater relative knowledge despite the complexity - a source of considerable satisfaction."* (27) (p.21)

The operating conditions of process technology are such that they require workers who have more knowledge and more control over the whole productive process than they had previously needed. This all leads to greater satisfaction in work or, as Blauner analyses it, to a work situation which is 'self-actualising instead of self-estranging' (p.154) The benefits accruing to the worker which we have described so far are entirely intrinsic, relating

to the experience of work itself. The level of work satisfaction is also influenced by the amount of security which a particular job carries and this is best looked at as a factor producing extrinsic or instrumental satisfaction. Current experience of process technology suggest that although fewer in number of jobs in process plants are very secure. This job security is, however, just as much a function of the kind of industry into which process controls are introduced as it is to the intrinsic attributes of automated machinery. Dealing with the second aspect, however, Blauner explains the situation as follows:

> *"Workers in the continuous process industries are far more secure in their employment than employees in most other industries. In an automated technology, the volume of output is not a function of the number of production workers as it is in pre-automated systems, but depends largely on the capacity of the technical equipment. Individual plants do not hire and fire as consumer demand rises and dips, as is common in the automotive industry. The number of workers necessary to operate and maintain the equipment has already been reduced by automation to the minimum required for safety and efficiency. For these reasons, labour tends to be semifixed or fixed cost in production rather than a variable cost, and the 'core labour force' in an automated technology therefore has an unusually high degree of job security..."* (28)

On this analysis job security is a structural aspect of process technology but process workers seem to perceive their roles as being very secure. Mann and Hoffman report that in the older plant examined for their study some 87% of workers felt

that their jobs were insecure is they felt that were it not for expanding business in the area their jobs would be threatened. In the modern plant only 1 in 5 workers or 20% felt that way. (29)

So far we have described how the nature of work changes under process technology and thus how the workers role changes. He seems to acquire more responsibility, have a less fractionated role to play, to derive a greater degree of work satisfaction and job security, to feel less alienated insofar he has more control over his work. There is one other important change which occurs and which we have not mentioned. It is often the case that a shift system has to operate. As Mann and Hoffman show it is quite possible that a shift system can add to the tension of the job, especially at supervisory levels, and disrupt somewhat the normal rhythems of family life. On the whole, however, process technology seems to afford the worker new opportunities in work.

The changes which promote those changes which we have described in the workers role equally affect, though in a different way, supervisory roles and the whole nature of supervision. Technical changes thus affect one set of relationships which are of central importance in the whole complex of work relations - those pertaining to authority.

Process Technology and Authority Relations

That authority relationships in an organisation are of strategic importance for social behaviour in that organisation is something we are no longer required to prove. Difficulties arise, however when it is recognised that different types of authority relations have different consequences for behaviour. Authority relationships are relationships of subordination and superordination. To remain stable these relationships require legitimation i.e. the subordinate must perceive the greater discretionary power of his superior as legitimate. Authority relationships, then, are social relationships and as such are governed by patterns of mutual and reciprocal expectations - supervisors expect workers to act in certain ways; workers have presumably internalised these expectations and act accordingly. However, in the event of non compliance the superior can level certain sanctions against his subordinates for his role is invested with greater power. If what we have just said represents the bare bones of the theoretical analysis of authority it should be immediately recognised that in practice the types of expectations involved vary enormously, the sanctions supervisors can apply against non compliance are subject to the same degree of subtle variation. Finally, it must be

recognised that (a) the nature and type of authority relationships which prevail in any one organisation are not entirely accidental but directly related to the special operating problems of that organisation and (b) authority relationships are related directly to the nature of the workers participation in organisational life. (30)

Authority relationships can be looked at in a variety of ways. Insofar as authority is pervasive, direct and continuous it can be regarded as yet another feature of modern organisation which produced the alienated worker. Blauner regards close supervision in this light. In this sense the relationship between supervisor and worker is one of domination. Blau and Scott, however, differentiate another 'supervisory style', that of leadership. In this kind of relationship there is likely to be more consultation between management and worker and the supervisor in this situation is likely to command more layalty and 'informal authority' and secure a higher level of productivity from his subordinates. (31)

The nature of authority relations under automation is a topic which holds considerable interest. Hierarchical authority relationships and organisational structures - mechanistic systems in the terminology of Burns and Stalker - have been shown to be a

necessary feature of assembly line production and a particularly distasteful aspect in the social relations of industry. (32) The need for such relationships was a function of two special characteristics of modern factory production - a high degree of work specialisation which raises problems for the coordination of work flow, and the direct link between effort and productivity which placed a premium on management to secure the maximum amount of work from the worker. Underlying this relationship was the purely market relationship between worker and organisation - that which Blauner refers to as the 'commodity' concept of employment. In this situation the motivation to work and to seek intrinsic satisfactions in work is not high and the domination type of authority tends to prevail. (33)

Just in the same way as writers see in process technology the reintegration of work and an increase in the responsibility of the worker so do they expect, and find, a qualitative change in the 'governing system' of the organisation and changes in the nature of and style of supervisory roles. In the governing system the change is towards greater decentralisation; in supervisory style there is a shift towards a reliance on 'impersonal mechanisms of control' and consultative supervision.

It is in the nature of organisations as social systems that change in one part of the system will exert pressure for other parts to change. In the study by Emery and Marek changes in supervision are analysed as but one part of the process of change in the total 'socio-technical system'. Four aspects of change in supervision are selected out. They notice first of all that with the integration of the operatives' role giving him overall responsibility and control over a much wider section of the technical process the supervisor has more opportunity to concern himself with the maintenance of the 'boundary conditions' of the parts of the plant under his command. That is to say, he can spend more time servicing his department and ensuring that disruptions of the technical system are kept to a minimum. Secondly, since the operative is 'one step removed from the process' his key functions are only overtly performed in times of crisis. In a situation such as this there is little need for constant inspection or supervision. Because of this two further changes occur in the superior - subordinate relationship. In the first place it comes to be expected that supervisors do not in fact carry out inspections; that their function is not to control staff. Related to this there is the second change -

which is essentially a change in expectations - that when required the supervisor is consulted for his professional advice only. In the Mann and Hoffman study one of the implications drawn from a series of findings similar to those we have just described was the supervision can, under process automation, be concerned more with the 'human relations' aspect of their role, and that this in itself is likely to lead to greater satisfaction in work.

Blauner, too, observes this change in the pattern of supervision - a change which, for the worker, means more freedom. His point is that 'This freedom is possible because the work team which runs an individual plant takes over many of the functions of supervision in other technological contexts.' Likewise, of the changeover to consultation Blauner writes:

> *"The chemical operator probably has more personal contact with persons in higher levels of supervision than do workers in mass production industries. These contacts generally are for consultation on production problems and are therefore more satisfying than administrative or disciplining contacts. In automated production, when the workers' function becomes responsibility rather than skill, consultation with supervisors, engineers, chemists, and other technical specialists becomes a regular, natural part of the job duties."* (p.147-148)

It appears then that authority relationships in process technology rest more upon the positive commitment on the part of the operative to keep the system serviced than on any negative sanctions on the part of management to ensure compliance.

Apart from these very important changes in the style of supervision with process automation very important changes occur in the government framework of the organisation in which supervisory practices take place. With process technology as Joan Woodward has shown the structure of management changes. The length of command in the organisational hierarchy tends to decrease as technical systems come to resemble process conditions, that ratio of salaried staff to manual staff tends to change in favour of the former. Woodward and her colleagues found that in process firms there were over three times as many managers for the same number of personnel as in unit production firms. Similarly at this stage of technical advance the organisational system tended to be very flexible with little of the rigid specification of roles one finds in the more traditional bureacratic form of organisation. (34) Woodward and her associates also found that, in these circumstances, the task of controlling personnel was in many ways built into the machinery; that 'the plant itself constituted a framework of discipline and control' (p.29) and that 'Any demands on the operators were in fact made by the process rather than supervision'.

Although we shall come to her detailed explanation of this organisation later her thesis is briefly that different production

systems present different 'situational demands' to management. The necessary sequence of events and operations notably in development, production and marketing which ensure the normal, profitable functioning of the firm provided a special framework of circumstances within which management organisation had to be worked out. Underlining and to a large degree determining these management functions was the technological system and this is shown in the analysis to be the most important variable affecting the structure of management.

We come now to the end of our discussion of process technology for the moment; in a later chapter we shall be returning to the studies we have been discussing here. To round off this particular section of the discussion three final points need to be mentioned. First of all it seems relatively well established that when writers eulogise on the humanistic implications of process technology their expectations are to large degree borne out by experience. Process technology does seem to reverse some of the dehumanising processes inherent in, say, mass production type industries. It must be emphasised, however, that the gains we have described are the product of process technology and not, as some writers have erroneously assumed, of automation generally. I shall show in the next section that other varieties of automation

bear little resemblance to process technology: in actual fact, they may intensify some of those industrial pathologies which process technology seems to alleviate.

The second point must relate to the paucity of studies available. We still lack a comprehensive attempt to study process technology in all its aspects. The examples we have used cover a limited range of process industries and most of them are industries on the frontiers of innovation. As such the 'sample' we have used may not in fact be truly representative of all process plants.

Finally, and more important, it is readily apparent the studies we have used to illustrate. the discussion deal only with a limited range of problems and then from within a rather special theoretical frame of reference. We noted earlier in this chapter that the frame of reference brought to the data and the theoretical assumptions made by the writer significantly affects the kind of problems he selects out for special examination. Not one of these studies relates changes in the structural morphology of the firm to changes in the distribution of power within the organisation. Not one of these studies relates socio-technical changes to new opportunities for industrial strategies on the part of trades unions when it is well established

fact that different work environments afford different opportunities for industrial action. Sayles, for example, has shown how effective power can be distributed between various work groups, each having a different skill composition and each being related in different ways to the overall productive process. (35) The reason for this neglect of the industrial relations aspect of organisational behaviour is that the studies we have been discussing adopt a 'unitary frame of reference' for the study of organisations. It means in practice that they are more likely to study those processes which tend to support co-operative relationships in industry rather than those which invariably produce strains and tensions. (36)

So long as a situation such as this is allowed to persist our knowledge of process technology in particular and automation in general is likely to suffer from great gaps in the area of our theoretical concern. We shall be taking up this problem again later. In the meantime we must turn now to a discussion of some of the studies concerned with the more primitive form of automation - 'materials handling and linked processes' or what has been more conveniently referred to as "Detroit automation".

Section Three

Automatic Handling Devices, Transfer Machinery, Detroit Automation

To the purist the type of technology which we shall now discuss would not be considered as automation. Insofar as automation always involves sophisticated control devices geared around decision-making problems then there is some justification in this view but then it would also have to be explicitly admitted that the type of process which could be properly considered as automation is extremely limited in most advanced societies. On the other hand, if we take the view that there are varying levels of technical evolution it is possible to include 'Detroit automation' under the more general term, 'automation' but it must be pointed out that the kind of process we are referring to is at a more primitive level of technical advance. It is this latter view which is adopted here. (37)

If Detroit automation bears any resemblances to earlier forms of technology it is with assembly line production that these resemblences will be most evident. In fact, this type of automation can be usefully considered as the next step from assembly line conditions in the evolution of technology. This type of automation resembles mass production methods both in its operating conditions and its implications for the structure and quality of work.

We have already described some of these aspects of modern industry commonly felt to be distasteful, self-estranging and which to various writers are to be modified by process technology. The type of industrial structure which these writers assume is being quickly modified is best examplified in assembly line work particularly in that industry with which mass production methods have traditionally been associated - the motor industry. It is convenient, therefore, to begin our discussion of the relevant case literature with a discussion of research carried out on automation in this industry.

The research I refer to is that of William Faunce in a Detroit automobile factory. (38) The second study to be discussed is the study by Walker 'Towards the Automatic Factory' (39) This is a piece of research carried out in the steel industry in a pipe mill. It is typically heavy industry where, prior to the development of automatic methods, work conditions were hot, smoky, exacting and generally heavy. Once more it is a work environment against which the improvements likely to come from automation can be usefully contrasted. Finally, we shall be using the study carried out by Fensham and Hooper on the problems of technical change - change prompted by the introduction of automatic looms - in a cotton mill. (40) This study carried out

in a British textile mill provides useful information on yet another variety of primitive automation.

Over the last few years workers in the motor industry both in Britain and America have come in for considerable research interest. This work situation has, for many intellectuals, come to typify in microsm the 'mass society' of detached individuals no longer engaged in a satisfying complex of integrated social relationships. It is a work situation in which the imperatives of size, hierarchy, specialisation and speed - all thought of as essential prerequisites of high productivity - have been fully institutionalised. Thus we have the well-known study by Walker and Guest, 'Man on the Assembly Line' and the companion volume 'Foreman on the Assembly Line' which both, in graphic detail, exposed the disatisfaction which is felt at the mechanical pacing of work and the breakdown of the social relationships of work. There is also the study by Chinoy 'Automobile Workers and the American Dream' which, amongst other things, discusses some of the safety-valve mechanisms which operate in these plants to reduce tension and feelings of anonymity and estrangement. Trapped by the economic fact of high wages Chinoy shows there are at least two important adaptations to this work situation on the part of the auto worker.

Either he redefines his own personal goals, often in phantasy, to, for example, owning his own business. Or, and this is the most usual response, he becomes child centred - planning the college education etc etc all in an attempt to remove the possibility of his own children ever having to work on the belt. (41) Likewise Blauner, in the study we have mentioned already, discusses in some detail the work situation of the automobile worker concluding that this is a work situation of extreme alienation on all the four criteria which he uses. (42) A recent study in Britain by Goldthorpe and Lockwood has shown that to some extent motor car workers are self selected men - the type of man who does not seek intrinsic satisfactions in work and does not, therefore feel particularly deprived in his work situation. (43)

Be all this as it may it should now be evident that if automation will, as some writers suggest, transform such a work environment a study of automation in such a plant is particularly suited for the purposes of evaluating this claim. The studies in Detroit by William Faunce are of direct relevance here. Faunce has been concerned in a series of publications to trace the effects of automation on the plant social structure and on the attitudes of workers. He has been able to survey what changes occurred in work, work groups, on the problems of monotony and tension, on supervision and, unlike the conclusions which have been reached about process automation Faunce's thesis is that

'In general the data suggest that the social structural changes which can be attributed to the change in production technology were sources of disatisfaction in the automated plant.' (44) And, more omiously and also in direct contrast to the conditions found in process plants, 'With the advent of automation, the long trend towards decreasing control of work pace by the industrial worker has almost run full course.' (p.371) Faunce's research on the adjustment problems of workers in automated plants was based on a random stratified sample of 125 workers who had had experience of automated technology in the most highly automated car plant in Detroit. He deals with changes in the work and plant social structure and the with the effects of these changes upon work satisfaction and attitudes towards industrial work. His most important findings were as follows, four of the most important being singled out for special attention. The first and most obvious change which occurs concerns the amount of materials handling involved in assembly jobs. Here Faunce reports a reduction from 80% to 44%. What these figures mean in practice is that the new work was physically much easier. This is a significant change in job content, although few changes occur in work conditions. Noise levels, fumes etc etc do not change with automation.

Under most forms of automation the worker is as we have seen one step removed from the process of production and Faunce's research provides corroborative evidence for this generalisation. In the whole sample only two workers reported that they could actually operate (i.e. control) a machine. In this situation fewer workers were able to work at their own speed. A third change directly related to this was that in the new plant, in contrast to those in the older plants, many jobs required almost constant attention for the economic consequences of an unscheduled stoppage are too great. A fourth feature of the new plant was that no new or greater skill was required and no special training schemes were set up. The layout of the machine, the nature of the new job requirements in short, the operating conditions of the new plant had important implications for the social structure of the plant and for the attitudes of the men. Workers themselves were reported to feel more responsibility but at the same time more fatigue - a fatigue which seem to be related to the intensive and constant monitoring of the machines. Further, the changes which occurred in the social milieu of the plant - 'in-plant social structure in Faunce's terminology - were such that the worker felt increasingly <u>isolated in work</u>. Plant layout first of all decreased the opportunity for social interaction and what social interaction

which did take place typically occurred in much smaller groups. Finally, plant conditions are such that in conjunction with the isolated nature of the new work roles, workers are less likely to identify with a particular work group.

Changes such as these in the analysis by Blauner (op cit) were regarded as contributing to the meaninglessness of work and thus to the extent to which the worker felt alienated from work. Faunce writes: "It might be hypothesised that a decrease in the opportunities for social interaction and an increase in the amount of supervision would be sources of disatisfaction with automated jobs. The data collected in this study support these hypotheses." (p. 373) Authority relationships tended to become more formal and intense and this was reported as preducing a great deal of disatisfaction. Similarly there were no significant changes in the amount of pay nor in the possibilities for promotion for, as he points out, 'There is also some evidence from this study that the range of the status hierarchy is even more compressed in automated than in non automated plants." (p. 375)

In the last part of his analysis he turns to the question of how far automation will affect the worker's attitude to work. He points out that: 'Generally a change which is perceived as increasing the importance and amount of responsibility of a job

could be expected to affect the relative importance of work in the life of the worker, the effect of work upon self image, and the workers' perception of the general status of industrial work." (p. 378) He concludes that with automation the validity of this proposition can be severely questioned for there arise a situation in which there are few appropriate forms with which to evaluate blue-collar work and increasingly opportunities for advancement will be blocked.

In Faunce's work, then, the benefits which accrue from automation only marginally affect the worker and then only to intensify what in a word can be summed up as alienation. The benefits are rather transferred to the productivity of the overall process. The motor industry, both in Britain and America, have, through their high levels of productivity been the growth points in the economy during 1950's and continue to be so. This industry has not, however, been so clearly advanced in the design of its basic work operations and thus in producing a self-actualising work environment. One last point needs to be noticed about Faunce's study. He claims that in the automobile industry the introduction of automation did not place any great strain on the everyday relationships between a management and worker although the grievance rate did increase somewhat in the

beginning. The reason implied in his analysis for this state of affairs was that automation did not significantly change work conditions or job classifications. The unions were able, therefore, to retain the same benefits for their members as they had realised under non automated conditions.

Whereas in the automobile industry not all production operations are automated - in the Faunce study of a most highly automated plant out of a work force of 1,600 men 500 were still employed on assembly and other non automatic operations - the effects of automation seems to be to reinforce some tendencies inherent in mass production methods. This state of affairs in which the worker feels isolated, where skill levels remain largely unchanged where work groups are not characterised by strong ties of solidarity etc etc might conceivably be explained because of the very primitive nature of the type of automation involved. The validity in this suggestion is attested in the study by Walker in the U.S. Steel Corporation's continuous pipe mill where production methods affecting work flow and work organisation, in Walkers own words, "pushed the process in question a long step towards the automatic".(45) In the scale of technical evolution the pipe mill resembled process automation though not reaching

quite the same degree of sophistication and as such represents a more advanced type of automation than that studied by Faunce for the overall system was more continuous and extensive in its operation.

This study by Walker may be said, as he himself points out, "to belong to the general literature of 'technological change and human relations' with which social science has for some years been concerned" and attempts to assess the consequences of change for the structure and functioning of work groups and the attitudes of workers. It is essentially a socio-psychological analysis of change conceived from within a theoretical framework drawn from George Homan's 'Human Group' and the analysis of the dynamics of change which is given there will be looked at more closely in a later chapter. For the moment we are interested only in the more permanent changes which occurred in the structural morphology of the organisation of the plant, as these are described by Walker.

The integration of the production functions required for the manufacture of seemless pipes on the basis of continuous flow and automatic machinery changed the labour requirements of the new steel mill in certain fundamental respects. Briefly, the new work team required was both smaller in number and functionally integrated to a much higher degree than was previously found to be

necessary. Whereas pipe making in the past required many different job operators organised into specialised but fractionated work groups grouped around one particular part of the process the introduction of automative methods in the new mill rationalised considerably the whole work group structure and the nature of work itself.

In the first place jobs in the new mill were physically easier with the anachronistic exeption of one which could not be automated. There were also significant changes in the functional and social relationships of work groups. Firstly, work groups were greatly reduced in size from approximately 25 men to 9 men and, secondly, more functionally integrated, each operator's work being organically related to the work of another. Similarly the new mill changed the internal status structure of the work teams. Whereas in the old mills there were five operational subdivisions and under each key operator 3 or 4 helpers, under the new conditions there were nine operational subdivisions requiring only one operator. This served to level status differentials within the operating group. In the new situation it took quite a long time for the new teams to 'settle down', as it were, and it is this period of adjustment which is the main concern of Walker's analysis.

The new jobs were regarded by the operative as having responsibility and they expressed satisfaction with them although greater demands were placed on their intellectual abilities. It was commonly expressed that the work in the new mill was 'mentally harder'. Walker quotes one worker as saying of his new job:

> *"... You have to think more about the job you're doing. You can't look around. In the old mill the job got so you didn't have to think - no mental effort. This job is very touchy - you have to watch all the time and think every minute. They should give a lot more credit to thinking. Even when the mill is turned on automatic you still have to think all the time."* (p. 31)

Just in the same way as the nature of the job and of the working groups change in the new mill so did the pattern of supervision. The supervisory hierarchy 'flattened' a little and at the same time the number of contacts which workers had with immediate supervisors - the so-called 'interaction rate' - increased. In the old mills the number of levels between the worker and the plant superintendant was 4; in the new one it was reduced to three. However, in the course of the settling in period supervisor - worker relationships deteriorated badly. At the outset there was clear evidence of consultative supervision. In the second round of interviews, a period in which there were severe disputes about the new incentive system, these relationships regressed to formality and domination. When the operational and financial problems were overcome the

relationships settled at a new equilibrium in which the flow of command was still downward and in which some workers expressed disatisfaction for they were excluded from the planning process.

Finally, for the moment, there is the extent of promotion opportunities. The avenues of mobility were seen to be serverly restricted in the new mill because of the formal educational qualifications required for higher administrative and technical posts. Also the mill was operated on the smallest number of men necessary to ensure continuity of operation. In circumstances such as this there are few, if any, avenues for upward mobility. For most of the men the move to the automatic mill was a step which guaranteed the security of their job; to the men left in the older mills their jobs seemed now considerably less secure.

The most important feature of the new circumstances for Walker is without question the new level of integration achieved in the new mill by the work teams. From an initial period of group formation where the group, fearful if the new environment and resentful of the management did not really constitute a high morale group we find at the end of the period precisely those features which were absent and wanting at the beginning - cohesion and high morale.

The contrast with the work of Faunce is clear and only serves to emphasise once more the point that the social implications of automation will vary with the type of automation being used. Whereas with one it seems inevitable that for example, the worker shall feel isolated and deprived of the feeling of controlling his own work in the other it is precisely these features which are made possible in the new plant.

The framework of Walker's study was, as pointed out, drawn from George Homan's. 'Human Group' but unlike a great deal of literature in the 'human relations' tradition Walker does take into account tension and strain and the conflict of interests which occurred in the first few months of the operation of the new mill. His anlytical framework still rests, however, on what we have earlier referred to as a 'unitary frame of reference', for he clearly regards the kind of disputes which arose in the mill as avoidable had the management been aware of some of the operative variables in this highly complex group situation. Walker discusses and elaborates on certain situations which to someone adopting a different set of theoretical assumptions would represent classical conflict situations. One of the main 'points' of this case study is the demonstration, largely achieved, that systems of incentive payments are intricately

linked with a particular production system; that modifications of production, especially when these modifications affect the degree to which the worker can directly influence the level and speed of production as was the case in the steel mill, necessitate changes in the method of payment. The workers who operated the new mill had to suffer a 20% reduction in 'take home pay' at the outset for the mill was still technically inefficient and as such could not sustain a viable system of incentive payments. The men tolerated this for a while but disatisfactions which the incentive plan when it arrived produced a 'deadlock' situation in wage negotiations, a threatened strike and a considerable drop in productivity. It is clear in Walkers discussion that the negotiating parties differed fundamentally in their 'ends' and 'aims'. Walker writes of this situation:

> *"Members of management argued that they could not put in an incentive plan until the workers were making an effort to operate the mill normally. The workers made it clear that they would not increase their work pace until the incentives were installed."* (p.137)

Walker himself develops his description to show that the circularity inherent in this situation and the ways in which various 'forces' were impinging on each 'actor' in the situation. It is clear in the text that over a whole range of issues there were conflicts between management and men. In the new situation,

for example, differences occurred over what aspects of the new job deserved what amount of credit. Workers expressed the view that since they were being asked to think more on this job they ought to be rewarded for it; management claimed that this new requirement had been accounted for in the higher job classifications which existed in the new mill. (Walker page 171) Similarly it is clear that the workers felt a persistent sense of job insecurity and also expressed the view that the proportion of the benefits accruing from the new mill which was coming to the worker was not sufficient. Walker quotes one man as saying: *"I recognise that the company has to put out a lot of production to get back the money on their investment but the general feeling among the men is that the company is getting a lot more out of increased production than the men are sharing."* (Walker p.184)

To someone less interested in making management more efficient and more inclined to try and understand the dynamics of this situation it is clear that the initial period in the operation of the mill - a period of technical adjustment - was accompanied a series of adjustments in expectations relating to the labour contract in the new technology. (46) Both actors in the situation - management and men - were attempting to influence the behaviour of the other by establishing new forms

which would govern their new relationship and in so doing define what expectations one can legitimately hold of one another. In this situation each side was using what sanctions were available. In the circumstances described by Walker conflict seems inevitable but instead of regarding this situation as 'normal' in the circumstances i.e. where there were no rules already laid down to cover adequately the industrial relations aspects of the new mill, Walker attributes this disruption as a combination of slack management and fear and lack of faith on the part of the men. It is produced as a situation which 'good human relations' could have certainly avoided. Still, despite some inadequacies of his theoretical analysis, a problem which we shall return to more closely in a later chapter the general outlines of the plant social system likely to found in this type of technology are clearly presented.

The third and final study which we turn to in this section is conceived of within a similar theoretical framework and concern the impact of automation - in this case the introduction of automatic looms into a textile mill - on textiles workers, their attitudes, social relations and reactions to a change in production technology. The first concern of this study is to understand the problem of resistance to change and the framework

they use is drawn from the Tavistock Institute of Human Relations' work on socio - technical systems. We shall be discussing this framework in detail in the next chapter so for the moment it is only necessary to point out that in this study the mill is seen as a socio - technical system ' consisting of the interdependent social and technical organisation which includes all the machines, materials, products, individuals and groups in a dynamic relationship. (p.5)

Briefly, the central thesis of the book is that technical changes may be hindered by 'the recalcitrance of attitude change' on the part of workers. However, one would not be in a position to understand such recalcitrance unless it is realised that attitudes and frames of reference are supported and influenced by a certain pattern of group organisation which, in its turn, is supported by a particular system of rules and practices specific to a certain type of technical culture. To be more specific, Fensham and Hooper found that the changeover towards a set of attitudes and a frame of reference for understanding and facilitating the completion of work under automatic conditions - *from what they term a 'loom centred frame of reference' to a 'sett centred frame of reference'* - was naturally hindered by the persistence of a system of group identifications supported

by a 'non - automatic culture' appropriate to a mill still employing older non automatic production methods. The innovation studied was the introduction into 'Radbourne Mill' of 112 new automatic looms. The study has a comparative dimension to it for the company in which the changeover took place already operated a mill - Debenham Mill - with new automatic looms and the authors use this mill as a backcloth against which to measure changes in Radbourne.

It is their concern to show that the changes which occurred in the job structure and social relations, both at plant level and management in the new mill, can only be understood in relation to the technical problems associated with the new mills. Briefly, they show that the two main factors which arise from using automatic looms as opposed to non - automatic looms are, firstly, that production operations become continuous rather than discrete and secondly, the speed of production increases. The very high costs entailed in 'downtime' have tended to increased the pressure for continuous operation and in terms of operational requirements this leads to a situation in which the preplanning of all production operations so that they are integrated with one another becomes economically and practically essential. This in itself implies much better communication between workers and

supervisors and between different departments. In Debenham mill these problems had been met by bringing into existence a regular production meeting of the management group and by a variety of devices for improved communic ations. To characterise and to oversimplify, the integration of production functions necessited by the automatic looms seemed to draw together the governing system of the mill. In the Radbourne Mill the form of structural change was different from that at Debenham but the tendencies towards integration of the management group was clearly in evidence in both cases.

In the operative groups two work roles underwent considerable change - change which not only affected the content of the jobs but also the social relations of production. These two roles were the traditional weaver and overlooker.

Fensham and Hooper describe the changes in the weaver's task in terms of the changes which were effected in the technology and suggests in summary that three main feature of the change stand out. First of all, and in line with what might be expected with only the simplest form of automation, 'there was a considerable reduction in the proportion of the work-task which was manual'.(p.94) This was related to the second change, again in line with what is often observed, towards a decrease in actual contact with the

cloth. Finally, a component of the weaver's task which they refer to as 'supervision' and which we have elsewhere referred to as 'monitoring' increased considerably. In this changeover the rhythm of work also changed in the direction of more systematic work methods. The need for one weaver to control a much larger group of machines, coupled with the need to supervise his machines more closely, made it imperative that some form of 'system' be built into the weavers' role. Systematic surveillance of the machines ensured production continuity.

Overlookers are also responsible for the inspection and maintenance of the new automatics and this role, too, changed in significant respects though not, as we shall see, with the same consequences as those changes which took place in the weavers' role. Briefly, two changes, arising from the nature of the new looms, took place. Firstly, the manual component of the overlookers task became more complex. Essentially a maintenance mechanic or engineer the overlooker had to master new techniques for dealing with automatics. Likewise, and in line with what took place in the weaver's role the element of supervision or systematic inspection was increased. This particular change in role seems also to be a common feature of most types of automation where maintenance functions seem to acquire a new

importance and are organised on a preventitive rather than on a 'crash' basis. (47)

For both groups of operatives there was an initial period of adjustment during which time they acquired a new frame of reference for work. They point out that with automatic looms it is essential for both groups to regard cloth production as a whole and to avoid any tendency to be concerned with only one loom or merely a few looms as is the case in non-automatic production. In the initial period both groups still adopted a largely 'loom centred' view of work. They also show that this loom centred frame of reference was still supported in various ways both by management and by other workers. Management, for example, still retained a payment system and a punishment system which was taken over from non-automatic methods. Whereas in the old methods the weaver was paid in part for good quality cloth in the new conditions he did not have the same degree of control over quality. When taxed for poor quality the weaver's felt considerable resentment. This observations reinforces the points made by Walker concerning the complex interdependence of payment systems and supervisory practices within the framework of problems raised by a particular production system. One kind of payment system is not necessarily suitable

for a different technology. Fensham and Hooper regard these difficulties as transient; they would wither away as the non-automatic culture of the mill, institutionalised as it was in a particular group structure, withered away.

By far the most important changes occurred, however, in the structure of work relations between these operative groups. Weavers and overlookers became increasingly dependent on one another for the successful operation of the new mill. As one weaver put it; 'Its absolutely essential. If you can't get on with your overlooker and the other two people, you might as well pack up.' This change in the social relationships obtaining between different operating personnel represented a change towards the emergence and integration of work groups and the gradual break up of role groups. It means, in the context of our wider concern with automation that as the system in question becomes increasingly sophisticated there is a probability that the integration which takes place between technical operations finds its counterpart in an integration in work tasks and the emergence of work groups.

This finding is quite in line with the observations reported by Walker in the pipe mill which we discussed earlier. Whereas

previously the work task of the weaver was relatively isolated in the sense that she was not dependent upon the actions of the other weavers or overlookers to the extent that they are in automatic conditions, each operative group could retain its own separate identity. Not surprisingly, Fensham and Hooper show that in non automatic conditions weavers 'stick together'; they help one another on the job even though this is not a formal job requirement. Similarly, overlookers who have, it ought to be mentioned their own union, could remain in relative isolation from the weavers. In non automatic conditions, to sum up, the daily contacts and significant social relationships in the plant obtained between members of the same occupational group. This is what Fensham and Hooper refer to as a role group. In the new sheds the patterns of interaction required for the successful operation of automatic looms was conducive to the formation of work groups i.e. groups, cohesive in themselves, but comprised of different occupations.

The parallels between this study's findings and the findings of Walker are quite striking but the range of problems examined did, of course, vary. In that respect it may not be entirely legitimate to make direct comparisons between the two for they have not selected out for special attention the same variables.

But this is a limitation which we shall just have to accept for some time to come. Both studies are conceived of within a unitary frame of reference, and the inadequancies of this framework are more accentuated in the Fensham and Hooper study. There is not, in the whole book, one reference to conflict or tension. They do refer to absenteeism, an initial low morale and to complaints about the speed at which weavers now had to work. Likewise they quote some workers as showing considerable disatisfaction with the management of the new looms. However, the overwhelming impression they try to convey is one of harmony - a harmony which would have existed from the beginning had the management been aware of those variables in the situation which tended to support a set of attitudes and beliefs more appropriate to non-automatic conditions. This neglect of the problems of the conflict between management and worker, of the differential distribution of authority in the organisation - little is said in this study about authority relationships - is to be explained in part by the fact that the changeover which they described was achieved largely without much conflict but it is still legitimate to question their analysis of this situation. Whereas in their explanation of this state of relative harmony Fensham and Hooper place great stress on the cohesiveness of the weaver

group prior to the innovation as a determining factor in producing the 'correct' attitude towards the innovation (indeed, they regard their study as substantiating the hypothesis that: 'When the cohesiveness of a role group increases as a result of technological innovation, the establishment of new frames of reference and favourable attitudes to the change is more rapid than where cohesiveness is constant or has decreased'.) (p.229) it is still possible, from a different position, to suggest that few difficulties occurred because the operative groups's interests were largely achieved. One cannot, obviously, reinterpret research data so completely but the point being made is that this harmonious change could be explained from a different theoretical standpoint. There is no reasonto suppose that a theory of conflict cannot account for stability in social relationships, indeed, a good theory would be able to do this. (48)

However, despite this limitation (and we shall take up this thread in our argument in the next chapter when we discuss the theory of socio-technical systems around which this study was constructed) there is much to commend in this study especially the insistance that the factory, or in this case the mill, be regarded as a social system having a particular structure and culture which is embraced by the personalities involved. This

orientation to the data has some positive results. In the first place it ends to offset the possibility of explanations of, for example, resistance to change, in purely psychological terms but whether or not the explanations they offer are the correct ones or, at least, the best ones is still open to much controversy. Secondly, by discussing structural change and the ways in which this change was perceived always in the context of the technical changes themselves has had the pleasing result of stressing the essential interdependence of social and technical change. Thirdly, whatever the limitations, of its theoretical explanation of events, this study does provide a clear picture of the social consequences of yet another type of automation.

We have now come to the end of this section dealing with 'Detroit automation'. At the end of the last section which dealt with process technology and its social consequences the point was made that; ' ... other varieties of automation bear little resemblance to process technology; in actual fact, they may intensify some of those industrial pathologies which process technology seems to alleviate.'. It is clear that this view is very largely true. As the level of technical complexity increases and as all production operations become increasingly interdependent on one another there is a clear possibility that work groups can be reconstituted, that skill levels can be raised and that the worker can find new forms of satisfaction in work.

Section Four

Computers in Offices

In this section we turn to what for most people is the most intriguing aspect of automation, and it is an intrigue which is grounded very largely on the known capacity of computers to solve extremely complex problems at a speed for which there has been constructed a new time measurement. We have already discussed in the last chapter some of the theorising which has taken place on the implications of computers for management and administration. Not only did it appear to be the case that the structure of administration would be changed in significant ways - we mentioned (a) the growth in power of chief executives (b) the diminuition of the 'middle manager' role (c) the emergence of new strategic groups of technical experts and many other things besides - but it is also usually suggested that these changes have profound implications for the structure of society at large. When such claims are being made it is particularly important to pay special attention to the available evidence. A great deal has been written about computers and their potential applications but there has been almost total neglect of this field by social scientists - research on the industrial implications of change being confined almost exclusively to the factory or the

shop floor. In this section we shall draw upon four research sources - two British, two American - and once more our interest is in how far substantive research can lend support to some of the views we have already discussed.

At the centre of the storm is the computer hardware and it is essential to point out immediately that the range of problems which can be solved by computers varies tremendously. They range from the simplest of data processing functions such as the calculation of wages bills or the solving of mathematical and physical formulae in accordance with programmed instructions to the most complex of decision making problems in situations where there are many variables. It is also quite certain that their current uses and potential is only a fraction of what may be expected of them in the future. Not only do they vary in function but they also vary considerably in capacity. We shall show later that the size of the computer installation is an important factor to be taken into account when considering its consequences of the structure of a firm's administration; the point now being made is that this variation in computer hardware makes it difficult to generalise too freely about computers. In some of the more journalistic accounts this elementary fact has not been heeded. Scott has pointed out that:

"The changes which may follow the installation of a computer in an industrial firm are, at least in general terms, only a special case of the relations which have been traced between technical organisation and social structure." (49) This means in practice that if we are sensitive to the many subtle ways in which technology articulates with social organisation then we may arrive at a more balanced an realistic picture of the consequences of 'white collar' automation.

However, as has been pointed out, a situation persists, despite the fact that (a) there has been a considerable growth of general interest in the possible effects of computers and the white collar employee and (b) a fairly rapid increase in the numbers of computers being installed, in which pertinent social scientific work is noticeable by its absence. It has been estimated, as is shown in Table 1, that by January 1974 some 6,000 new computers will have been delivered to British organisations. These computers are for office work only no account being taken of the number of installations which may be used on factory processes. (52)

Number of Office Computers to January 1965

Year	No. Delivered	Cumulative Total
prior 1959	26	26
1959	10	36
1960	34	70
1961	55	125
1962	103	228
1963	162	390
1964	215	605
Estimates of Minimum Future Deliveries		
1965	265	870
1967	400	1,200
1970	670	3,320
1974	-	6,000

Table 1.

It is clear from the tables that the rate of introduction of computers is beginning to accelerate but these figures in themselves do not give a sufficiently clear indication of the sociological importance of this spread. More information is needed on the uses to which such installations are being put. The report from which Table 1. was extracted contains such information and it is clear, in Britain at least, that the computer revolution is taking place only in the repetitive and relatively simple office operations and not in those 'areas' where the impact of computers portends to be really serious i.e. in management decision-making. The report shows that, of the installations surveyed the highest

percentage were engaged on the relatively simple problem of payroll accounting - some 21% in fact. Furthermore, of the 328 organisations who submitted information most reported that clerical methods were the work operations most commonly taken over by the computer. The report reads: "There is little sign of any development away from the processing of the popular computer jobs, like payroll, to the more advanced systems of production control and management accounting. While this is undoubtedly taking place in some installations, there is no evidence of any general trend in this direction." (para 17 p.14) It appears that in Britain, at least, the claims of those who predict the metamorphosis of the middle manager or the disappearance of the clerk are still somewhat premature. However, by showing that these prognostications remain futuristic is not to diminish the importance of such claims. It might well be that things will develop as the pundits have suggested they would.

Still, even at the current level of unsophisticated usage the computer has, and is having, important effects. Computers significantly affect certain classes of clerical work, indeed it is here that they are currently having their greatest impact; (51) at the same time the growth in demand for computer systems is bringing to the office new groups of technical experts - the

programmer and the systems analyst. (52) The assimilation of new groups into a work environment inevitably possess problems. How powerful are these groups to be? Are they to be part of the 'line' or the 'staff' of office work. As we shall show in a moment it has been the experience in some firms that the role of these experts is rather diffusely defined and the consequent ambiguity surrounding their role can lead to tension. (53) How can these workers be trained? Can existing clerical staff be diverted into computer work? How does the existence of these new strategic groups affect the status order of clerical work? These and a host of other questions can be raised at this moment.

Since clerical work seems likely to be changed it is important that we know the consequences of these charges for the clerical worker - the black coated worker. If it is true, as some writers have predicted that office work - traditionally respectable, non routine and, above all, secure - will come more to resemble factory work, how will this change affect the ideology and political attachments of office workers? Will they then, despite probably a lower income, still be able to retain the somewhat higher degree of social honour and prestige accorded to them over and above the manual worker? Similarly one can ask how the structure of administration will change -

how authority will be distributed and how far the so-called 'time span of discretion' of the managers role will be affected with computers. We shall give some tentative answers to these questions in a moment illustrating the consequences of computers for employment, for work roles and for the structure of management. We shall also mention some of the ways in which white collar workers might be expected to react to these changes in their work situation. What is clear already is that despite the fact that computers are only now beginning to penetrate industry and even then rather unimaginatively they are, nonetheless, raising important sociological problems.

The reports upon which we shall draw for our discussion come from four sources. These sources are by no means exhaustive of the literature but at least they are either reports upon or based upon concrete, structured research. The first and for our purposes most important document is the study by Mumford and Banks 'The Clerk and the Computer' - a case study bases upon six years research in two firms which adopted a computer system. Specifically concerned with the impact of computers on clerical work and the attitudes of the clerical worker to technical change into his work situation - a work situation which it should be added, has been rather immune to technical innovation - this study

is probably the most systematic to date.

The second source is the O.E.C.D. report 'Office Automation Administrative and Human Problems' which is a document comprising four reports of computer installations in various European countries and is edited by w. H. Scott. The third source is a study carried out by Mann and Williams on the effects of the installation in the accounts department of a large electric light company in America. Finally, we have the work of Ida Hoos in America which concerns a whole range of problems related to employment, to the structure of management organisation under automation. (54) Taken together these reports yield a fairly authoritative picture of the impact of automation in the office.

Computer Automation and White Collar Employment

The first substantive problem to which we turn is the problem of employment. A great deal of speculation is based upon the possibility that in the future it will not only be the blue collar worker who shall be subject either to the vicissitudes of the labour market or the threat of permanent technological redundancy but also the white collar employee. The implications of this possibility are far reaching. They relate not only to the work experience of the white collar worker but also to his social standing. Lockwood in his study 'The Black Coated Worker'

forwarded the explanation that one of the reasons why the clerk felt himself to be superior to the manual worker, was accorded greater prestige, and was apathetic both to unionism as an occupational strategy and radicalism as a political creed, was to be found in the much greater degree of job security experienced by this group of workers. (55) Job security was not, of course, the only variable in this complex situation. Another is the nature of the work itself (based as it was on primitive office technology in small clerical establishments) which often resulted in a situation when the clerk dealt with the core of the firm's business, and probably more important, encountered close, non authoritarian relationships with his employer. The structure of such a work situation was conducive to the development of strong attachments to the aims and goals of the firm. The work was not standard; clerks had little of an 'occupational community' as had many industrial workers and all of these factors contribute to higher status and an individualistic outlook. The two kink pins of this situation - job security and work situation - threaten to be undermined by office automation. Some accounts suggest, for instance, that clerical work shall increasingly come to resemble factory work in that it will be standardised, monotonous and carried out in

large offices in which close relationships between employee and employer are not easily generated. There is clearly some justification for holding this view and certainly such a change will explain in part the post war growth in white collar unionism for the white collar employees relationship with management is now 'universalistic' rather than 'affective'. (56) Likewise it has been suggested as we saw earlier that there will emerge a 'white collar proletariat'. Both suggestions are based firmly on the consequences of computers on office employment. But once again, on the basis of current evidence these views seem futuristic.

There are, in fact, two aspects to this employment problem - the macro problem of office employment generally and the micro problem of the employment consequences of a computer in special instances. Dealing first with the macro problem it seems fairly clear at the moment that the employment consequences of computers are far from drastic. The computer revolution comes at an appropriate time for it will relieve demand pressure on the market for clerical and white collar workers. In the Ministry of Labour report from which we have already quoted it was shown that in the next ten years computers will take over some 9% of office work - some 300,000 office jobs but in so doing will have

only slightly helped to reduce the growing demand for office workers. On the assumption that the demand for office workers will rise by some 2% annually for the next decade (the demand since 1931 has been 3%) the number of extra jobs created will be some 700,000. Evidence such as this would suggest that, at least in the short run future, there is little cause for concern at white collar unemployment. However, these are aggregate figures and conceal the redeployment effects which computers may have. The report suggests that some redeployment will have to take place. Evidence on the micro problem is best collated from individual case studies. Summarising the findings of four European case studies W. H. Scott suggest that:

> *"It would appear, therefore, that the reduction in clerical employment occasioned by the extension of office automation is still being more than offset by the increased demand due to certain long term factors which are operative in advanced economies, such as the steadily increasing scale and complexity of administrative systems and the growth of the 'tertiary sector'."* (p. 94)

Even so, in a dynamic situation evidence such as this can remain only tentative. Improvements and innovations in computer technology may in the near future render these predictions obsolete. In the study by Mumford and Banks neither of the firms examined experienced any redundancy nor any labour displacement. The authors do point out, however, that if used effectively

computers should cut down staff. (1 p.172) They account for this descrepancy between expectation and fact by showing that in both firms a 'hardware' approach rather than a 'systems approach' was adopted in relation to the computer. This means in practice that instead of exploiting the potential of the computer for changing the whole work system the firms studied merely used their installations for simple clerical procedures. More white collar redundancy may therefore be expected as businessmen come to realise the full potential of computer technology.

Computer Automation and the Social Structure of the Office.

If at the moment the debate of the employment consequences of computers can remain only inconclusive the same is not true of the debates concerning other aspects of the white collar work situation. It is now fairly clear that the effect of computers in offices is to (a) introduce changes in the office division of labour by creating new occupational categories (b) alter the patterns of social interaction and task interdependence between different occupations and (c) create the opportunity for changes to be made in the structure of management - usually towards centralisation of management functions. Combined or entailed in these changes are the necessary changes in job content, skill etc inevitably associated with technical innovation.

The changes which occur in the office division of labour and in the content of office jobs are best described by looking at the occupations involved. Three groups can be singled out for special attention though they by no means exhaust the number of occupations affected. These groups are clerks, technical experts and managers.

Clerks - the traditional black coated worker - have been at the centre of concern for obvious reasons but it is still not clear precisely in what way their jobs are affected. Ida Hoos has suggested on the basis of research into twenty data processing installations that clerical work becomes more routine, pressured and monotonous; that offices become 'paper processing factories' and that skill levels nor job grades are significantly affected. (57) On the other hand, although agreeing on some points with these observations the British study by Mumford and Banks concluded that when a firm moved to a computer from a punched card installation clerical work is not greatly changed. (58) In the detailed case studies which comprise this study - one case dealing with bank clerks, the other with clerks in a manufacturing firm - certain changes were, of course noted. In describing these changes this study relies not upon a detailed and objective description of the changed nature of clerical tasks but relies upon the verbal statement of office workers themselves as they described in what

way their jobs had changed. Certain changes were stressed by the bank clerks; some 50% believed that the computer had made their work more accurate, over 30% felt that their work load had increased and a similar proportion felt that they now had more responsibility. (see table 13 p.) op cit. However, on three aspects of work - pay, the amount of supervision and promotion opportunities - a majority of the clerks in both firms were agreed that little change had taken place. The overall impression, recognised by the authors themselves, was that computers, in the cases they studied, had had little effect on clerical work nor on the attitude of clerical workers. They show in the text that their findings are somewhat dissimilar to some American research which has been carried out but explain this by pointing out that " ...*the kind of impact a computer has on work is conditioned to a large extent by the situation into which the machine is introduced.*" (p. 193 op cit) They also recognise the probability that as the firms come to adopt a 'systems approach' to their computers and as the amount of work handled by the computer increases the effects on office work will be much more extensive.

It appears, therefore, that since the consequences of office automation for the clerk depend very largely upon the

complexity of the installation it is impossible at the moment to generalise about the group of workers.

Changes in the office division of labour, and, potentially in the distribution of power in the office are brought about by the emergence of new groups - the computer programmers. Mumford and Ward (59) have analysed some of the dillemmas inherent in this new role. They write at one point, for example that; since computer technologists are committed to change and seem to adopt an overall view of the functioning of the organisation they often come into conflict with departmental interests. The problem is much more serious than a territorial one. They write:

> *"Computer technologists will be striving for rational management organisation in order to realise the potential of their machines. In doing this they will be altering the functions of management and perhaps eliminating some management positions altogether. Therefore, unlike the normal staff advisers, the new specialists represent a threat to the jobs and power positions of many line managers."* (p. 246)

In one of the firms studied in 'The Clerk and the Computer' considerable resentment was allowed to grow in this group because of the lack of necessary cooperation for the completion of their task. Since this is not a role traditionally associated with office work and especially since this role is likely to overlap

with existing roles, possibly to devalue them, it is likely that the programmer will meet with some degree of hostility or uncooperation.

Yet another unfamiliar characteristic of this role is that its adherents are rarely identified with the interests of the firm. Mumford and Banks show how the new programmers, recruited in this instance from existing clerical staff, quickly refashioned their orientation to bank work no longer perceiving their long term career prospects as being linked to the fortuned of the bank. Furthermore, unlike other staff specialists such as scientists, the programmers require some skill in interpersonal relations. At least, this is what Mumford and Ward have suggested, but since they are likely to be recruited from a rather narrow technical background it is unlikely that they will have these skills. (40) It is also clearly possible that the existence or the creation of such groups of experts could modify in significant ways the way in which the status structure of the organisation is perceived not to mention the possibilities for the transfer of effective bargaining power within the firm. However, despite what may have been written on the 'irresponsibility' of such groups (see Chapter 2) there is little research available to substantiate such claims. It seems likely for example that

the power, influence and strains which might characterise this role are transient features; that given a much greater understanding of their particular needs the problems currently associated with this group would disappear.

The third group of personnel to be affected by computers are managers but once again a responsible appraisal of their position is handicapped by the lack of research into this field. There are, in fact, two aspects to the managerial problems associated with computers. On the one hand there is the problem of the structure of management - how are managerial role distributed? What authority relationships hold between them? On the other there is the managers themselves - what is their new job? How much discretion have they? How far has the computer removed their decision making functions? How far do they accept the changes made necessary by the computer?

Computer Automation and Management

Dealing first with the problem of management structure the most immediate issue to arise is that of centralisation. The existence of a computer to which a great deal of work can be transferred raised questions of departmentalism and the alignments which exist between different departments. In her study Ida Hoos clearly saw tendencies towards the centralisation

of management functions and decision making. (61) Similarly, Mann and Williams report that such centralisation is clearly possible in a situation in which 'Rules and regulations are substituted for individual decision making'. (62)

It appears that when a computer installation takes over work which was previously carried out by separate departments a clear possibility exists for the transfer of managerial, and especially departmental functions, to a central executive. It is because this possibility exists, of course, that some writers have come to predict the elimination of middle managers from the authority structure of the organisation. At this point in time there is not enough evidence to support or refute such claims and, moreover, since a great deal obviously depends upon the nature of the computer installation in the first it is probably misleading to make such wide generalisations. Despite this, evidence does exist to show the ways in which the job of the manager may be changed with automation.

Urs Jaeggi and Herbert Wiedemann writing about research carried out in Germany claim that the computer removes a large amount of the controlling the details of the collection and evaluation of data releasing them instead to concentrating on supplying higher management with much more precise information

and advice. (63) The task of management also changes so that they can now spend more time on the human relations aspect of their role - coordinating work teams, improving work procedures etc etc.

A complimentary aspect of the computer is that the manager's tasks become more specialised and precise. Since a great deal of the everyday decisions have been built into the system those 'non-programmed' decisions are made with a greater degree of certainty for the computer plays a vital role in processing all the necessary information for the manager. In the research by Mumford and Banks, however, no major changes occurred in the decision making functions of management. One significant change which these researchers regard as important for understanding the managerial reception of change - a reception which, in this instance was guarded and unethusiastic since the computer was seen as likely to affect personal status - was that the manager becomes removed from the operation of his office. He is no longer fully aware of all the operations which go on; he no longer fully understands the system. It is in the context of this that computer programmers can be seen to acquire a great deal of power.

It appears once again that since there is a lack of relevant research, and since a great deal depends upon the uses to which

the computer is put, we are not in a position to predict what changes will occur in the nature of management, at least, not in such a way that could be considered scientifically precise. There is certainly little empirical justification for some of the views which we discussed in the last chapter.

Before concluding this final section one last point needs to be made and it is a point which we shall be returning to in chapter five - the white collar worker's response to technical change. It is only in the last few decades that the white collar worker has been subjected to far reaching changes in his work situation so in many respects he is traditionally ill-adapted to such change. On the other hand, his manual counterpart has been continuously subjected to change, is more unionised and has evolved a more elaborate system of rules to apply to technical changes. The question arises therefore, 'how will this group of workers react to change?'

Once again the research information is scant but what does appear to be emerging is that the white collar worker will accept such change as long as it is in line with his own personal aspirations and goals. (64) What appears to be happening at the moment is that the traditional clerical worker - the man who takes more responsibility and strategic decisions than his employers

usually credit him with - is likely to experience an expansion in his role, an increased interest and more responsibility. At the bottom end of the clerical grades, however, work is likely to become more mundane and systematised. However, since these jobs are likely to be held by younger women and girls with little attachement to an occupational career line anyway white collar workers can be expected to accept change with the minimum of anxiety. Mumford and Banks try to show that a great deal of anxiety can be avoided if management pays more attention to the social and psychological problems involved in changeovers.

The research which we have briefly discussed in this section goes only a little way in answering some of the questions which we raised earlier. We know very little of the response of white collar workers to automation; we know even less about managerial responses. We need to know more about the ways in which computers will affect the work ideologies of clerical workers and, more especially, we need to know how a changed work situation for this group of workers will change the range of occupational strategies available to them. Will they, for instance, turn more and more to trades unions or some other kind of association? Mumford and Banks found in their study no tendency whatsoever to trades unionism but at the same time they also recognise that in the cases

they examined the effects of the computers were quite marginal. These and other questions require answering and one of the reasons they have not been so far answered, despite the general neglect of the field which we mentioned earlier, is that current research has failed in many respects to bring to the data a theoretical model which not only attempts to account for the interdependence of technology and social organisation - especially office technology - also to spell out more precisely what are the variable which govern the behaviour of workers in work.

Summary and Conclusions

In the foregoing sections we have tried to do three things. Primarily we have been concerned to bring together some of the principal findings of sociological research into the problems of automation. This in itself was an important exercise for not only were we able to derive some indication of what is currently known in the body of social research we were also able to show up some of the limitations of many of the more general theories and views which surround this subject. Thirdly, in discussing these case studies we were concerned to illuminate the limitations of existing knowledge and to suggest some of the theoretical difficulties associated with these studies.

The overall impression is that although there is exists a growing body of case material concerning the effects of automation in specific instances it is not always clear whether the changes described were fortuitous or necessary. It is by now well established that although different production systems tend to be 'governed' by social systems which are somehow 'appropriate' to them there is still, nonetheless quite considerable room for alternative organisational designs. (65) One of the questions which case studies should answer, therefore, is: *"are the changes observed meaningfully related to the changes which occurred in technology?"* The operative word being *'meaningfully'*. To answer this question future research must bear in mind the twin functions of theory - to delimit the problem and to analyse it i.e. explain it. This in itself requires that we have some preliminary model of what are the operative variables in the situation even though this model itself may be subsequently modified on the basis of new research data. Of the studies described very few brought to their research such a model and of those which did, and I am thinking here of the study by Fensham and Hooper, the model used facilitated the analysis of only some problems. As such, some of these studies were not entirely successful in delimiting the field i.e. showing what were the

specifically sociological problems of automation. Research in industrial sociology and organisational theory is currently revealing some of these variables which determine the structure and functioning of industrial organisations. Out of the many variables which have been shown to be of decisive importance technology has a special role to play.(66) However, although the studies which we described analysed social change always in the context of the technical changes themselves, albeit less successfully with office automation, the relationship between the technical changes and the social changes were not very systematically related. The situation now is that although we have this body of evidence we are still not in any firm position to predict with accuracy what will be the effects of automation in a firm. Theoretical difficulties aside this review of research has produced some substantive results.

The first and probably most important point is that the term 'automation' conceals within itself at least three different types of technology and that each type has different social implication. Moreover, the type of change which occurs, not only in the structure of the organisation but also in the content of work and in the satisfaction of workers seems to be directed related to the level of automation reached. In the more fully automated systems -

exemplified, for example, in process technology - a work environment seems to be emerging which, in terms of which we analysed it earlier, tends to be 'self actualising' rather than 'self estranging'. It is paradoxical, however, that at the one extreme - process plants - where the worker stands to gain a great deal from work, it is here that fewest workers are required.

In the office the advent of automation implies some radical changes in the office division of labour, in the status of office workers and in the power of various groups. These changes can be expected to intensify as firms come to adopt a 'systems approach' to their computers rather than a 'hardware approach'.

We have described these changes in the body of the chapter. What needs to be said now is that these changes represent only tendencies, that in specific instances one might find examples which would contradict these generalisations. This, however, is a limitation which must be accepted for all the sociologist can claim is that the evidence he has available points not to the details of future work systems but to their general form. One last limitation ought to be mentioned; although it has been shown that many of the dire predictions discussed in chapter two are not completely grounded in experience it does not follow from this that these predictions were 'wrong' in any sense; rather it illustrates only that they are premature.

Notes to Chapter Three

1. T. Schultz and A. Weber "Technological Change and Industrial Relations"

   In Heneman et.al. "Employment Relations Research" N. Y. Harper 1960 Schultz and Weber draw a distinction between 'unverified projections' 'structured sociological research'. The former have little grounding in empirical research and because of an abundance of studies of this type they rightly point to the need for more rigorous empirical accounts of automation.

2. William Faunce "Automation in the Automobile Industry"

   American Sociological Review August 1958 Vol. 23 No. 4 p.401

3. W. H. Scott (Ed) "Office Automation: Administrative and Human Problems"

   Paris 1965 O.E.C.D.

4. Joan Woodward "Management and Technology"

   London H.M.S.O. 1958

5. R. Blauner "Alienation and Freedom: The Factory Worker and his Industry"

   University of Chicago Press 1964

6. Daniel Bell "Work and Its Discontents" in his End of Ideology"

   Glencoe Free Press 1963

7. R. Blauner op cit see note 5.

8. See the brief discussion of some arguments in chapter two section thee 'Automation and the Social System'

9. R. Blauner op cit see note 5.

10. The last few years have seen a growing concern with the problem of alienation. The term is used here in the sense outlined by Melvin Seeman "On the Meaning of Alienation" A.S.R. XXIV (1959) 783-91 and by Blauner op cit. It refers to five dimensions of the worker's role and his experience of work. These are (1) powerlessness (2) meaninglessness (3) normlessness (4) isolation (5) self estrangement. Blauner, however, does not treat normlessness as a separate category.

11. Daniel Bell op cit see note 6.

12. Alain Touraine. See his "Workers Attitudes to Technical Change"

    Paris O.E.C.D. 1965

13. R. Dubin "Industrial Worker's Worlds: A Study of the Central Life Interests of Industrial Workers" in A. M. Rose "Human Behaviour and Social Processes"

    Routledge 1962

14. See Bendix "Work and Authority in Industry"

    Harper 1956

15. Claude Durand "The Worker and the Occupational System"

    in Tourraine op cit see note (12) pp 30

16. Durand op cit see also Blauner op cit and Argyris C. "Personality and Organisation"

    N.Y. Harper 1955

17. Peter Berger "Some General Observations on the Problem of Work" in Berger (Ed) "The Human Shape of Work : Studies in the Sociology of Occupations"

    Collier Macmillan 1964

18. Claude Durnad op cit see note (15) pp 43

19. R. Blauner op cit see note (5) pp 133

20. Floyd Mann and L. Richard Hoffman "Automation and the Worker" Holt Dryden 1960

21. Joan Woodward "Industrial Organisation : Theory and Practice" London. O.U.P. 1966

22. Fred Emery and Julius Marek "Some Socio-Technical Aspects of Automation" in Human Relations vol XV 1962

23. Emery and Marek op cit 1962

24. Mann and Hoffman op cit 1960

25. Mann and Hoffman op cit pp 52

26. Blauner op cit

27. Emery and Marek op cit pp 21

28. Blauner op cit pp 128

29. Mann and Hoffman op cit pp 53-54

30. For an extremely valuable account of this aspect of organisational control see Amatai Etzionni "A Comparative Analysis of Complex Organisations" Glencoe III Free Press 1961

31. P. M. Blau and W. R. Scott "Formal Organisations: a comparative approach" Routledge 1963 Chapters 6 and 7.

32. T. Burns and G. M. Stalker "The Management of Innovation" Tavistock 1961

33. Blauner op cit see note 5.

34. Woodward op cit 1966

35. Leonard R. Sayles "Behaviour of Industrial Work Groups"

New York Wiley 1958

36. The phrase 'unitary frame of reference' is used by Fox in his "Industrial Sociology and Industrial Relations" Research paper 3 the Royal Commission on Trades Unions and Employers Associations. London H.M.S.O. 1966.

37. See Chapter One, Section One.

38. William Faunce "Automation in the Automobile Industry" op cit see also his "Automation and the Automobile Worker" in Social Problems Summer 1958.

39. C. R. Walker "Towards the Automatic Factory" New Haven Yale 1957, see also his "Life in the Automatic Factory" Harvard Business Review Vol. 36 Jan. - Feb. 1958.

40. Fensham and Hooper "The Dynamics of a Changing Technology"

Tavistock 1965

41. E. Chinoy "Automobile Workers and the American Dream"

42. Blauner op cit

43. Goldthorpe J. and Lockwood D. "The Car Assembly Worker" A Case Study and a Theoretical Critique"

B.J.S. Vol. 17 1966.

44. William Faunce op cit reproduced in "Labour and Trades Unionism" John Wiley 1960 p. 374

45. Walker op cit see note (39)

46. For a discussion of this term see chapter four

47. Fensham and Hooper op cit

48. See R. Dharendorf "Out of Utopia" in Coser and Rosenberg "Readings in Sociological Theory"

49. W. H. Scott op cit see note (3) p.15

50. Computers in Offices report of the Ministry of Labour Manpower research unit 1965. H.M.S.O.

51. Computers in Offices op cit

52. See Enid Mumford and Tom Ward "Computer Technologists" in The Journal of Management Studies Vol. 3 No. 3 October 1966

53. Mumford and Ward op cit

54. Ida Hoos "When the Computer Takes Over the Office" Harvard Business Review July - August 1960.

55. David Lockwood "The Black Coated Worker" Allen and Unwin 1958

56. The terms are those of Talcott Parsons and derive from his pattern variable scheme. There is some evidence, however, to assume that this interpretation of white collar unionism is substantially correct. See, for example K. Prandy "Professional Employees"

57. Hoos op cit see note (54)

58. Enid Mumford and Olive Banks "The Computer and the Clerk" Routledge 1966 p.184

59. Mumford and Ward op cit see note (52)

60. Mumford and Ward op cit see note (52)

61. Hoos op cit note (54)

62. Mann and Williams "Observations on the Dynamics of the Changeover to E.D.P." A.S.Q. Vol. 5 1960.

63. Urs Jaeggi and Herbert Wiedemann in Scott (Ed) op cit note (3)

64. Mumford and Banks op cit note (58)

65. This problem will be dealt within more detail in the next two chapters.

66. See next chapter for documentation of this point.

IV

AN APPROACH TO THE SOCIOLOGY OF ORGANISATIONS

Section One

The Theoretical Problem

In the last chapter an attempt was made to discuss some of the principal findings emerging from a growing body of case material concerned with various aspects of automation. It became clear that although a 'picture' was gradually emerging - of the ways in which automation may be expected to affect the structure of work organisations, it was nonetheless true that there were both theoretical deficiencies and substantive omissions in this body of literature.

On the theoretical level - clearly worked out models of the variables which govern the structure and functioning of organisations were rarely employed when technical installations were examined; this was particularly the case with office automation. A limitation generally in evidence was the general failure to state explicitly the relationship which holds between a form of technology and a form of industrial organisation. It was also shown that the adoption of a 'unitary frame of reference' for the examination of industrial problems often resulted in a situation where problems, for example of power and

conflict - both of which are particularly interesting in relation to automation and both of which would be systematically examined from with a 'pluralistic frame of reference' - were often neglected. The arguments put forward in the last chapter lead inevitably to the conclusion that the terms in which the sociological problems of automation are best analysed are yet to be worked out.

In this chapter an attempt is made to rectify this situation through a discussion of organisational theory. We shall discuss the state of current theory as an aid to empirical research, examine various models of organisations and of the factors which condition organisational behaviour and see how far these models help us understand the relationship between technical and social change at the level of the firm. We are, in effect, trying to trace as completely as is possible on the basis of current research cause and effect relationships between types of work situations and their associated patterns of behaviour. Put differently we are trying to ascertain what variables operate in the structure of the work situation to render industrial behaviour predictable.

One cannot hope at this point in time to elaborate a

formal model of the sort which so obviously seems to be required and which at the same time can be regarded as having been substantiated both within specific industries and between industries. Nonetheless, considerable headway has been made, especially with regard to the theory of socio-technical systems, towards the elaboration of such a model. This elaboration has come from many separate directions; many strands of thought and interest are being woven together to make a more coherent whole. To anticipate briefly, there is now a growing recognition of the important role played by systems of technology in the social organisation and functioning of organisations; there is also an emerging awareness of the importance of 'environmental' factors as these affect the structure of the organisation. Finally, through successive modifications of classical management theory and great forward strides in the sociological rather than the psychological analysis of industrial behaviour much more is now known about such crucial problem areas as the nature of the worker's involvement in organisational life and the factors which govern his work behaviour.

To appreciate the significance of this emergent approach to industrial analysis we shall discuss in what ways it has been

modifying existing organisational theory and organisational models. We shall try and make exlicit as far as it is possible some of the assumptions made in the past about organisational structure and behaviour and to show in what respects these assumptions have been modified. Approaching the discussion in this way not only serves the useful purpose of outlining a model of industrial organisation but it will also illustrate why it is that some of the studies which were discussed in the last chapter made the theoretical errors which they did.

Before beginning on this discussion a few words are necessary on why an elaboration of the sort to be outlined below is in fact required. The briefest is that in order to understand large scale organisations one needs to have some conception of what are the most important facets of this complex reality which have to be given special attention in one's own particular analysis. This problem arises because, like all other forms of social organisation, large scale organisations has a multidimensional reality. To the economist an industrial organisation or a commercial undertaking is primarily an economic unit. To grossly oversimplify, his interest in it is restricted to a determinate range of problems, for example, the ratio of capital to labour, costs per unit of

production, efficiency etc etc. To the political scientist an organisation is a system of power and authority rationally articulated to achieve certain goals or dispense certain functions. His interest, too, is restricted to a specific range of problems. He might, for example, be specifically concerned with the distribution of power or the legitimation of authority. Burns has argued, for instance, that the political processes of organisations has been a much neglected area of study. (1) To the sociologist an organisation is a rather special device for ordering social conduct around some specific objective; it is, in fact, a special collectivity - a system of social relations.

I am not concerned at this point to legislate on which view is the correct one - they are all correct. Organisations have three identities - the economic, the political and the social - and the study of organisations must pay special regard to this fact. It is for these reasons that the sociologist must carefully define his special way of looking at organisations. In what is to follow we shall illustrate how some writers have solved this problem.

Some General Features of a Social System Model of Organisations

One of the implications of using the term 'organisation' is that we are referring to something which has an existance

independent of its constituent parts. This fact has a double significance. In the first place it suggests that organisations have a permanency, that they have a special relationship to society as a whole. In fact, some writers have suggested that organisations are best conceived as sub systems of the much larger social system. (1) We shall be elaborating on the important implications of its view later. For the moment it is only necessary to point out that what goes on inside organisations has important implications for the external relations of the organisation and as such for society as a whole. Etzionni captures the sense of this argument when he says that modern society is an organisation society. (2)

The second implication of the view that the organisation exists independently of its constituent parts concerns the way in which we are to conceive of what goes on in organisations and what it is which governs organisational behaviour. Ultimately, of course, when we speak of an organisation we have some notion of men doing things in an ordered manner; that they do these things for only some of the time; that whilst they do them they have some specific end in sight. The concept which mediates between the view of an organisation as being men-doing-things and the view of the organisation as some kind of

suprapersonal entity is the concept of role. Viewing the members of an organisation as role players and recognising that they are 'playing' in a rather special organisation having goals invites the second formulation that organisations are systems of roles. Analysing the concept further it must be recognised that all we are referring to when we use the term 'role' is a pattern of reciprocal expectations which 'actors' hold of one another. It means also that each actor is aware of what these expectations are and plays out his role in accordance with them. It is in these terms that the sociologist thinks of social relationships and it is in terms of social relationships that he thinks of organisations.

Without at this point going further into this description for we shall be concerned with it in much greater detail later, it is clear that a whole range of problems are opened up. We can ask, for instance, how far the men who are asked to play roles play them out successfully, how far they identify with the role, how they themselves 'interpret' or 'define the role'. Likewise we can ask why it is that organisations seem to differ in ways in which roles are allocated, defined and related to one another. In short, we can ask what it is that gives an organisation a distinctive structure. But apart from the range

of problems which are raised it is also clear that the character of these problems is theoretical. Beginning from role concepts and patterns of expectation we can in fact build up complex models of social systems. These models will assist us in not only accounting for the particular structure adopted by an organisation in meeting its particular purposes but also to account (i.e. explain) for the behaviour of men in such organisations.

The model which we have briefly touched upon here is that of the organisation as a social system; it is the sociologist's way of looking at organisations. It is not exclusively the 'correct' way to look at organisations and it is by no means a commonly accepted way, even amongst people calling themselves sociologists or behavioural scientists, or whatever. However, it is a way which has rather special implications and we shall elaborate on these in a moment.

The model of the organisation to be developed in this chapter conceives of the organisation as a social system in the sense outlined above; it also conceives of this social system as being 'institutionalised' in technical systems - machines, tools, skills etc - so that it is possible to speak of a 'socio - technical system'. Since it is also true, as we have already

briefly implied, that organisations exist in a certain wider environment and that forces in this environment (e.g. the State, the market, etc.) have effects on the organisation and vice-versa, it is convenient to extend our conception of the organisation as a socio - technical system to that of an 'open socio-technical system'. The central purpose of this chapter is to elaborate this model and illustrate its utility for the analysis of industrial organisations. It should not be supposed, however, that this model is complete or that it is brand new. Neither is true. The model is still in the process of development and can only be understood in the context of a much wider body of theory and theoretical development.

In the nineteenth century as J. H. Smith has pointed out the term 'organisation' still meant something like entrepreneurship; it still retained that sense of 'getting something done'. (3) In twentieth century the term has increasingly become understood as referring to a special structure, a special way of ordering things, especially management hierarchies. It is only in the last decade or so that the conception of the organisation as a social system has arisen, and then only in response to a theoretical tradition which stressed the conception of an organisation as a way of rationally structuring the behaviour of

management. In order to elucidate our model we turn to this development looking first at the classical school of organisational theory.

The Classical School

To characterise the diverse group of writers who, from the beginning of the twentieth century began to concern themselves with the problems of rational bureacratic administration (Max Weber), with the means by which such administration could be made more efficient (Fayol, Urwick) and who at the same time developed a new body of knowledge which Alain Tourraine has called 'psychotechnology' - work measurement, motion study, and the like - under the one heading is to neglect the important divisions of opinion which exist within this school. Some writers feel it is more appropriate to split the group into two - those concerned with scientific management and who can be usually grouped around the intellectual leader, Frederick Taylor, and those concerned to spell out a system of rules, almost of deductive logic, within which management can structure its activities. However, for our purposes the central tenents of this body of thought are far more important than the differences which exist within it.

The central concern which links them all together is the concern to make industrial organisations more effective in the

realisation of their goals. This does not properly apply to Max Weber since he was more concerned to analyse the properties of rational administration but his theory of bureacracy has had an important influence on the growth of our thinking about organisations. Not directly concerned, therefore, with the effectiveness of management the central core of Weber's theory of bureacracy - that bureacracy is the most rational form of administration - is still, nonetheless, in line with what the theorists of formal organisation also maintain.

Three features of this approach are particularly important. In the first place the classical school contained a theory of formal organisation which was to have an important effect on the subsequent development of organisational theory, and, of course, the way in which we think about organisations. Secondly, the classical school made a series of assumptions about the behaviour and motivation of men which produced important reactions. Finally, the classical school seemed to espouse a certain ideology of work relations which blinded them to the dilemmas and contradictions inherent in large scale production and which led them to adopt a unitary frame of reference for looking at behaviour within organisations.

The essential orientation of the classical school was practical; they regarded themselves as organisational designers rather than social scientists. But they were designers with a mission and this mission was to make management systems more efficient, to design the execution of work in such a way that the organisation derived maximum (not morely optimum) benefits and they believed in the course of this the workers would benefit too. It is here that we have the essential ideological nature of this body of 'theory'. Taylor, the father of scientific management conceived of one of his tasks to be 'to bring about harmony, not discord'. (4) His basic commitment is to the belief that the development of a science of management from which rules could be derived to make work more efficient and more profitable would remove any possible cause of friction between management and men. He urges us to realise that scientific management is not 'any efficiency device ... it is not time study, it is not motion study ... in its essence (it) involves a complete mental revolution on the part of the working men'. (5) He goes on in this testimony to the House committee which investigated various systems of management in 1912 to suggest that through the application of scientific principles the two sides of industry will be in a position to take their

eyes off the growing industrial surplus for it will become so large that 'there is ample room for a large increase in wages for the workmen and an equally large increase in profits for the manufacturer.' (op cit) His system implies an harmonious view of industrial relations with workers and managers accepting the same framework of rationality so that each can equally perceive the logic of the new methods and actively embrace them. We can mention in passing taht in an ideal situation Taylor maintained that trades uions would not be necessary, nor would techniques of collective bargaining.

The second essential component of this school concerns the way in which they viewed the individual and his work motivations. In their concern with 'psychotechnology' Taylor and his followers designed elaborate experiments for work measurement, for calculating the best way of completing work and for calculating the best structure of incentive payments. Without outlining what they contributed in this respect it is clear that they relied on a mechanistic economic theory of man's commitment to work. They believed for example, that although one could meticulously measure a man's work, split it up into its most essential operations, specify how these operations ought to be related to one another, the man will work harder and be satisfied with a much higher level

of reward than could be achieved with more primitive methods of work organisation. George Friedmann has rightly criticised the 'technicist' orientation of Taylorism and its failure to conceive of the worker as deriving other important pysychological satisfactions in work. (6) Subsequent thinking about man's relationship to industry andwork has sought to remove the unsympathetic mechanicism built into Taylor's system.

Taylor, as we have suggested tried to derive a system of rules for rationalising work itself but probably of equal importance to the classical theorists was the way in which they conceived of the structure of the formal organisation of work. At the centre of their thinking in this respect, and exemplified in the work of Gulick and Urwick, was the assumption that the more a job could be broken down into its constituent parts the more efficiently could it be carried out and, by implication the more efficient will the overall production system be. As Etzionni describes it they also believed that the division of labour itself should conform to certain principles such as 'specialisation by purpose', 'specialisation by process' 'specialisation by clientele' etc etc. Furthermore, they argued that work tasks ought to be controlled and designed by a central authority - the postulate of unitary control. It was in this body of theory that propositions about

the role of line management were deveoped, about the optimum relationship between line and staff organisation - the postulates of functional demarcation. They were concerned to spell out the precise responsibilities of each department and each manager and to define explicitly all work roles.

It is not necessary for the purposes of this essay to elaborate further on the prescriptions made by the classical school. It is enough to point out what were their major assumptions. One further assumption, as Joan Woodward has pointed out, was that the principles which they elaborated were applicable to all forms of organisation and administration.- the postulate of universality. (7)

In all of this their generic concern was with formal organisation - the bare bones of organisational design - and subsequent critics of this approach admonished them for not paying sufficient attention to the other equally important aspect of organisational life, informal organisation. The implication of this is that these theorists could only present a limited picture of organisational functioning, that by not paying sufficient attention to the worker's attachment to groups other than those prescribed by the firm, they therefore failed to reach a deep understanding of the true nature of organisational life.

The criticism of the classical theory did not, however, proceed along these lines. The postulates which they laid down were subject to increasing criticism primarily because they were seen not always to work in practice. It was this realisation that inspired the famous Hawthorne experimenters to seek further into group functioning for explanations of changing productivity levels and it was the growing realisation of the importance of work groups, amongst other things, which prompted the development of a different theoretical tradition - that of human relations.

Still, the contribution of the classical school to organisational theory has been an important one. Those people concerned with industry were made to realise that the form taken by an administration has an important bearing on its effectiveness or success. Furthermore they raised the possibility of a science of organisations as such. But the ultimate testimony to what they themselves would consider their success is to be found in the fact that a concern with industrial problems as they defined them still persists in management education and although the scientific status of classical theory can be severely questioned it has had an enormous practical effect on the

behaviour of management. For the social scientist, however, the importance of the classical school derives more from the reactions it produced than the contributions which it made.

The most important reaction from the point of the emergent social science of organisations came from a group - by now expanded into something of a tradition - of writers identified with Elton Mayo and the Hawthorne investigations. The school is the human relations school. It seems largely from a negative reaction to classical theory and manifests a deep concern with the problem of work groups and the informal organisation of industry. The initial impetus in its theoretical development comes from the work carried out by Mayo and his colleagues in the Chicago plant of the Western Electric Company between 1927 and 1932. The development of this approach has been continuous ever since.

The Human Relations School

Whereas the classical school relied upon (a) a mechanical conception of the organisation frozen in scientific immunity from the play of irrational elements either from within itself or from its environment and (b) an atomised conception of the industrial worker having, under the right remunerative conditions, a healthy respect to the organisation - an undivided loyalty, as

it were, the human relations school presents a different view of organisation as leadership and an image of man as group man or social man. Inevitably the many writers identified with this school are not all in agreement with one another. Landsberger, for example, has pointed out after an extensive review of the literature, both pro and anti, that any attempt to tar them all with same brush as Kerr did in his description of them as 'plant sociologists' is merely 'academic gerrymandering'. (8) Still, there are common themes of this school which can be singled out. It is instructive to examine (a) their ideology (b) their view of the plant and the organisation (c) their conception of the industrial worker and the nature of his attachment to work. Viewing these elements as all interrelated with one another is an essential prerequisite for understanding the theoretical system of human relations and its limitations.

We suggested earlier that one of the starting points for the human relations movement was the observation that some of the strategies for management prescribed by the classical writers and designed to improve efficiency were seen not to work in practice. The experiments reported in 'Management and the Worker' by Roethlesberger and Dickson seem to confirm in meticulous detail that the variables which governed the behaviour

of workers were not physical - such as the intensity of illumination - but social. This was an important break through for it placed the work group and the analysis of work groups at the centre of the social and psychological analysis of industry. But the influences on the development of human relations and its interest in the group came also from a philosophical tradition concerned with the implications of 'anomie' and social disorganisation. Sheppard has traced the intellectual roots of this concern to the French sociologist, Emile Durkheim but it was Mayo in his 'The Human Problems of an Industrial Civilization' who provided the school with its moral and ideological directives. He sees industrial society as annihilating 'cultural traditions' and breaking up those social codes which formerly 'disciplined us to effective working together'. (9) His work suggests that the remedy to this is to recreate the society in work, to re-establish the society of the work group. His interest is in maintaining order and stability. It is from this concern with order that subsequent criticism has charged the human relations writers as either being totally blind to the conflict inducing mechanisms of modern industry or else to be largely concerned with the efficiency of management. (10) The debate over this 'manipultive charge' still goes on but it is less important than the debate over the framework of explanation evolved by human relations. But before turning to this we can illustrate the nature of human

relations by turning to some of the findings of various studies associated with the school.

As Kerr and Fisher have analysed it, two findings were basic. (11) The first was the small group is the elemental component of the organisation and that the members of these groups, in true Paretian tradition, were seen to be moved by 'sentiment' rather than 'reason'. Experiments with incentives has shown that by deliberate action workers would place a ceiling on their earnings. This observation ran contrary to any explanation which could be developed from scientific management. It became clear, however, that this 'restriction on output' was a rational action on the part of the workers and this observation lent support to the view that workers do not operate from the same universe of logic as managers. Furthermore, detailed observation had revealed some of the mechanisms employed by small groups to sanction deviance and reaffirm the solidarity of the group. Subsequent work in social psychology has been concerned, especially in the field known as group dynamics, to analyse these mechanisms much further. Some of the conclusions of the Hawthorne experiments follow naturally from this as do many of the prescriptions built into human relations training programmes. For example there are the propositions that 'the

level of production is set by social norms, not by physiological capacities' or that 'often workers do not act or react as individuals but as members of groups'. We tend now to accept these propositions as common place but at the time they were a significant modification of earlier thinking. It was this concern with groups and the ways in which groups set their own norms that directed attention to the problem of informal organisation.

Overgeneralising somewhat the central core of human relations, not only as it was known at the time of Hawthorne, but subsequently with the work of George Homans and Whyte, is that organisations are made of groups and sub groups, that coexistant with the formal prescriptions of management there is an informal organisation of operatives which exerts a control in its own way, that some of the more recalcitrant problems of industrial organisations concerns the ways in which these groups ought to be related to one another. In practice, therefore, human relations programmes lay great stress on leadership and the need for management to ensure the establishment of the effective conditions for group functioning. These prescriptions, as Kerr and Fisher have shown, follow inevitably from the assumptions made about the nature of man - that he is social - the

nature of industrial society, that it is anomic, and the nature of the organisation, that it is made up of groups which exert their own controls. (12)

Human relations have come under attack from a number of positions and out of the furor which has ensued sociologists are now more aware of a much wider range of variables which affect industrial behaviour. Many of the criticisms which have been levelled at the human relations approach are illegitimate; they have been concerned far more with the philosophy of human relations and insufficiently with the detailed studies undertaken. (13) However, even accepting this the criticisms have performed a valuable function in laying bare the limitations and explanitory power of the theoretical system of the school. Landsberger sees the main group of criticism as centering around four areas - (a) the view of society held by its adherents (b) the image of the worker presupposed in the system (c) the apparent neglect shown to the problems of industrial conflict and (d) an almost total failure to take into account the purpose and behaviour of trade unions. To this list of problems areas Kerr and Fisher have added that the school has been criticised for not taking into account the wider environment in which the firm

functions as a variable affecting what goes on inside the firm. Furthermore, they have been criticised for not dealing adequately with the problem of power either within the organisation or in the wider society. The criticisms which have been made under these headings form a fairly coherent whole. Thus Kerr has objected to the view that anomie and disorganisation are the prime features of industrialism but even more fundamentally he disagrees with the Mayoist suggestion that the return to social solidarity as he conceived of it was the most desirable solution. Kerr prefers a system in which there is institutional demarcation, divided layalties etc etc for he believes that it is only under such a pluralistic system the basic freedoms can be realised. (14) Other writers have taken exeption to the ideology of human relations for in its quest for industrial harmony and in its abhorrence of conflict of any kind it unwittingly serves the cause and interests of management. A more impartial but still related objection is that in adopting this concern for order Mayo in particular and human relations generally have assumed what is still to be proved; that there exists a basic harmony between management and worker. Fox has suggested that this 'unitary frame of reference' employed in thinking about industry serves primarily a reassuring function, that it can be at the

same time used by management for purposes of persuasion and as a technique for legitimising authority. (15)

Likewise, a great deal of justified criticism has been applied to the way in which human relations writers conceive of the nature of the workers attachment to the organisation. His involvement is thought of in social terms; he wants the satisfaction and security of the group; he is not the homo-economicus commonly assumed. It is believed, too, that he is quite willing to subject himself to the requirements of authority. What this view neglects is that the worker is also economically involved in the organisation and, as Koivisto has suggested, he is a goal setting and goal achieving creature. In this sense his attachment to the firm is only partial and his relationship to it primarily a market relation. He may also be a member of a trades union - a fact which human relations writers have avoided to systematically take into account - and as such his loyalties will be divided; at some point he may have to accept the authority of the union over and above that of his employer. A different line of criticism has suggested that since the whole emphasis is on the group the relationship between the worker and his work has been neglected. There is a presupposition that whatever the work, the worker could be made satisfied if sufficient

attention is paid to its 'human relations aspects'. Daniell Bell has referred to this attitude as 'cow sociology'. (16)

Other lines of criticism dwell on the fact that the role of unions are neglected in this scheme, that even where they are mentioned they are regarded rather bloodlessly as a communication channel between management and worker. Their functions in articulating grievances and manipulating power are totally neglected. In fact, it is in the analysis of conflict that the theoretical framework of human relations has shown its greatest inadequacies. Whyte in "Pattern for Industrial Peace" - a book which describes the state of industrial relations in the American firm Inland Steel Containers during the period 1937 to 1950 - regards the conflicts which occurred as a function of certain types of communication failure and unions are seen as making a positive contribution to the management of the organisation. As Kerr and Fisher have pointed out, little reference is made in this study to factors outside the firm which were producing inevitable, tensions between workers and managers. No reference is made to the war, the cost of living, the tightness or looseness of the labour market etc etc. (17) These points lead also to the criticism that human relations tends to regard what goes

on inside the firm independently of what goes on outside it. Daniel Bell has pointed out that: "There is no view of the larger institutional framework of our economic system within which these relationships (he is referring to worker management relationships) arise and have their meaning." (18)

The criticisms of this approach which we have mentioned so far are not all based on firm research evidence but recent research is gradually charting out other variables which govern the behaviour of men in organisations and this research is also bringing into question at least some aspects of human relations. Two aspects are of particular importance; one concerns the supposed relationship between formal and informal organisation, the other concerns the role played by technology in the 'human relations' of the organisation.

The human relations had assumed that in the organisation there coexisted two different orders of reality - the formal requirements of management as these were embodied in the codified structure of the organisation and the informal arrangements of working men. It was also assumed that these informal arrangments lay behind such 'irrational behaviour' as restriction of output etc etc. The conclusion to which recent research is pointing is that the distiction between formal

organisation and informal organisation is misleading, that there is only one organisation and that behaviour can be analysed (i.e. explained) from within the structure of the work situation itself.

One piece of research of considerable interest in this respect is that by Lupton reported in 'On the Shop Floor' a study of the behaviour of work groups in two different industries, the garment industry and an electrical engineering workshop. (19) This study questions the analytical value of the formal/informal dichotomy and the assumption that worker's behaviour is to be understood as the outcome of the discrepancy which exists between the managerial logic of efficiency and the behavioural norms of the informal group. The standard human relations explanation of such phenomena was couched in terms of group sentiments. The research by Lupton suggests that contrary to this (i.e. the view that the group controls the individual and that the individuals' attachment to group norms was sentimental in the sense given by Homans) worker's behaviour is rational <u>in the context of the situation</u>. Lupton was specifically concerned with the problem of restriction of output and he found that in only one of his cases could such behaviour be said to exist. In the engineering workshop, organised on an assembly line basis, well defined groups had emerged which controlled the level of earnings. In the

garment shop, on the other hand, no such group did emerge and the women workers were completely responsive to incentives. He explains the difference by reference to a range of factors which although operative in both cases affected each differently. Some of the variables were (a) the state of the market for labour (b) the technology (c) the existence or otherwise of a sense of occupational attachment. Many more characteristics were seen to be related to these differences. The implication of this study is that, contrary to human relations assumptions, workers do act rationally when the situation allows and that the distinction drawn between formal and informal organisation is at best misleading; workers' behaviour is a function of the structure of the work situation and is also influenced by non work factors.

A second piece of research which suggests significant limitations in the theoretical framework of human relations is the study by Sayles, 'Behaviour of Industrial Work Groups' (20) This study points to the important fact that work groups vary, that if management wants to try and build up harmonious relationships they must recognise that all groups are not on the same level. Sayles was able to distinguish four industrial groups - the apathetic, the erratic, the strategic and the

conversative. Each stood in a unique relationship to the productive process, each was composed of workers having different skills. Apathetic behaviour was typical of unskilled workers. Erratic behaviour was common with assembly line workers. Strategic behaviour i.e. well calculated threats and strategic bargaining was common to important and well placed operators such as welders who could easily stop the whole work process. Conservative behaviour - restrictions on occupational recruitment, demarcation disputes etc etc was found to be common in traditional craft groups. These groups correspond to the state of technology so that in an important sense technology becomes an important variable in the prediction of work behaviour yet this is another dimension left hardly analysed by the human relations tradition. We shall be discussing in a moment other studies which show the important role of technology as a limiting factor in industrial relations; for the moment it only remains to point out that even for the analysis of that aspect of work life where the framework of human relations was at its best, namely work groups, there were still important ommissions.

In the account so far an attempt has been made to illustrate the way in which, almost dialectically, the range of concern of organisational analysis has widened. From a rather narrow concern with the design of formal organisation and psychotechnology which was the case with the classical school there emerges in human a relations an expansion of interest into the problems of work groups and worker motivation. In our criticisms of these schools we were ourselves adopting a particular standpoint. The position adopted here, although not formally worked out, has been described by one writer as the structuralist approach. (21) In its essentials this approach regards the organisation as a social system the operation of which is subject to the type of variables which we have outlined above. The view of the organisation as a social system is the one which seems to be prevailing and it is to this that we now turn.

Section Two

Social System Models and the convergence to open Systems Models

In this section the suggestion is made that within organisational theory there has been a certain convergence - an agreement on what are the constituent elements of industrial social systems - but at the same time these convergent tendencies have not yet been fully articulated into a formal model. Hickson has recently suggested that the major convergence in organisational analysis has been concerned with the problem of 'role specification'. By that he means the degree to which organisations precisely define their component parts and the relationship between these parts. Role specification becomes a rather loose indication of the degree of bureacratic organisation. (22)

An equally legitimate view - the one adopted here - is that some of the more important convergent tendencies relate to the ways in which systems of technology serve to define the boundaries within which social systems can be designed; put differently we are learning more and more about the role played by technology as a conditional factor in the structure and functioning of social systems. In this section we shall discuss this tendency for, as we concluded in chapter three, the explanation and prediction of the changes which are likely to

ensue from automation would seem to presuppose the existence of a theory of a theory of organisations which can take into account the subtle relationship between technical factors and social change. Furthermore, in the last section of this chapter we have indicated how both the formal and the human relations school of organisational theory has failed to appreciate adequately the role of technology as part of the structure of the organisation.

Other convergent tendencies are also in evidence. Probably the most important outcome of the structuralist critique of human relations was the model of the social system adopted by that school was too simple and too insensitive to the problems of power and conflict - two of the most important institutional facts of modern society. Furthermore, they had failed to conceptualise adequately the nature of the internal relationships of the organisation; not realising that apart from being 'social' they were also economic and managerial. This underplaying of the differential distribution of authority and the differential distribution of economic reward explains in part their inordinate interest in industrial order. Also there is the argument, accepted by the Mayo School, that the

firm could be studied independently of the environment in which it functions. Critics stress the necessary interdependence of both internal and external variables. One of the naive presuppositions to which this neglect inevitably led was the view of the worker being loyal and significantly attached to the firm; that his loyalties were divided between his family, his union, his community and the firm was something they had failed to take into account.

Nevertheless, recognition of the essential interdependence of these internal and external factors and greater attention being paid to the problem of technology and the opportunity it affords for the design of the plant social structure is leading to a much more comprehensive view of the organisation as a social system. These accelerations and refinements in our conceptualisation of the elements involved in this system has been facilitated by advances in our knowledge of role theory and the patterns of interdependence of social structure and systems of values and beliefs. Together with this we are now beginning to acquire a much more sophisticated knowledge of human motivation and especially of the nature of the individuals involvement in organisational life. It is hoped that some of these relationships will become clear in the course of this chapter.

Whereas the ideological support for human relations came from a tradition which had at its centre the need to ensure social order the structuralist model stems from a tradition concerned with conflict and change. Whereas one of the intellectual fathers of human relations was Emile Durkheim the intellectual roots of the structuralist model stem from Max Weber and to a certain extent, Karl Marx. (23) The former analysed the nature of bureacracy and the legitimation of authority; he was concerned with the differential distribution of power and commitment, the latter presented a radical account of the nature of the social relationships of capitalist production. Subsequent work stemming from the initial insights of Max Weber has been concerned with the dynamics of bureacracy and the problems of authority structures. Marx defined a series of different research problems, those of alienation, exploitation, conflict and social change. Between them, they defined a range of research problems with which modern theorists are still concerned. The nature of their influence will become apparent in the course of this discussion.

A variety of tendencies seem to be converging on the notion of the organisation as a social system. One influence of considerable importance comes from the school of thought

known as structural functionalism. Exemplified in the work of Talcott Parsons the notion of system is central to this body of theory. (24) Even in the famous Hawthorne experiments a system concept was used in the analysis of the data, a concept which in this case was taken over from the Italian sociologist Vilfredo Pareto. The use of system constructs in social-scientific analyses is in fact a formal recognition that various elements in society are necessarily related to one another. The question arise, therefore, of what it means to say that an organisation is a social system. Already we have given a partial answer to this question. We have suggested that organisations are special forms of social devices set up to achieve certain goals, that their most important constitutive elements are the roles which men play and the ways in which these roles are related to one another. It was suggested that the relationships obtaining between different roles constituted the structure of the organisation. Ultimately, of course, roles are played out by individuals having their own distinctive attributes but in the analysis of organisations as systems these individual differences are less important for the prime focus of interest is on the 'situationally shaped' roles which these individuals play out. It was also pointed

out that a notion, directly linked to that of role, was that of expectations. Expectations, as Parsons has analysed them are always 'doubly contingent', that is to say, they are always reciprocal - the expectations of one actor are of central importance in explaining the behaviour of another. Thus a manager or supervisor will 'expect' his subordinates to act in a certain way. The subordinates can be regarded as having 'internalised' these expectations i.e. he knows what is expected of him and he acts accordingly. At the same time, the worker 'expects' the supervisor to act towards him in a certain way, the supervisor is aware of what these expectations are and he acts accordingly. It is in this way that stable social relationships are built up. However, the fact that these mechanisms can operate at all presupposes that ego and alter, worker and supervisor, understand each other within the same framework of meanings, symbols, values, norms and beliefs. In short, there is the presupposition of a common culture which both actors accept. Part of what we mean by a social system then refers to people playing out certain roles in an ordered way i.e. within a given structure and within a given cultural framework.

The implications of these points are not immediately apparent but as Rex has illustrated the use of these notions helps us to analytically describe social situations ranging from cooperation through conflict to anomie. (25) Whereas, for example, in the system of Parsons the use of these categories of explanation has resulted in a body of theory which tends to be concerned solely with the integrative aspects of social systems there is no reason why they should not be equally relevant to the study of change and conflict once it is recognised that the expectations which ego holds of alter can differ considerably. But apart from the analytical utility of these concepts at this level the question still remains of delimiting more clearly the constitutive elements of organisations as social systems and describing how these elements are necessarily related to one another.

For the structural functionalist the problem resolves itself into one of specifying what are the functional imperatives of the organisation as a system proceeding then to show how these functional imperatives are met. Schneider writes: "The structural functional approach is essentially a means of anlysis which related the various roles, groups,

institutions and personalities in a social system to the needs of the social system as a whole." (26) Schneider, drawing directly on the work of Parsons, then postulates that the social system meets these prerequisites by bringing into existence a certain 'structure' i.e. a special arrangement of roles. The design of this structure will vary but despite any possible range of variation organisations can be analysed in these terms. He then goes on to specify some of the most important features of any social system singling out (a) the division of labour or the way in which necessary work is allocated amongst different roles (b) authority systems which 'sanction and enforces the division of labour, thereby maintaining order .... (and) ... serve as a means of communications' (op cit pp 24) (c) prestige or status structures (d) distribution of satisfactions and rewards. He claims that 'Any analysis of a social system which does not deal with these general structural elements would necessarily be incomplete' (pp 26)

In the brief outline given by Schneider all of these structural elements are directly related to the prime functional requirement of maintaining order. Thus the authority system can enforce the division of labour, the prestige system can act as a 'means for motivating individuals to play their proper roles

and to play them well' and this too serves to maintain the stability of the system. The system of allocating rewards is seen also in this light. It is also in these terms claims Schneider that the analysis of social disorganisation or system breakdown can be carried out. Generally, a system will break down because its functional imperatives are not being met and although this breakdown can be precipitated for a number of reasons one of the most important is the failure or organisational members to properly embrace their roles.

Social systems do not, however, subsist in isolation; indeed, the idea of system implies that of system boundaries and system environment. Furthermore it also entails some notion of the system adapting to or responding to that environment. It is in these terms that Talcott Parsons has described the structure of organisations as social systems. (27) For him all social systems must solve for basic functional problems; (a) adaptation - the accommodation of the system to the demands of its situation (b) goal attainment - the defining of objectives and the mobilisation of the appropriate resources for the attainment of these objectives (c) integration -

ensuring that the various components of the system work harmoniously together towards the achievement of the goals and (d) Latency and pattern maintenance; this essentially refers to the way in which the system ensures a continuity in the cultural attachments and motivations of its members.

Each of these represent problems for the system in question and it is made clear in Parson's system that these problems can be exacerbated or made easier by the nature of the environment in which the system functions. In meeting these problems social systems evolve social structures and in this scheme organisations, especially economic organisations, are located in the goal-attainment sub system of the wider society insofar as they 'produce' the generalised facilities with which wider goals can be achieved. In modern societies these generalised facilities are thought of as wealth and power. (28) Of more importance to the present discussion are his views on the nature of formal organisations as social systems, on the one hand, and his view of the ways in which such systems are to be analysed on the other.

First of all he suggests that the organisation has to be analysed around the attainment of its goal because in this way we discover how it will solve its adaptive and integrative problems.

In his own account he sees the primary adaptive exigency of the organisation as the procurement of resources both financial and human; in its integrative aspects the problem resolves itself into one of deciding how these resources are to be allocated within the organisation. Furthermore, another integrative problem is to define the precise nature of the commitments of the organisational members. In analysing these processes two sets of relationships are crucial - the external relations of the organisation and the internal relations of organisational members. Both are merely aspects of the same reality. One set of external relations concerns the procurement of resources. Thus the organisation is linked both to capital markets and labour markets. Another aspect of these external relations concerns the problem of 'disposing' with the organisations 'products'. Inverted commas have been used as recognition of the fact some organisations do not dispose of commodities in the usual economic sense; hospitals, for example dispose of certain professional services but it is still meaningful to speak of the external (client?) relationships of hospitals. Parsons himself does not attempt to formulate any propositions about the ways in which these internal/external relationships influence one another but he does make some comments on the structure of the

organisation which follow on from his specification of its main functional problems.

The way in which the organisation mobilises its resources and thus achieves its goal is clearly related, so Parsons argues, to the process of decision-making. He distinguishes three types of decisions - policy decisions which define the relationship of the organisation to its environment, allocative decisions which govern the way in which resources are to be employed on the actual process of goal attainment and co-ordinating decisions. This last category relates to the overall integrative problem of the organisation in ensuring cooperation from its members. It is here that the problem of control arises. Organisational members may not, for a multitude of reasons, wish to participate in all this goal achieving activity. As Parsons inimitably puts it '... relative to the goals of the organisation, it is reasonable to postulate an inherent centrifugal tendency of sub units of the organisation, a tendency reflecting pulls deriving from the personalities of the participants, from the special adaptive exigencies of their particular job situations and possibly from other sources, such as the pressure of other roles in which they are involved.' (29) In this situation sanctions must be available to ensure compliance.

These three types of decisions find their institutional expression in three hierarchical levels of the organisation. Starting from the bottom there is the technical level where the actual product is made, or, as is the case with certain professional-dient relationships, where certain services are dispensed. Above the technical level there is the managerial level where decisions are made which co-ordinate the various parts of the organisation and above this there is the institutional level. Exemplified in the board of directors this level connects the organisation to the wider social system ensuring for example that what goes on within the organisation is legal or else to mediate between the organisation and significant actors in its environment. In his scheme of things each level has a distinctive functional primacy. The technical level (operators, workers, doctors etc etc) are concerned with goal attainment and adaptation. The managerial level specialises in integrative problems and the institutional level is concerned with latency problems.

There is much more to Parsons scheme than has been indicated. There are, for example, certain propositions about the nature of line/staff relationships, about responsibility, about the role of the professional but above all about the nature of the organisation's relationship to the wider society and especially

to societal values. Furthermore he has some perceptive comments to make on the economic dimension of organisational functioning and on the nature of the labour contract.

The most distinctive part of his analysis, however, concerns the 'cultural-institutional' level of organisational functioning. He has attempted to show in this respect how certain values in the wider society exert a vertical control over the organisation. Thus as economic units firms must conform to the value of 'economic rationality'; as major social subsystems they also must remain within the law and respect the public interest. The nature of the labour contract is clarified somewhat if thought of in these terms. In the first place, to the extent that the firm conforms to law it must recognise free labour. However, unlike in a slave system the existence of free labour poses a motivational (latency) and integrative problem - that of securing a level of commitment sufficient for work tasks to be carried out. Furthermore this problem is exaccerbated since the actor is not merely an economic man; he is also a householder and as such his occupational role is in many respects a boundary role mediating between the organisation and the family. We shall discuss the implications of these points later in the next section when we discuss how this commitment problem is perceived from within the theory of

socio-technical systems. In the meantime it only remains to point out that with this analysis by Parsons the frame of reference of organisational theory widens considerably as does the range of problems which can be analysed when the organisation is regarded as a social system.

Parson's scheme has been criticised for being too formal and too abstract. (30) It is true that he nowhere refers to empirical work to substantiate some of his views and neither does he attempt to formulate any testable hypotheses. Despite this limitation he has performed a valuable function, at least on the theoretical level, of breaking down the insularity and 'atomism' of much organisational theory. He has shown the importance of adopting what has elsewhere been referred to as an 'input - conversion - output' model of the organisation, a model which stresses that organisations are dynamic mechanisms striving to achieve certain goals in a much larger social system.

Despite these very valuable observations Parsons has little to say on the relationship between technology and social systems other than that it is around this that the technical level of organisational functioning is structured. In this respect his analysis is concerned more with occupational roles and the ways in which these roles are related to the functional problems of

the organisation rather than the ways in which they are related to technology. On this level - he differentiates three main groups, operative roles administrative roles and executiveroles - his analysis is incomplete but since it was not his purpose to formalise all these relationships this is in no sense a criticism. His two papers, whatever other limitations they might have, do show the importance of a system construct for organisational analysis. Parson's two papers on organisational theory deal in the main with what he himself calls the 'cultural-institutional level' of organisational theory. There is he claims another point of departure for the analysis of organisations as systems and he refers to this as the 'group or role point of view'. Preminantly concerned with groups and sub parts of the organisation it is largely left out in Parson's analysis. In the work of the Social Science Department of Liverpool University this line of analysis has been extensively employed.

In a series of publications, all of them empirical studies, the Department at Liverpool has been concerned 'to develop basic knowledge of industrial institutions and behaviour' and although their approach has been practical ('to make possible a more immediate contribution to the development of industrial and social policy') they have nonetheless taken pains to ensure a close

relationship between theoretical development and empirical research. (31) Their focus of interest has been on the attitudes of workers to social and technical changes and on the factors which influence these attitudes. In the course of their researches they have come to employ a 'frame of reference' for regarding industrial plants as social systems which elaborates on what we have referred to as the role or group point of view. Although it would be possible to select out many aspects of the plant as a social system four aspects in particular are used by the Liverpool researchers. There are (a) formal structure - the organisational chart, the precise formulation of roles etc etc (b) informal structure - the spontaneous group organisation which always develops within the framework laid by the formal structure (c) the occupational structure - the division of labour and its associated patterns of status and rewards and (d) tradition. All of these are, of course, abstractions from the same reality and in practice constitute an interdependent systems. Nonetheless, the individual can be seen as having a role to play in each of these three structures and his attitudes can be seen to be conditioned by the interplay between them.

In this framework there is postulated a close relationship between the technical organisation of the plant and the social structure of the plant. The relationship is not seen, however, as a determinate one; rather it is truer to say that 'whilst technical organisation sets certain limits to the possible variation of social

structure these limits are fairly narrow for some aspects and broader for others'. (op cit pp 16). Thus technical organisation has a direct influence on the occupational structure or division of labour defining precisely how many men with special types of skills are required for the operation of the process though, of course, these demands can be modified either by tradition or by trades unions or both, Similarly, technical organisation has an important influence on informal structure determining, for example, the layout of work groups and the extent to which teamwork and cooperation is necessary. Finally, the analysis of the inter-relationship of these variables in a study of technical change in a steel mill has shown that they also influence the attitudes of workers to a considerable degree. (32)

This description of the organisation as a social system serves to direct the researcher's attention to the most important groups within the organisation and to assess the ways in which these groups exert control over their members. The inclusion of the category, 'tradition' as a component part of the social system is merely another way of saying that factories or organisations generally tend over the years to acquire a certain culture and habitual ways of doing things or treating people. As such the model outlined here is very close to that used by

Fensham and Hooper in their study of the textile mill. (33) In this study that factory was thought of as a social system comprising (a) technology (b) personalities playing out (c) roles which in their turn were co-ordinated into a certain (d) structure which in its turn reflected a certain culture. Again, these variables were thought of as merely aspects of the same reality having a relationship of complete interdependence.

In our discussion so far a number of aspects of the organisation as a social system have been described. We can illustrate them with a diagram.

Components of the Organisation as a Social System

CULTURE

Internal — Formal Org/Informal Org — External

(Tradition) — Roles — (Institutional environment)

Division of Labour

STRUCTURE — PERSONALITIES

Technology

MARKETS

The framework just outlined represents the barest categories around which we can think of the organisation as a social system and as it stands at the moment it is unrealistically static. It still remains to be shown how this framework can be of use in the analysis of dynamic processes such as technical change or else in the explanation of why it is the structure evolved by one organisation is different from that of another. We must ask in what sense does this emerging framework help us to preduct industrial behaviour. Put differently we must ask what are the variables which underlie the detailed operations of social systems described in these terms.

Just in the same was as there has been a convergence in organisational theory around the view that organisations are social systems bounded by an environment which exerts controls upon it and in some sense 'insitutionalised' in a technology, research has begun to spell out some of the dynamic forces which operate upon this system (a) to give it a particular structure and (b) explain the behaviour which goes on within it especially industrial relations behaviour.

In developing the argument to lend support to this claim let us first look at that aspect usually designated as formal structure. It will be remembered that in the classical school

of organisational theory there was the assumption that all management organisation is subject to the same principles. More often than not the many prescriptions offered by the classical writers to make industrial organisations maximally efficient instruments pointed in the direction of a form of social organisation which Max Weber analysed as bureacracy. The essential characteristics of the bureacracy as Max Weber analysed are all too well known to require recounting. It is sufficient to point out that he conceived of bureacracy as the most rational instrument for the purposes of achieving complex objectives. A rigid division of functions between offices each governed by rules serves the purpose of rationalising administration. A systematic delegation of authority not only leads to hierarchy but is an essential prerequisite for the carrying out of offical duties since the rights and powers of each role incumbent are clearly defined. This 'theory' of bureacratic organisation has sparked off a tremendous debate and has been an important source of ideas since it was first formulated. One of its essential components is that of the prime functional importance of rigid role specification and formalisation under the principles of legal-rational authority. The question arises, however, as to what it is which prompts the evolution of such a structure and

whether or not such a form of administration is as efficient as he claimed it would be under all conditions. Recent research has pointed to some important limitations in Weber's argument. Joan Woodward has shown that a bureacratic form of administration sends to be appropriate only to certain kinds of industries and the work of Burns and Stalker in the electronics industry points to the conclusion that for certain types of firms a bureacratic form of organisation would be positively inefficient. (34, 35). Both reports point to the complex interdependence of formal structure and technology.

Burns and Stalker postulate two ideal types of industrial organisation, the mechanistic and organic. The former corresponds largely to Max Webers formulation of bureacracy. Such a structure is characterised by rigid role specification, hierarchical organisation and is considered by the authors to be ill-adapted to change. The second is characterised by loose role specification fluid lines of authority and consultation and informal lines of communication. To oversimplify the explanations for this difference offered by Burns and Stalker is that a mechanical structure is more suited to a firm which, for a variety of reasons, need not constantly adapt to a changing environment. On the one hand it may be supplying a stable market where demand is steady

and predictable occasioning little need for changes either in product mix or production technology. In this situation the ritual of formalisation is entirely appropriate. Firms with an organic structure are often to be found on the frontiers of innovation having to respond for survival to new technological developments or else to feed a variable market. Both conditions are found in the electronics industry. In situations such as this a premium is placed on speed of consultation and decision-making. Efficiency and competitiveness demand that cooperation takes place and that design, research and innovation be continuous processes. Rigid adherence to formalised roles and role requirements is dysfunctional and hence inefficient.

The implications of this analysis for the explanation of industrial behaviour are far reaching. What, for example, will the state of industrial relations be in a firm whose management structure is ill-adapted to the contingencies of its market and its technology? One could hypothesise that considerable disatisfaction might arise, especially amongst the technical experts, when their work is frustrated by lack of adequate channels for quickly translating ideas into production hardware. Burns and Stalker do not, however, develop their arguments to uncover their implications for industrial relations.

The technical means of production adopted by a firm are quite clearly related to the situation in which it finds itself and at the same exert a certain pressure for the management to adopt a certain type of structure. Woodward found after a survey of a hundred firms in South East Essex that certain 'structural variables' were clearly related to the level of technical complexity achieved by the firm. Structural variables are understood as referring to (a) number of levels of management (b) the ratio of managers and supervisory staff to other personnel (c) the span of control of the chief executive and of the first line supervisors. Taken together these structural variables give some indication of the shape of the organisational structure. She found that at both ends of the scale of technical complexity there tended to be a 'flat' management structure and that in the intermediary zones, exemplified in mass production the form known as bureacracy was commonly found. The operative variables underlying this pattern tend predominantly to be technical. The technical characteristics of the system do not, however, determine the management structure; rather they provide a framework of opportunities within which management can operate. At the same time Woodward and her colleagues postulate a general relationship between the 'tone of industrial relations' and the nature of the

technology and management structure. She claims for instance that; *'The intractable problems of human relations were concentrated in the technical area where production control procedures were most complex, and sometimes more rigorously applied; in batch production where products were manufactured intermittingly, and in the standardised production of a large number of parts subsequently assembled into a large number of products.'* (36)

In process production, just to further the illustration, the tone of industrial relations is good. Some of the reasons for this adduced by the team were (a) less tension and pressure from the process production is largely self regulating (b) smaller working groups (c) smaller spans of control of first line supervisors. These variables she maintains contribute to relatively harmonious relationships between management and workers by removing from the relationship some of these features found in mass production industries - pressure, domination and insecurity. It appears then that the structure of an organisation - the way in which roles are allocated and prescribed and the relationships which hold between these roles - is heavily influenced by both the external market relations of the firm and by its technology. Moreover research evidence seems to be pointing to the conclusion that different types of structures have different implications for the tone of

industrial relations or, for what is but another term for the same thing, for the level of conflict inherent in the organisation.

If the work of Woodward and Burns illustrates some of the ways in which the nature of the firm's external relationships and its technology help to determine the formal structure the work of Walker and Guest on assembly line workers, of Sayles on work groups illustrate the ways in which systems of technology can affect informal organisation. (37, 38) We have already briefly discussed the work of Sayles and his conclusion that attitudes and behaviour of workers are best thought of as an outcome of the structural conditions of work. He was able to identify the structural conditions which gave rise to certain types of work groups each displaying different types of industrial relations behaviour. The research by Walker and Guest on assembly line workers showed amongst other things that informal work groups tended not to arise under the work conditions of the assembly line. The rhythm of production, the physical distance between work stations, the noise and the high turnover of labour all seemed to militate against the formation of cohesive and spontaneous informal work groups.

The work of the Liverpool researchers into the problems of labour relations in the Lancashire coal field can also be cited

in this context as lending support to the view that not only do work groups appear to be determined by the nature of the technology but the types of industrial relations behaviour - strikes, work to rule, restriction of output, absenteeism etc etc - experienced by an organisation is significantly affected by the types of work groups to be found in it. (39) Thus the researchers revealed an inverse correlation between morale (assessed in terms of satisfaction with available rewards) and 'unorganised conflict' and a positive correlation between morale and 'organised conflict'. Thus those groups with a high degree of morale were more disposed to questioning the behaviour of management and to resorting to formal union procedures in advancement of their claims. These groups were usually the high status groups at the coal face. Their behaviour was explained in this study as being only partly related to the frequent breakdown of peace rates in the face of an unpredictable work processes which are a common feature of most pits. Rather their behaviour seems to bebest explained by the fact that these groups have a higher market situation - a factor related to their skill composition - and also by a greater degree of group solidarity and the fact that face workers tend to be older and more experienced men. On the other hand, groups lower down the status hierarchy tended to resort to forms of

'unorganised conflict' - absenteeism etc - in the advancement of their claims.

Mention of industrial relations behaviour brings sharply into focus two problems, both related to one another, and both having important implications for the emerging model of organisations as social systems. The problems are respectively (a) what is the nature of the relationship between management and worker and what variables influence the amount of conflict or cooperation in this relationship? and (b) from what frame of reference are we to approach this relationship? Consideration of these problems would not merely contribute to our knowledge of industrial conflict, it would also further our analysis of the dynamic functioning of organisations as social systems.

So far, to adopt an organic analogy, it has been suggested that organisations are adaptive organisms located in an environment, that the achievement of organisational goals necessitates certain 'transactions' with that environment. Furthermore it has been shown that the technology which an organisation employs as part of its goal attainment function has important implications both for the structure of the system on a formal level and for the informal organisation of work groups. Both aspects have important implications for attitudes and behaviour within the organisation.

The analysis so far, to sump up, has shown what variables affect the structure of industrial social systems but there are aspects of this structure not yet examined, the relationship between managers and workers being of particular interest. It is of interest not merely because it raises the old problem of authority relations in general and the problems of power and exploitation in particular but also because it raises acute problems, at least for the model of organisations as systems being developed here, of the way in which we are to conceive of the nature and experience of work and of the workers involvement in work. In short it raises the problem of how we are to conceive of the industrial worker. Alain Touraine has recently shown that if we begin from the assumption that the industrial worker is seeking *'self actualisation'* as his goal in work, seeking, in effect, to control his own work, then our view of the dynamics of industrial relations must necessarily change. (40) This is not merely an 'academic' problem; as we saw earlier in our discussion of both the classical school and the human relations school their view of man as being motivated in the one instance by sentiments and in the other by reason was part of the reason why their analysis of industry was so unsatisfactory. The problem is a crucial one because our view of the industrial worker will significantly affect

the way in which we try to assess what his expectations are and what factors serve to articulate these expectations. This in itself is a crucial exercise for it is in the nature of things that the worker's expectations must be taken into account in any analysis of his actions.

At the same time it must not be forgotten that any satisfactory explanation of the behaviour of workers must take the behaviour of managers centrally into account. It is only by specifying what expectations each 'actor' holds of the other and by appreciating the nature of the sanctions each can bring to bear upon the other in order to enforce these expectations that we can understand the dynamics of industrial behaviour. It is here, too, that the problem of what frame of reference to adopt arises. If the organisation is thought of as a team as it is in what Fox has identified as the 'unitary frame of reference' and if it is observed in practice that management and men are not 'pulling together' explanations for this phenomenon might be sought, as they are in the human relations tradition, in the breakdown of communications between the two groups. If, on the other hand, the same phenomenon is described by someone adopting a 'pluralistic' frame of reference, a determined search would be made to isolate those areas in which the expectations of the two groups no longer

cojoin and to use this as the starting point of the analysis. Different explanations necessarily ensue from these contrasting positions.

The implications of these points can be clearly shown if we examine worker - management relationships from two angles namely, that they are both economic relations and authority relations. These two aspects are directly related to one another. Allan Flanders has expressed it this way: 'In return for the price which the employer is prepared to pay for his labour, the employee surrenders control over a large part of his life.' (41) In this sense they are also contractual relations and again as Flanders has pointed out they have always had some contractual foundation in law. Underlying both dimensions of the relationship is the question of the nature of the worker's involvement in the organisation and the nature of his expectations in relation to the job itself, the rewards to be gained from doing the job, the system of authority and work conditions generally.

As Parsons has analysed it authority relations persist, in part, because there is always a threat of the workers commitments to other groups being placed before his commitment to the organisation. Often the engineering of this commitment for management's ends is seen as the function of leadership and the

existence of the problem in the first place is seen as the primordial organisational paradox. Certainly Selznick views it in this way. He writes: *'The whole individual raises new problems for the organisation, partly because of the needs of his own personality, partly because he brings with him a set of established habits as well, perhaps as commitments to special groups outside of the organisation.'* (42) It is for this reason that Parsons and Smelser consider it more appropriate to think of the worker not as homo economicus, although he certainly is this, but mainly as a householder. The needs of his family represent one set of commitments to groups outside the organisation. The trades union is another such organisation which can claim the loyalty of the worker over and above his firm. The problem we are referring to here is the latency problem discussed by Parsons, but the question arises as to whether or not the problem is as severe for all employees as it is thought to be for the operative. Etzionni has suggested that it is not; that since some groups of workers are more committed to the organisation their continued loyalty is not in question. Furthermore, he hypothesises that the controls used by management to ensure conformity if not commitment will vary systematically with the nature of the employees involvement in the organisation. (43) Thus he postulates that where the employee

(or any other organisational member) is alienatively involved in the organisation the type of control exerted by those in authority tends to be coercive. Where someone is calculatively involved in an organisation - a sales executive, for instance - the types of controls which are appropriate are manipulative. Conformity is ensured on a stick and carrot basis. Finally, where involvement in the organisation is total or moral - as is the case, presumably, with priests - the most appropriate form of control is in itself moral, a reference to the higher order symbolism of the organisation. Using this typology of involvement and control Etzionni examines a number of different organisations. Applying his scheme to industry he suggests that business concerns try predominantly to rely on manipulative methods of control although with operatives at the bottom end of the hierarchies of reward and power coercion may be applied.

Obviously this scheme has considerable comparative utility and although it can be questioned on a number of points it is helpful in highlighting the complex relationship between involvement and control. At the same time it is clear that Etzionni has in no sense exhausted the anlysis of authority relationships. Apart from meeting the latency problem authority relationships come into existence to ensure that work is coordinated and controlled, to

ensure, in fact, the continuous operation of the system. But however the problem is approached the nature of the members attachment to the organisation will always be problemmatical. The question arises, therefore, 'what is the nature of this attachment'.

There appears to be two types of answer we can give to this question. One is to suggest that his attachment is economic and contractual. This is the economists answer and carries further to suggest that economically the operative is a commodity subject, like all other commodities, to marginal productivity costing. Furthermore, it is assumed that the reward value of the job can be exhausted in monetary terms; that there is an equivalence in economic value of the contribution made by the worker to the firm and the benefits the worker, as a householder, can derive from the purchase of goods with his wages. (44) The relationship is terminable at will for both parties. On this basis the behavioural assumption is made that both 'actors' play out their roles slavishly in accordance with the norms of economic rationality.

This view of the worker's attachment to work is valuable but it also neglects some of his other attachments. He may also be intrinsically attached to his work tasks like the craftsman and

derive important social and psychological satisfactions in work which are not measurable with economic yardsticks. These other intrinsic satisfactions, whatever they may be, are just as important as monetary rewards for their removal or violation can easily result in industrial action of various kinds. This was quite clearly stated in Gouldner's study of the wildcat strike which took place in a gypsum plant. (45) A study of a strike precipitated by a change in management this study introduced the important notion of indulgency pattern. This indulgency pattern comprised a system of expectations held by the men, often not formally recognised, of the way in which the plant ought to be run and they themselves treated. Prior to the appointment of a new management the plant atmosphere was informal and personal. Workers were allowed a few concessions which they valued highly - stopping work before time, for instance, or completing work in unorthodox ways. With the new management steps were taken to increase efficiency; these expectations embodied in the indulgency began to be violated; ultimately a strike was precipitated ostensibly on a wage demand but in reality being caused by this systematic frustration of the indulgency pattern.

It is clear how the notion of involvement can be broken down and translated into the language of expectations and, equally

clear, how the notion of expectation can be seen as central in the explanation of behaviour. The same concepts can be used to describe the labour contract mentioned earlier. The worker 'expects' an amount of money comensurate with his effort expelled in work; he also seeks to maximise his monetary rewards to supply his household with the means by which other goals may be achieved. (46) Often this means he bargains, usually on a collective basis, for higher wages and work conditions. He may, as Touraine has suggested be bargaining to regain his control over work.

At the same time managers expect a certain effort and diligence to be expended in work. Whereas the worker acts in terms of the demands, both internal and external which are being made upon him especially from his family, the manager in his turn is acting in terms of the pressures upon him to maintain a certain level of work, at a certain cost, so that the firm can remain competitive. That these sets of expectations come inevitably into conflict is hardly surprising. As Mayntz has summed it all up; "Organisation members pursue their own goals and react adaptively to the manifold tensions generated by the demands made upon them" (47)

The range of expectations involved in this situation is enormous. The worker may expect to be able to identify with his

work. He may expect management to always act in such a way that the boundary requirements necessary for the successful completion of his task - such as the ready availability of materials - are always met. The Liverpool study into labour relations in the coal industry found that the most highly cohesive face work groups often expressed considerable disatisfaction with management precisely for the reason; the boundary conditions for the completion of their work and thus, in this instance, for the realisation of a certain level of economic returns, were not being satisfactorily met. (48) The worker may likewise expect that the autonomy of his skill be maintained. This expectation would be of particular importance where technical changes threatening to undermine his skills. Whatever the case, however, it is important for theoretical purposes to constantly remind ourselves of the entrenchement of these expectations in a system of work relations which in itself is largely the outcome of the interaction between the technical system and the organisations objectives as these relate to the process of goal attainment.

We have largely completed this review of what it means to say that an organisation is a social system. At every step in the outline it was clear that every facet of the organisation whether it was formal organisation, informal organisation, the

system of rewards or whatever, were inextricably bound up with one another. Furthermore it was made clear that attitudes and behaviour within the organisation could be largely explained by reference to the structure of the work situation. However, although we have mentioned the importance of such factors as technology, authority relations and patterns of involvement, of expectations and their linked sanctions we have not been able to 'tie' these elements into a more formal and dynamic model of industrial social systems. One of the nearest attempts at doing so, however, is emerging from the work of the Tavistick Institute of Human Relations on the theory of socio-technical systems. It is to this that we now turn but it should be immediately pointed out that at its current state of formulation this theory suffers, perhaps, from having too many affinities with certain beliefs and assumptions of the human relations system. We shall discuss these difficulties as we outline current thinking on the nature of socio-technical systems.

Section Three

The Theory of Socio-Technical Systems: The Tavistock Model

Recognition of the importance of regarding industrial organisations as social systems having as one of their major 'system constants' a system of technology leads inevitably the concept of socio-technical system and, since these systems are 'located' in a wider environment, the formulation necessarily extends to that of an 'open socio-technical system. At least, the logic of this outline leads to such a conclusion. In practice, the notion of socio-technical systems developed slowly and painstainly out of a series of empirical studies carried out by the T.I.H.R. into pressing industrial problems. (49) Although this approach to industrial problems has been shown to have a great deal of practical use there are some qualifications to be made to it as a theoretical model and it is the purpose of this section to discuss these and, in doing so, help to articulate further some important aspects of the emerging social science of organisations.

The concept of socio-technical systems was first introduced by Trist and Bamforth in a study of the longwall system of coal mining. (50) It became clear in the course of this study that some of the more recalcitrant problems of mining - low morale,

strained labour relations etc etc - were all bound up with the nature the underground situation and the hazards of this environment, with the pattern of mechanisation and with the types of work groups to be found. Similarly the growing productivity of some pits after nationalisation suggested that non technical innovations in the design of work were probably just as important as the technical. It was suggested in this study that, in fact,

> *"So close is the relationship between the various aspects that the social and the psychological can only be understood in terms of the detailed engineering facts and of the way the technological system as a whole behaves in the environment of the underground situation."* (51)

This, at the time, represented a break with the human relations tradition which tended to regard technology as relatively unimportant compared with social and psychological situation of men at work. The various aspects of the underground situation selected out in this study and whose interrelatedness prompted the notion of socio-technical system were such factors as the organisation of work groups, the problem of shift organisation and cycle control and the coordination problems of management. The early mining studies dealt with small social systems - the organisation underground - but subsequent developments in the use of a socio-technical approach have demonstrated the validity of the approach at the level of the organisation. I refer in particular to the

work of Rice carried out in an Indian textile mill. (52) His work has shown not merely the interdependence of social, psychological and technical features of production organisations but the ways in which these, in their turn, are bound up with economic and financial conditions of the industry of which they are a part. Whereas the basic distinction at the root of the development of socio-technical system theory was that between 'the technological system' and the 'social structure consisting of the occupational roles which have been institutionalised in its use' Rice has shown how these in their turn are governed by an economic measure which can exert its own pervasive influence - the extent to which the human and technical conditions effective meet, within the framework of economic targets, the goals of the enterprise. As he puts it, a socio-technical system must have 'economic validity'.

Unlike classical organisational theory which, as we have already shown, tended to focus attention on the internal problems of organisations, the model adopted by socio-technical system theorists is that of the organisation having certain regular transactions with an environment. To function at all the organisation requires certain inputs. These are the same inputs as conceived by the classical economists. They are land,

labour and capital. In securing these the organisation enters into a system of market exchanges with other organisations and personnel. One strategic exchange in this respect is the exchange of wages for labour power of a certain kind. This exchange is of particular importance since it affects the cost-operating conditions of the organisation and, therefore, the price at which goods and services can be offered to an 'output market'; this, in its turn will determine the economic health of the organisation. The implications of these points are far reaching. To take one illustration which is of topical interest, it is often the case that for a given level of production a firm might employ x-unit of labour at y-unit cost. A change in demand for the product might require a higher level of production which can only be met by hiring further units of labour. If the cost of these extra units of labour per unit of output is not sufficiently low then the firm may find that it will loose on this extra production. It will thus loose part of a growing market. Its competitive position will become increasingly tenuous. In circumstances such as this it might be necessary to increase the productivity of existing resources and this, in its turn, might mean more technical innovation. It has been hypothesised that the faster rate of growth of

automation in America is in part explained by 'imperfections' in the market for labour making the cost of labour unrestrictively high and thus the attractiveness of technical innovation correspondingly increased. It is not only imperfections in the labour market - such as Trades Unions - which might prompt the sort of change just described; labour shortages could conceivably have a similar effect. Where shortages exist the bargaining power of those groups with the monopoly of the required skills is increased enormously; in such a situation it might be cheaper for the firm to invest in labour saving machinery than to hire these high cost labour units. Whatever the situation, it is clearly important, as these two illustrations show, to take into account as systematically as possible the external relations of the organisations in any model purporting to explain the internal functioning of that organisation. It is for this reason that in the theory of socio-technical systems organisations are seen as 'open systems'.

Apart from the inputs just mentioned the existence of the organisation in a <u>steady state</u> i.e. in which it is carrying out regular commerce or exchange with its environment and fulfilling its 'mission' satisfactorily, also presupposes the rational and predicatable organisation of human functionaries. (Emery and

Trist 53) Moreover, this organisation of human resources must be rational within the framework of a technical system for such systems set certain requirements of the social system and *'the effectiveness of the total production system will depend upon the adequacy with which the social system meets these requirements'*. (Emery and Trist op. cil) In socio-technical theory the technological component of the organisation, insofar as it converts inputs into outputs, is seen as playing a major role in determining the self regulating properties of the enterprise. Thus Emery and Trist point out that 'The variation in the output market that can be tolerated without structural change (in the organisation W.W.) is in large measure a function of the flexibility of the system of technical productive - its ability to vary its rate, its end product or the mixture of its products'. The corrollary of this is that the tolerable variation in the input markets - the extent to which, for example, the enterprise can function with an irregular supply of labour - is similarly dependent upon the flexibility of the technical system.

It is within the process of converting inputs into outputs - whatever these may be in practice - that a particular kind of structure emerges. It is a structure which, on the one hand can operate the technical system and on the other mediate between the

organisation and its markets. In this respect there are close parallels here with the work of Talcott Parsons on organisational theory where organisations are conceived as adaptive or 'converting' mechanisms very much in the same way as I have indicated. The parallels should not be drawn too far since in this case much more attention is focussed on the technical component itself, and its modes of interaction with the social system of the enterprise.

Explicitly, attention is focused on three groups of problems:

(1) (a) the technical system itself

(b) the 'work relationship structure' and its constituent occupational roles

(2) The analysis of (a) and (b) in relation to the internal problems of <u>coordination</u> and <u>control</u>

(3) The analysis of external influences on the organisation

In the analysis of technical systems particular attention is paid to the requirements these impose on the social system. Emery, reviewing some of these 'demands' isolates eight major aspects which have emerged in the work of the Institute.(54) Briefly, they are as follows:- (1) <u>The natural characteristics of the material</u> being worked on imposes limits on the social organisation of the enterprise. In coal mining, to take an extreme example, it has been shown that uncontrolled variation in underground

situation have an enormous influence not merely on the organisation of work but also on the degree of strain (or psychological stress) experienced by workers. (2) The immediate physical work setting is of almost obvious importance as a factor related to morale or tension though it is not clear whether, in the absence of other predisposing features, this particular aspect of the 'internal environment' can exert an independent effect. (3) The spatial layout and spread of the process over time exerts an important influence on many aspects of the enterprise. It affects the layout of work groups and thus the possibilities which exist for the formation of stable work groups or role groups. If the temporal nature of the process requires shift work it will attenuate a special kind of coordination problem at the level of management. (4) The level of mechanisation is probably of decisive importance for it determines the relative contribution of men and machines to the overall production process. As we saw in the last chapter in the discussion of process automation the level of mechanisation has a significant bearing on the type of managerial control and supervision required. On the most general level it seems clear that the more production depends upon machines rather than men the more will management resort to the use of 'impersonal mechanisms of control' rather than the

techniques of direct supervision. And, as the work of Woodward would indicate, since process automation represents the ultimate divorce of human effort and productivity - the two being directly related with lower levels of technical complexity - there is likely to much less pressure from management upon the worker to increase his productivity and this would seem to be conducive to 'better industrial relations'. Perhaps we can add to Emery's own account the need also to pay special attention not merely to the level of mechanisation but also to the depth and span of mechanisation. (5) The phases of operation of the productive process clearly affects the nature of the interdependence between different work functions and, in its turn, affects the nature of the coordination problem faced by management. (6) The degree of centrality of different production operations is an important dimension of the technical system for the implications it has for the structure of supervision and the overall effectiveness of the system. It is usually, the case that some operations are more necessary than others for the overall effectiveness of the system. In mining, for example, the efficiency of face work will be of greater importance for the efficiency of the total system than will 'bye work' - clearing up, painting etc etc. It is usually the more 'central operations' which are at the centre of management

attention. Of course the centrality of certain operations depends in its turn on the nature of the machinery. In process technology the most important operations are concerned with maintenance, whereas in assembly line production the most important operations are concerned directly with production. (7) The maintenance operations required affect the structure of the enterprise in other ways. It may be necessary to unify under one line of command both production and maintenance operations. This is particularly important with process technologies where the cost of 'downtime' is usually considerable. On the other hand in thoses cases where a machine can be out of action without too much disruption of overall production then maintenance and production can remain organisationally separate. (8) The supply operations are strategic to the functioning of the system since they affect the rate at which production can be carried out. At each point in the process the appropriate materials must be available else production continuity is threatened. Organisationally, this means that the planning of supply operations must be given high priority. Emery suggests that this is particularly the case with higher levels of mechanisation where, as with maintenance, the greater rate of throughput raises the cost of stoppages enormously. In this respect Emery's observations are directly

in line with these of both Fensham and Hooper and Mann and Hoffman. In both cases the importance of long range planning of operations is stressed with the higher forms of mechanisation and automation.

This list, which Emery does not claim is exhaustive, has emerged gradually in the work of the T.H.I.R. Of the importance of these dimensions Emery writes:

> *"Sufficient empirical work has been done to indicate that it is a rule, not the exception, for these different technological facts to exert a significant influence, even though not necessarily an overwhelming influence on the social system. The failure to consider these facts makes it difficult to assess the validity of the findings of so many of the social scientific studies done in this field, including many doen on the effects of automation."* (55)

Viewing the demands of the technical system in this way yields, so it is claimed, a systematic picture of the tasks and task interdependencies required by the technical system. Following from this Trist has suggested that these demands are met by 'bringing into existence a work relationship structure'. (56) The nature of this work relationship structure will be significantly affected by the required components of the system under its particular conditions of mechanisation, phase operation spatial layout etc etc. (Emery) At this point the notion of 'occupational role' is introduced to act as a bridge between the nature of the task and the experience of the person doing the job.

> *"Occupational roles express the relationship between a production process and the social organisation of the group. In one direction they are related to tasks which are also related to each other; in the other to people who are also related to each other." (Trist)* (57)

With the introduction of the notion of occupational role a whole new range of problems is opened up. As Emery suggests a role concept can not only act as an important bridge relating social and psychological phenomena but it helps to delimit the area in which sociological explanations alone can be regarded as adequate. That the notion of role is more of a relational or sociological rather than a psychological concept is something sociologists have insisted upon for a long while. It cannot be used legitimately without other concepts such as expectations, role obligations, sanctions etc etc all of which are involved in the theoretical treatment of social interaction. Regrettably, however, socio-technical system theorists have tended to concentrate more upon a psychological analysis of role behaviour. I use the word regrettably not because role analysis has not got its psychological aspects, clearly it has, but because the exclusive concern with these aspects alone serves only to under-utilise the explanitory potential of the concept. It is regrettable that this is the case especially when they have so clearly recognised the importance elsewhere of treating the

worker as a 'whole man' whose conformity to organisational requirements is always problemmatical. This deficiency may only be temporary. In 'Organisational Choice' the researchers were acutely aware of the existence of a work culture amongst groups of face workers in the pits which stressed certain qualities such as the need for autonomy, friendship, pulling together etc etc. It is a culture entrenched in particular operating conditions and evolved from the experience of successive generations. (58) (Trist etl)

The value of a return to a system of work which retained the importance of the traditions of responsible autonomy characteristic of simpler methods of mining was clearly demonstrated in this book. The analysis could have perhaps been carried further to analysis of occupational cultures. How far, for example do skilled face workers regret the loss of the traditional control which they have exercised in their work in the face of mechanisation. The point being made here is that it has elsewhere been shown that occupational cultures have a significant effect on the behaviour and expectations of workers; that the attitudes a worker has about his job are not merely determined by the nature of the tasks which comprise that job; rather they are passed down 'traditionally' from generation to

generation; they are supported and given a wider meaning within a community context; they are related to both the status order of the enterprise and the community at large; they are, in all probability an integral part of his self identity. As such they are likely to have a significant effect on what the worker expects not merely from his job or task but from work as a whole. This theme will be taken up in a little more detail in the next chapter when we consider the so-called phenomenon 'resistance to technical change'; it is enough to note at the moment that a valuable modification to socio-technical theory would be made if this notion of occupational culture could be more systematically taken into account. The reason for saying this is that at the moment the analysis of occupational roles in socio-technical theory remains rather narrowly psychological.

Whereas the framework of analysis just outlined seems more appropriate at the level of the plant the second group of problems dealt with by socio-technical system theorists apply to the organisation as a whole. On this level attention is drawn to the ways in which the work relationship structure and occupational roles are related to other aspects of the organisation dealing in particular with the problems of production and servicing on the one hand and the governing functions

of management on the other. At this point the analysis attempts to show how an organisation, through processes of 'internal elaboration' meets the 'demands' of its situation to become and 'internally self consistent structure'. (Trist) These problems are traced through the two concepts of 'coordination' and 'control'. (Emery) Coordination and control are seen as the primordial acts of management. Coordination of the long term plans of the company and of the many parts of the organisation is always a problem for management. The problems of control, however, arise from a different source. It is to be sought in the face of the ever-present threat of 'irresponsibility' i.e. 'the possibility of role occupants acting in terms of their personal and social influences to the detriment of the productive process'. (Emery p.33).

The problems of control and coordination, Emery points out, come sharply into focus in the supervisory role. He can ensure that people play out their roles properly by a variety of devices ranging from coercion to manipulation but the most important point is that the type of control used will vary predictably with the type of task structure maintained by the technology. Thus where the system allows for the development of relatively autonomous work groups, as in the longwall system of coal mining,

the nature of supervision differs from those cases where work tasks are relatively isolated. In the former, control is exercised by the group, itself leaving the supervisor to concentrate on supply operations. In the latter supervision tends to be more direct and pervasive. Work groups which can exert control over their members are said to have the quality of 'responsibly autonomy'. (Trist) However, the distribution of power and responsibility in an organisation is not entirely random; the distribution is thought of as following certain principles - all of which are derivable from a rational appraisal of the conditions necessary for the stable functioning of the social system of an enterprise.

Although the technical system and external influences impose restrictions upon the structure of the social system it is nonetheless true that this system has certain properties in its own right. Emery formulates these under four propositions - the requirement of optimal structuring, the requirement of optimal distribution, the requirement of maximum institutionalisation and the requirement of effective communication. Dealing with these briefly in turn it is suggested that (a) there needs to be a balance between roles, statuses and power for without this it might be impossible to achieve overall coordination. (b) The

distribution of reward needs to be in line with the distribution of responsibility else the 'typical wage contract' is likely to be a source of instability. (c) 'The effective operation of the social structure requires that its members be motivated by their commitment to the goals of the organisation ...' (Emery p 40) (d) Finally it is necessary that the flow of information should (i) be such that all members understand it and (ii) be sufficiently extensive that members can, in fact, discharge their responsibilities.

Finally, the last group of problems to which this theory directs our attention concerns the relationship between the organisation and its environment. This relationship is expressed, as we have earlier indicated, with the notion of 'organisational goals'. The problem arises though that in a complexly differentiated collectivity there may not be common agreement on what these goals are or on how they are to best achieved. The so-called principle of 'maximum institutionalisation' may not apply; sub groups of the organisation may have needs and committments of their own and it is these groups which pose the major 'dilemmas' for the enterprise. (Emery) These webs of committment and affiliation, of attachements to given roles and set practices place social limits on the extent to which the organisation can remain flexible in the face of disequilibriating changes in its internal or external environment.

The outline of the main framework of socio-technical system theory is now complete. It seems a legitimate conclusion to this brief review that the theory, as it now stands, consummates certain trends which were already in evidence towards an integration of 'organisational theory' around the notion of the organisation as a social system. It has spelled out further some of the key variables which underly the operation of industrial social systems especially those relating to the technical system. Moreover the frame of reference of socio-technical system theory would seem to be useful for the formulation of a whole host of hypotheses about different aspects of industrial behaviour. In the next chapter we shall be using this framework, together with some of our own modifications to look at the twin problems of organisational change and the pheonomenon which has come to be known, innappropriately as 'resistance to change'. In the meantime we can recap on some of the theoretical difficulties associated with this theory. It has already been suggested that socio-technical theory perhaps suffers i.e. has certain inadequacies as an explanatory theory, because it has too many resemblances to human relations sociology. In relation to this claim I want to make two arguments; the one

is that the nature of the labour contract or the 'effort bargain' has not been sufficiently well worked out and because of this there is a tendency to over emphasise the importance of the worker's relationship to his actual job and to the problems involved in stimulating a 'task orientation'. This emphasis, although justifiable in the sense that the people concerned with socio-technical systems have been, in their roles as consultants, concerned to 'improve' the design of work roles so that the worker may experience certain intrinsic satisfactions in the performance of his task has nonethless served to leave as a secondary aspect the workers relationship to the organisation. It is this latter relationship which, as we have already argued, is both a market relationship and a relationship of subordination and superordination which underlies much of what is referred to as 'industrial relations' behaviour. What we are in fact referring to here is the complex nature of the worker's involvement in his work and his organisational role; it is a complex which includes much more than what the worker expects from the role itself i.e. from the actual job. It seems a legitimate argument that the worker not only seeks, or, to be more precise, expects certain intrinsic satisfactions in work itself but he also expects to exercise more control over his work; he seeks a work situation

which is 'self actualising' rather than 'self estranging'. It is clear that to achieve such a work experience the worker will have to bargain for more discretion, to bargain, in fact, for more responsibility. As a householder he is also interested in achieving job security and more money with which he can achieve other goals. His involvement in work, therefore, would seem to be best thought of as having at least three major dimensions - the economic, the social and the political. It is the expectations which relate to these three dimensions which underly the workers behaviour in work.

These points lead directly to the second criticism that the problem of power has not been adequately dealt with. Other than saying that the stable functioning of industrial social systems requires that there be some degree of correspondence between roles, responsibility and power - the requirement of 'optimal structuring' socio-technical system theorists have little to say on the ways in which different groups use their power to their own advantage. Little reference is made to the processes whereby expectations are articulated onto concrete demands for positive action; little reference is made to the range of sanctions each principle actor - manager and worker - can bring against one another. Little

theoretical recognition is given, therefore, to the dynamic problems of industrial conflict. Insofar as these charges are legitimate it is clear that socio-technical system theory neglects to analyse what for most people is the most pervasive aspect of industrial life in a capitalist society. Our conclusion is, therefore, that by failing to appreciate the nature of the workers involvement in work in terms of which we analysed it earlier and by not paying sufficient attention to the phenomena of power in modern industrial social systems the theory of socio-technical systems remains incomplete. In the next chapter we shall turn to two specific problem areas where it will be shown how this incompleteness can lead to an inadequate analysis of the processes which occur, especially with technical change, and especially in relation to industrial relations behaviour.

Conclusions

Technical changes have the potential of initiating social change in organisations. Not only can they modify the ways in which work tasks must be carried out but they can have important consequences for the structure of industrial social systems. It is clear that the type of changes which will occur will depend upon a complex interaction of many forces - technical,

social, political and economic. On the technical level the extent of change will depend very largely, as we argued in the last chapter, on the depth, span and level of technical innovation. It seems clear also that the changes to take place will be discussed and modified by both managers and men each seeking to optimise their own gains from the change. It is in the nature of industrial change, therefore, that technical change is rarely, if ever, spontaneous; it takes place within a matrix of group involvements and affiliations. Because of this technical change has important implications for the structure of power and authority which exists in the organisation and also on the nature of work roles both at operative and managerial levels. Technical change is therefore ubiquitous and it is important if we are ever to understand the consequences of technical change that we be able to bring some order into this highly complex reality. This inevitably entials breaking the problem up and spelling out what are the key variables which underly the structure and functioning of industrial social systems.

It has been argued in this chapter that a model of the organisation as a social system was required if we are to begin to understand organisational change induced by types of technical change. Various models of the organisation were discussed and

criticised and the view was held that within organisational theory there has been a convergence - a greater level of agreement on the ways in which we are to think about organisations - around the theory of socio-technical systems. This convergence has come about largely for two sets of reasons. In the first place it has become increasingly realised that the precepts of both the classical school and that of human relations, although providing important initial insights, are now basically inadequate in many respects. They fail to take into account the problem of power and tension; they rely on an image of the worker which would appear to have no basis in reality. Apart from that it is also an impoverished view of man's potentialities to assume, in the case of the classical school that he would subject himself to meticulous external controls over his work or, in the case of human relations, that the degrading and self mutilating aspects of industrial jobs can be offset if management pays more attention to the building up of a meaningful framework of group relations. What now appears to be required is an image of the worker as a 'self actualising' agent seeking positive satisfactions in work.

Apart from these and other criticisms which have been directed at the theoretical structure of various organisational models it was also the case that these models failed adequately

to conceptualise the ways in which systems of technology articulate with social systems. Because of this they could not be employed to systematically analyse technical change.

The theory of socio-technical systems goes some way towards meeting both of these requirements. More than this adequate cognizance is taken of the extremely important fact that organisations have a triple identity. They are one and the same time economic, social and political units. As we have shown this fact has important implications for analysing the nature of the relationship which subsists between manager and worker. At the same time this theory suffers in certain respects from having too many affinities with human relations. A view of industrial relations as being primarily harmonious emerges whereas had more attention been paid to the nature of the labour contract and to the inevitable system of constraints which underly the behaviour of both managers and the managed it would have become clear that this 'unitary frame of reference' was inadequate for an understanding of the operation of industrial social systems.

It has been possible to reformulate the theory of socio-technical systems in such a way that a distinctively sociological conception of the components and functioning of

social systems can be used in conjunction with the socio-technical analysis of production systems. Because of this we are now in a much better position to identify what are the key problems of the sociological analysis of technical change. Finally we have been able to demonstrate unequivicobly the importance of developing theoretical models to guide and inform empirical work. Were the theoretical approach advocated in this chapter employed in the empirical studies of automation discussed in the preceding chapter then many of the pitfalls of pure empiricism would have been avoided. In the chapter to follow it will be shown how the theoretical scheme outlined can be very usefully employed in studying two empirical problems - those of organisational change and the phenomenon of resistance to technical change.

Notes to Chapter Four

1. Talcott Parsons "Suggestions for a Sociological Approach to the Theory of Organisations, 1 and 2"

   in Talcott Parsons "Structure and Process in Modern Societies" Glencoe Free Press 1960 pp 16-96

2. Amitai Etzioni "Modern Organisations"

   Foundation of Modern Sociology Series, Prentice Hall Inc Englewood Cliffs New Jersey. pp 1

3. J. H. Smith "The Organisation as a Social System" in "Personnel Management" (Ed)

   Nancy Seear published Institute of Personnel Management, London.

4. Frederick Taylor's Testimony before the Special House Committee to Investigate the Taylor and Other Systems of Shop Management quoted by R. Bendix "Work and Authority in Industry" pp 274

5. Testimony op cit note (4) quoted Rheinhard Bendix (op cit) pp 276
   John Wiley and Sins Inc. New York 1956

6. George Friedmann "Industrial Society"

   Glencoe Free Press paperback 1964 edition pp 64

7. Joan Woodward "Industrial Organisation: Theory and Practice" pp 35

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8. Henry Landsberger "Hawthorne Revisited"

   Ithaca: Cornell University Press 1958.

9. Elton Mayo "The Human Problems of an Industrial Civilisation"

   New York Macmillan 1933 pp 188

10. See for example "The Perspectives of Elton Mayo"
by Bendix and Lloyd Fisher in Amitai Etzioni (Ed) "Complex Organisations: A Sociological Reader"
New York Holt pp 113-126

11. Clark Kerr with Lloyd Fisher "Lant Sociology: The Elite and the Aborigines" in "Labour and Management in Industrial Society"
by C. Kerr. Doubleday Anchor paperback 1964 pp 43-82.

12. Clark Kerr and Lloyd Fisher op cit see note (11)

13. This is one of Landsberger's main points. See note (8)

14. Clark Kerr and Lloyd Fisher op cit see note (11)

15. Alan Fox "Industrial Sociology and Industrial Relations"
Research paper 3 Royal Commission on Trades Unions and Employers' Associations. London H.M.S.O. 1966 pp 5 para. 17.

16. Daniel Bell "Adjusting Men to Machines"
Commentary Jan. '47.

17. Clark Kerr and Lloyd Fisher op cit see note (11)

18. Daniel Bell op cit note (16) p.86

19. T. Lupton "On the Shop Floor"
Pergamon 1963

20. L. Sayles "Behaviour of Industrial Work Groups: Prediction and Control"
Wiley 1958

21. See Amitai Etzioni "Modern Organisations"
op cit note (2) pp 41

22. D. J. Hickson "A Convergence in Organisation Theory"
in Administrative Science Quarterly September 1966 pp 224-238

23. See Etzionni op cit note (2) pp 41

24. See for example, Parson's "The Social System" and the book "Towards a General Theory of Action" by Parsons, Shils. The use of system constructs is not by any means confined to the structural functionalists: indeed the notion of a system is central to all sociological theory. Great care is required, however, in the use of the concept since it can give rise to a falsely integrated image of the social system. This is particularly the case with industrial organisations where there are deep theoretical splits between the protagonists of the conflict and concensus schools respectively.

25. John Rex "Key Problems in Sociological Theory"
Routledge 1961

26. Eugene V. Schneider "Industrial Sociology"
McGraw-Hill 1957 pp 21

27. Talcott Parsons op cit see note (1)

28. This particular point is developed in Parsons and Smelser "Economy and Society"
Routledge 1956

29. Talcott Parsons op cit see note (1) pp 34

30. See Henry A. Landsberger "Parson's Theory of Organisations"
in Max Black "The Social Theories of Talcott Parsons"
Prentice-Hall Inc. 1964.

31. The publications of this group include W. H. Scott et al "Technical Change and Industrial Relations", "Industrial Participation" by J. A. Banks. "The Dock Worker" They were the subject of a review article by Richard Brown "Participation, Conflict and Change in Industry" Sociological Review Vol. 13 No. 3 1965. Their theoretical perspectives have been set out in W. H. Scott "The Factory as a Social Systems" in E. M. Hugh-Jones (Ed) "Human Relations in Modern Management" North-Holland, Amsterdam 1957.

32. Scott et. al. "Technical Change and Industrial Relations" op cit see note (31)

33. Fensham and Hooper "The Dynamics of a Changing Technology" Tavistock 1965

34. Joan Woodward op cit see note (7)

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36. Joan Woodward op cit see note (7) pp 180-181

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V

TOWARDS AN UNDERSTANDING OF CHANGE IN ORGANISATIONS

Section One

Two Focal Points and the need to understand change

In the last chapter an outline of socio-technical system theory was given in which the crucial role palyed by systems of technology in setting firm limits on the structural organisation of the enterprise was emphasised. The claim was made that given certain modifications, especially with respect to the problems of industrial conflict and the power relations surrounding the 'labour contract' and in the way in which the worker's involvement in the organisation was to be conceptualised, this theory would go a long way towards meeting the need for a systematic model of the industrial organisation which was so clearly necessary if we are to be able to relate technical and social changes.

In this chapter we turn to two substantive problems to illustrate the validity of these arguments. We shall deal first of all with the so-called problem of organisational change examining, with special reference to automation, the ways in which technical changes can affect the structure of industrial organisations. Secondly, we shall deal with the related problem

of 'resistance to technical change'. Conventionally, resistance to change is seen as taking place at the personality level or at the level of the small group. In this chapter the thesis will be put forward that the organisation itself can often be resistant to change. These arguments will be amplified later. In this chapter an attempt is made, therefore, to show the utility of socio-technical system theory in casting light on what are two pressing industrial problems. At the same time we shall develop the theory further than we have been able to in the last chapter showing once more the necessity of the modifications which have been suggested.

Our theoretical interest in these two problem areas arise out of certain practical considerations. Insofar as technical change is resisted then to that extent higher levels of industrial productivity will not be realised. As B.C. Roberts has pointed out:

> *"Social change is not only an inevitable consequence of technological change, it is also a necessary condition. Unless the appropriate changes take place, technological development is frustrated and the condition of society either remains or becomes stagnant."* (1)

Such a situation cannot be tolerated for long but it is no easy matter to control those factors which might lead to either

organisational or individual resistance to change for they are so little understood. To facilitate the acceptance of change one presumably needs to know what it is which might lead to resistance. Even more fundamentally than this one needs to know what changes to expect in the structure of the organisation before one could even begin to take thoughtful measures to introduce change successfully. Other than on an intuitive level we are not as yet in a position to make confident predictions on either count; we know so little of the interdependence of technology and social structure that we can hardly predict what consequences a change in technology will have even in one organisation. We know so little of the complex variables which operate to govern acceptance or rejection of change that we certainly could not predict whether or not change would be favourably received. One thing, however, is clear; it is that technical change is ubiquitous - changes in technology can set off a whole chain reaction of change throughout the organisation - and unless this change is 'managed' well the value of the new process will not be realised.

Technical change can result in changes in skill levels; changes in the social relationships of work, changes in supervision, in departmental relationships, in the power and status

of managers: it can render obsolete a payments system, exert pressures for centralisation or decontralisation, decrease or increase industrial conflict. All of these things and more can follow from technical change. In the circumstances it is easy at least to imagine that technical change will often be resisted - although this should not blind us to the possibility that change will be actively embraced! With possibilities such as this the management of change becomes an extremely delicate exercise. As Carter and Williams have put it.

> *"New methods of production react on management structure and bad management structure reacts back on the effectiveness of production, andmay lead to a wrong assessment of the value of a new product or process."* (2)

In other words, unless introduced and supervised carefully and unless attempts are made to anticipate the consequences of change the benefits to accrue from it will not be realised.

However, to indicate the range of problems which could be produced with technical change is not to suggest the terms in which they can be analysed. It is important that we have some way of relating one set of changes to another, to see the necessary interdependence of the many change processes. It is here that the theory of socio-technical systems together with our own modifications becomes particularly important. It can

help us to reduce the ubiquity and disorder of change to a coherent pattern of necessary events and to spell out some of the variables which will either facilitate acceptance of change or precipitate its rejection. The purpose of this chapter is to show the validity of this argument.

Section Two

Some limitations in change theory

We are interested especially in the structural consequences of automation and it may be that through a detailed examination of these we might be in a position to outline the type of industrial structure within which automation can be best exploited. That we should now begin to examine closely the principles which we currently employ to design work organisations is something which is almost universally recognised. However, even recognising that advanced technology may render obsolete some well institutionalised industrial practices it is by no means clear what type of work organisation we should aim at.

In the House of Commons on April 25th 1966 the Minister of Technology, then Mr. Frank Cousins, concluded a speech which had pleaded for a new outlook towards technical change with the view that what was necessary to exploit change was a new 'democratic relationship in industry'. He insisted that we must recognise *'that workers likely to be affected by the drive towards increased productivity must more fully than ever before be associated with the decisions made'*. (3) Whether or not the type of work organisation which Cousins would like to see brought about will in fact come about is entirely problemmatical. His point, however,

that changes will have to be made, even out of necessity, is well taken. In these circumstances our task at the moment is to describe what type of industrial structure is in fact possible. This point follows inevitably from what was argued in the last chapter - that systems of technology require 'governing systems' and patterns of work organisation which are 'appropriate' to their particular requirements and that in any case they will set determinate limits on the type of social system which can be designed to operate them.

These preliminary points lead to the conclusion that even when we come to consider very practical industrial problems we need to be informed by theoretical insights into those variables which underly the structure and functioning of industrial social systems. In our attempts to understand dynamic processes of technical and social change we must have recourse to a theoretical model which will direct our attention to the relevant sets of problems and also provide us with a framework from within which change processes and the consequences of change can be analysed.

We need to be clear first of all on what it is which leads to organisational change. Secondly, we need to clarify why it is that there is an inevitable discrepancy, at least initially, between what might be expected to change were the organisation

merely a mechanical structure which adapts automatically to new operating contingencies and what actually happens in practice. This leads us directly into a consideration of the social processes which take place whilst the organisation is undergoing change. In all of this well - formulated theory is an essential prerequisite.

Unfortunately the sociological analysis of industrial change has not been advanced as far as it should be. In a most comprehensive review of the literature Blau and Scott were led to the regrettable conclusion that: "Systematic studies of organisational change are virtually non existent." (4) There are very few well substantiated propositions concerning the processes and consequences of organisational change and certainly with respect to automation there is still as yet little understanding of the types of industrial organisation which automated technology can sustain. The reasons for the persistence of this state of affairs are varied but on that count not particularly difficult to describe.

Two sets of reasons would seem to account for this situation. The first set are theoretical and were discussed extensively in the last chapter. The second are what might be called orientational. On the theoretical level, as we were able to show,

the models of the organisation available to the researcher have not been adequate for understanding change, and especially technical change. With the classical school there was an unjustified emphasis on the formal structure of the organisation which blinded them initially from taking into account the problems raised by the fact that what the human relations school called 'the informal structure' always served to modify both managerial directives and the official blueprint of the organisation. Even with the human relations school - to whom we are indebted for the accounts they gave of the behaviour of work groups - there is a neglect of technical variables in the social systems of the organisation. In both schools there was little conception of the types of variables which will govern the form which the organisation takes. Both of them rely upon a closed system model of the organisation which blinded them to the influence of external factors such as the state of the markets which the organisation has to supply and to the fact that workers were not merely seeking satisfaction in work but also, in their roles as householders, seeking instrumental rewards in work. To grossly oversimplify, a legacy of theoretical confusion has been bequethed to us by the founding fathers of organisational theory. It is only in the

last two decades that significant advances have been made in organisational theory especially with respect to the view that organisations can be fruitfully thought of as social systems institutionalised in a technological and market matrix.

This lack of well-formulated theory has had important methodological consequences. Instead of attempting to test, in specific circumstances, certain hypotheses we find a strong reliance on purely inductive methods i.e. the belief that given a great deal of information about the processes of change in specific organisations we shall be able to evolve, retrospectively, certain general principles of organisational change. One instance in which this type of analysis has been extremely useful is reported by Woodward in "Industrial Organisation: Theory and Practice" and we shall return to this work in a moment. However, in "Automation and the Worker" by Mann and Hoffman the approach has only succeeded as we were able to show in chapter three in providing a great deal of information, the relevance of which is not entirely clear.

The reasons I have labelled orientational refer to the interest which the writer has in organisational change. To many people a concern with the processes of organisational change is only legitimate if our intention is to either gain some understanding

of how the birth pangs of innovation can be made less severe or else, if employed in the role of consultant, to institute measures of social engineering to ensure that the goals of the organisation can be effectively realised. An example of the first orientation is to be found in Guest's book 'Organisational Change' and in Sofer's "The Organisation From Within". (5) (6) In both cases specific studies, or, in Sofer's case, encounters are reported of organisations moving from a state of 'sickness' to 'health'. Guest's book is less a study of organisational change than a study of change in organisational performance and is described as 'a naturalistic field observation which relies primarily on the inductive approach'.(7) The significant change which he describes is not one in which fundamental modifications occurred in the size, structure or technology of the organisation (a motor car assembly plant) but a change in the style of plant leadership focusing particularly on the leadership style of the new plant manager. Some of the factors which Guest lays out for us to account for improved performance and higher plant morale are "more reciprocal interaction between subordinates and superiors, the elimination of fear, and an increase in favourable sentiments mutually expressed by superiors and subordinates towards one another ... (and) ... (changes in)

the basic behaviour linking middle and lower supervision to the manager and members of the top staff." (pp 115). The plant which he studied was only one of seven divisions in a much larger corporation and although it would be difficult to completely reinterpret Guest's 'findings' it does seem possible to draw the conclusion, from the very important fact which he himself mentions, that head office lessened the 'pressure' which was being exerted on the plant after the new manager took up his post. Part of the difficulty of the plant under the old manager apparently was that head office were being extremely critical and authoriatrian with adverse consequences for the tone of interpersonal relations. Still the point remains that this study is not a study in organisational change; it is the report of a man with a mission, someone who is seeking to describe those conditions which must be met if the interpersonal relationship in an organisation are to be rewarding and harmonious.

Sofer's book describes the author's consultancy behaviour in three organisations showing how a 'socio-therapeutic approach' to organisational behaviour can be of benefit to management - clarifying objectives, the relationships between groups and the like. In the last chapter he attempts some generalisations about the processes of organisational change which, although not based

on his three case studies, seem quite helpful in accounting for at least some of the socio-psychological problems encountered by groups which undergo change. We shall return to Sofer shortly. It should be made clear, however, that Sofer stands firmly in a human relations tradition and focuses primarily on the behaviour of groups. For our purposes, therefore, his account must be severely limited since in the nature of the case studies he draws upon he has little to say about technology but there are, nonetheless, quite valuable elements in this study.

Yet another orientation which we find within the literature dealing with organisational change is that which is explicitly concerned with changing the organisation or with defining strategies of change which ensure maximum acceptance of change. We can point in this respect to the work of Warren Bennis on planned change or to the growing literature of training groups or, as they are referred to, T-groups.(8) The planning of organisational change is now something of a 'movement'. The focus is on patterns of interpersonal relationships and the ways in which these can be made more harmonious and rewarding. The movement itself is part of the pragmatic tradition of American behavioural science explicitly concerned with social manipulation. A classic experiment which we can cite as an

example of this approach is that of Coch and French, "Overcoming Resistance to Change". Here is an action study of what happened when women workers who had been operating on a piece rate system were moved, without warning, to another part of the factory. They reacted strongly to this. A few left the firm altogether; absenteeism rates went up and output was restricted.

One of their principal conclusions is that when worker's participation in change processes is allowed their resistance, measured in terms of production figures is decreased. (9) We need dwell no further on this type of approach. Sufficient to say that these studies are conceived within a theoretical tradition more concerned with making management more efficient and less concerned to spell out systematically those variables which underly the structure and functioning of social systems. In brief they can tell us very little of organisational change itself.

We must turn now to the two points made earlier, namely that what is now required is a frame of reference which will direct our attention to change generating processes and to the processes which usually intervene between the managerial conception of what must take place and to what actually does take place. Secondly, that this frame of reference must take

as its starting point the view of the organisation as a socio-technical system interchanging in significant ways with an environment. By insisting in this way upon the need for a new frame of reference we do not want to suggest that the type of study we have briefly mentioned above are irrelevant to our central concern. Rather we should like to suggest that studies of this type far from being useless are best thought of as being limited.

Section Three

A socio-technical system framework for change analysis

Conceiving of the organisation as a social system institutionalised in a system of technology - the model which we outlined in the last chapter - helps considerably in guiding our thinking about the processes of organisational change. It does so in two senses. In the first place it can be used to describe the most important aspects of the structure of the industrial social system to be taken into account when we consider technical change. Secondly, through the modifications which we have introduced, we are in a position to predict more accurately the likely reaction of organisational members to technical and organisational change. In this section I hope to show the validity of the latter argument. In order to do so I shall have to introduce further modifications to the theory as it now stands.

The first claim i.e. that socio-technical system theory is directly applicable to the problems of organisational change because it helps us to examine key problem areas can be best examined in the following way and with the use of the following diagram.

Organisation Model

Social System

Economic System	Work Group Structure	Governing System
External Market demand level	Division of Labour Occupational roles	Centralisation
Rate of Production tolerable downtime	Task structure	Flexibility
Internal Costs labour, capital	Technical system demands and contingencies	Coordination Control
		Power

This diagram does not exhaust either the structural components of the organisation e.g. those features headed under 'social system' nor have I listed the many other structural variables which could be listed under the heading 'governing system'. It served, however, to direct our attention to some of the factors which would be taken into account by someone using the theory of socio-technical systems.

It has been shown in chapter four how these factors relate to one another. Burns and Stalker have shown, for example, how the external markets of the organisation significantly affect the degree of flexibility one is likely to find in the management hier archy. (10) Those firms having a stable external market and which do not have to operate continually on the frontiers of technical innovation and tend to evolve an inflexible

bureacratic form of organisation - a mechanisatic structure. On the other hand, those firms having to constantly adapt to developments in their technical field (Burns and Stalker studied electronics firms) usually evolve an organic system of management a highly flexible management machine with overlapping authority levels, free channels of communication flow etc. etc. Here is at least one set of arguments for adopting an open system model.

Woodward has shown how different types of production systems tend to be associated with different types of managements systems. (11) Trist and Bamforth have shown how the psychological problems of miners are intimately bound up with the socio-technical aspects of the underground situation. (12) In "Organisational Choice" Trist et.al. have shown how the governing system of the organisation, although subject to some variation, is inextricably bound up with the nature of the technical system of production. In his work in the Indian Textile Mill Rice spelled out the socio-technical system must also conform to certain economic criteria of efficiency and profitably. (13)

These few remarks are merely intended to show that the social system of the enterprise must be seen as the product of many interacting variables and, given that we have at least a general

understanding what these variables are we can begin to ask important questions about organisational change.

Earlier in this chapter I defined the focal problems of the sociology of organisational change as (a) describing what it is which leads to change and (b) accounting for the discrepancy between expectation - usually management's expectations - of what ought to follow the change and what does in fact follow the change. This is the problem of the resistance to change.

Discussions of this phenomenon ought, however, to be extremely cautious. "Resistance to change" only becomes problematical when the consequences of an innovation cut across existing group interests and patterns of established tradition. The magnitude of the problem is measured, often implicibly, by the extent to which what actually happens deviates from what ought to have happened were one dealing with a machine (the organisations) or a collection of automations (the workers). And, of course, both views are inadequate: workers are not pieces of inanimate matter which can be rationally manipulated not are organisations like machines subject to determinate principles of operation from which they cannot deviate. Unfortunately, this mechanical model of the social system is

one which is often quite readily accepted by management. In pointing this out Lupton went on to explaim: "The whole point about this model is that it treats the human being in the organisation as if he existed only as an instrument for the attainment of the objectives of the organisation". (14) By far the greatest difficulty with this model is that it fails to recognise that the individual is "someone who submits to organisational demands ... who reacts emotionally to them and ... as a rational being ... decides about things." (15) Given that the management model of the organisation is often defective in these respects it is not difficult to appreciate why it is that change will be resisted. It may even be the case that which we conventionally define as resistance to change - and by inference and implication such 'resistance' is a Bad Thing - may be, in its unintended consequences, extremely constructive from the point of view of the organisation. Managers will be made aware of the checks and limitations built into their roles; workers may have achieved a new conception of themselves in relation to their work and in relation to the organisation; they may, in the circumstances increase productivity. If, on the other hand, management succeeds completely in imposing its will and discipline on the labour force without overt resistance,

then such resistance can remain covert and will become apparent after a while in low production figures, absenteeism, high rates of labour turnover etc etc. These remarks have been intended merely to show the perjorative connotations of the notion of resistance to change. We can turn now to the first empirical problem of the sociology of change - what is it which induces change?

From the viewpoint of the open system model we have described changes will always have a double reference point. They can be seen as being externally generated e.g. when a shortage of skilled labour in the input markets creates a situation in which it becomes necessary to introduce technical innovations so that the demands of the output market can be satisfactorily met without too much strain on the organisation itself. Alternatively, where market demand is variable - as in the garment industry - the organisation must be constantly adapting to the problems associated with mixing new products and the like. Both of these examples could be taken as examples of externally generated change. To use Popper's term, the situational logic of externally generated change is as follows. (16) To maintain certain expected cost-profit ratios (i.e. the

economic stability of the socio-technical system) in the face of a situation in which the variables which govern such ratios are not entirely subject to managerial control, the organisation must aim at new operating conditions or else be prepared to accept a diminishing share of the output market. The achievement of new operating conditions may involve a change in technology or, if not, a change in management methods or even of management structure.

Internally generated change can be of many different types and stem initially frommany different motives. Emery sees one form of internal change as the achievement of a distinctive competence. The organisation becomes specialised in one area; it constantly improves its standing in that field - it innovates. The organisation thus seeks to achieve complete control over one market.

In the situation briefly described the organisation is clearly setting new goals for itself. Internal change can also result whenever new means are sought whereby existing goals can be more effectively realised. Increasing organisational effectiveness may entail changes in technical methods or changes in the structure of management or changes in the layout of work and in the patterns of work group organisation.

It is clear, in the two cases mentioned, that the pressure for change comes from within the organisation rather than from without. But this should not blind us to the fact that there is always an external reference. In both cases attempts are made to bring the organisation more closely into line with the norm of economic rationality and to enhance the social status of the organisation.

The actual detection of the need for internal change is an extremely difficult and complex process. Who is to say that there is a descrepancy between organisational goals and organisational effectiveness which demands remedial measures? How is this discrepancy initially perceived? Who articulates the problem into a problem? Who sets the goals anyway? These problems are particularly complex since we still persist in believing in the leadership myth that goal direction comes from the top. In large differentiates organisations this is quite clearly not the case. "In practice" writes Etzionni *"goals are often set in a complicated power play involving various individuals and groups within and without the organisation, and by reference to values which govern behaviour in general and the specific behaviour of the relevant individuals and groups in a particular society."* (17) We shall be returning to this point

later for it is of fundamental importance when considering how it is that the organisational plans of management can be modified. Far from having a free rein in organisational changes the management is curtailed by other group interests and recognition of this very important fact ought to offset any tendency to regard the organisation as a mechanical device adapting automatically to new conditions or, at least, something which is wholly subject to management control.

Having seen in general terms how the model of the open socio-technical system can help us to account for the generation of socio-technical change we must now turn to the ways in which it can help us ask the most important questions about organisational change. Put differently the model can help us state the problems of organisational change much more clearly than they have hitherto been stated.

Our discussion at this point must inevitably be of a paradigmatic nature since the theory of socio-technical systems, in its current state of consolodation has not been used to develop a series of deductive propositions concerning the processes of change. That it is capable of being used precisely for this purpose however is something which I hope to be able to demonstrate.

Given any technical change process within an organisation, and on the assumption that the reasons for the change have been satisfactorily stated a series of questions follow immediately. The most important question for our purposes concerns the way in which the existing technical system has been or is to be modified. We then must enquire into the ways in which this change is likely to affect the distribution of 'tasks' within the organisation. Having clarified these two problems we then must examine the ways in which the changes we have already described will affect the division of labour in the organisation - examine, that is to say, its effect on occupational roles. This third empirical task is intimately bound up with the fourth i.e. a description of the ways in which these changes, in their turn, affect the work group structure which persists or persisted in the organisation.

Now changes on this level must undoubtedly be bound up with changes in the management system and especially with supervisory and middle management. In the last chapter we were able to see how these changes might be related. In the coal mining studies of the Tavistock Institute there is a clear demonstration that a change in mining technology created new opportunities for supervision and control. In the early study

by Trist and Bamforth it was shown how a change from hand-got methods of coal production affected (a) the layout of work groups and the patterns of 'task interdependence' between various occupations. They also were able to show how (b) the deputy's role (i.e. the underground foreman) became more complex, requiring greater skills and taking on new coordinating functions. Both sets of changes were intricately related to technical change. In the later mining studies reported in Organisational Choice Trist et al. were able to show how the technical system of longwall coal mining could sustain - with economic effectiveness - at least two types of control systems. Either work tasks could be fractionated and work groups broken up or else work groups could be consciously developed and have 'resonsible autonomy'. In the former case the deputy plays a much more direct role - cajoling inspecting and coordinating. In the latter case many of the supervisor's control functions have been given over to the work group itself. This represents a shift from external or imposed control to internal control; in these circumstances the work group is said to have 'responsible autonomy'. (18)

Yet another case in which the changes of the type just discussed affected the governing system of the organisation is discussed by Fensham and Hooper in their 'The Dynamics of a

Changing Technology' - a study of technical change in a textile mill. They were able to show that the shift to automatic machinery in cloth production created conditions in which more effective interdepartmental communication became a strategic prerequisite for the successful production of cloth. (19) Such a change necessitated a more efficient system of communication between departments - the creation of organic dependency.

The type of control used by management can, of course vary with different circumstances. With process technology management can rely upon what Blau and Scott call 'impersonal mechanisms' of control. Having to keep an account of one's work operations in a log book which can then be checked is one such mechanism. Such a situation is reported in Blauner's study of the chemical operator in "Alienation and Freedom" (20) Here, supervision tends to be 'loose'; workers have a great deal of autonomy. Such a situation can be allowed to persist primarily because the output of the plant is, with automation, no longer dependent on the productivity of the workers. There is little need here for close supervision since the traditional functions of the foremen - ensuring that a sufficient amount of <u>effort</u> is being expended - is now no longer necessary. In the study of automation in a motor car plant by Faunce which we

described in chapter three supervision tends to be close. Again, however, this is to be explained in terms of the opportunities provided by the technical system for the development of different types of social systems which can, apart from producing human satisfaction or dissatisfaction, at least meet certain minimum economic criteria of profitability.

So far I have attempted to clarify what are the most important variables to be taken into account in the analysis of the structure of industrial organisation. In the analysis of structure one final point needs to be made and it is a point having direct relevance for the problem of change. Briefly, it is that the form which an organisation takes in attempting to meet its goals and the form which it will evolve to accommodate change is not merely a function of certain technical and economic exigencies of the type I have been discussing. There are of vital importance but it is also true that the human relations philosophy adopted by management in the design of its work systems can have important consequences for the structure of the organisation. By pointing this out I do not want to underemphasise the extent to which the social system of the firm will be significantly circumscribed by Trades Unions or other powerful groups nor the extent to which these groups will have

an important say in how the firm out to accommodate itself to change; clearly they cannot be neglected. The management's human relations philosophy, however, institutionalised in methods engineering departments, machine layout, types of management control systems etc etc will be an important factor (a) the structure of the organisation and (b) on the ways in which technical or social changes are introduced and received. There is, in fact, a growing literature on the importance of managerial philosophy in both respects. (21)

Charles Myers has pointed out that questions of management structure cannot be divorced from questions of management philosophy. (quoted J. H. Smith (22)) The late Douglas McGregor identified at least two types of philosophies which he labelled 'Theory X' and 'Theory Y' both relying upon different assumptions as to what it is which governs the behaviour of men at work and thus how men ought to be treated at work. Theory X is based upon the confident assumption, formalised in the scientific management of Frederick Taylor, that since the individual is not sufficiently well motivated to work he requires close supervision. Similarly there is to be found the belief in the principles of hierarchy and specialisation as basic functional requirements of efficient administration.

Theory Y relies upon the assumption that within the organisation the individual ought to derive certain satisfactions. Moreover, in achieving these satisfactions the individual will become a more effective organisational member. Those who hold Theory Y believe that it is a psychological imperative that individuals have responsibility, feel fully participant in organisational life and, above all, derive a great deal of self fulfilment in work. (23)

This formulation - Theory X and Theory Y - corresponds closely to the distinction made by Burns and Stalker between 'mechanistic' systems of management and 'organic' systems of management. It is true, however, that certain management systems are more appropriate than others: where we find mechanistic structures or a management system based upon the postulates of Theory X we can be sure that system corresponds fairly closely to the operating contengencies of that organisation. To point this out, however, in no way detracts from what has already been suggested about the importance of management philosophy in the structure of the organisation. The significance of the philosophy is to be seen elsewhere for our purposes. To be precise, the nature of the managerial philosophy will significantly affect the ways in which organisational changes are introduced.

It may be hypothesised, for example, that those managements which rely upon assumptions akin to those formalised in Theory Y will take special care to increase the level of employee participation in change process and, alternatively, those which operate on Theory X will not take the employee into account. It may be hypothesised further, and there is a great deal of evidence behind this hypothesis, that planned change on the basis of Theory Y may, in fact be more effective (defined in terms of production rates, work satisfaction etc etc). (24)

These, then are some of the most important structural variables which must be examined when we ask questions about organisational change. However, the actual, processes of accommodation to change are extremely complex. It is to these that we can now turn examining how far, in its current state of development, socio-technical system theory can help us understand these accommodation processes.

In socio-technical system theory at the moment there is little which could constitute a systematic theoretical analysis of the processes involved in an organisation adapting itself to new technological contingencies. Work has been carried out on the problems of individuals having to accommodate themselves to new tasks but there are strong theoretical reasons for supposing

that, for the purposes of understanding even the individual's response to technical change it is wrong to concentrate exclusively upon the individual. In a review of Bank's work on the attitudes of steel workers to technical change (25) Simon made the point that: "The major shortcoming is that the analysis, in focusing exclusively on the effects of the changes on individuals provides little direct information about how these changes affected social relations with the plant. It is almost as if each worker stood alone in his relations to the plant and that he did not remain within a structure of on going (if changed) social interaction where many of these attitudes towards the common experience were first expressed, molded and confirmed". This point, although made with specific reference to one study is generally applicable as a methodological injunction always to regard the individual in the context of his social relationships.

Even discounting, however, the difficulties inherent in an approach too exclusively directed at the individual it seems unlikely that the analysis of organisational change can be carried much further if the belief in the importance of a team model of the organisation - the unitary frame of reference - still persists in socio-technical system theory.

The reason for saying this is really quite simple. Within the literature on socio-technical systems there is little reference to the ways in which management-inspired organisational change can be modified in its practical consequences either by other entrenched interest groups or by informal group behaviour. It is assumed at the moment that organisations can accommodate to change through processes of 'internal elaboration' and 'differentiation' and in so doing reach a new 'steady state' - a condition of equilibrium. (Emery pp 3 uses the term 'quasi-stationary equilibrium'). What is actually involved in these processes is not made clear although Emery does later talk about the organisation coping with change by evolving new structures and functions. That organisations do not always manage to accommodate change is often resisted is also something to which he is apparently blind. However, he begins later to see the implications of Selznick's (26) point that organisational members are in fact real men with needs and interests of their own and that because of this they raise acute problems for the organisation. He writes of this fact that 'the dependence of an enterprise on persons to operate its technology constitutes one of its inescapable dilemmas'. (p 49) He goes on:

> *"Within an ongoing enterprise it is frequently possible for a 'hard-headed' leadership to deny the reality of*

the problem but it is extremely doubtful if any institution, industrial or otherwise, can persist without making some actual accommodations to the fact that whole men are involved, not just the psychological bits that fit the technological requirements". (p 49)

However one cares to express if this notion of 'dilemma' is extremely important but not sufficiently well elaborated in socio-technical system theory. It is at this point that modifications can be made, exploring further the conceptual dimensions of this notion.

In a recent paper attempting to show the ways in which social science can be of use to managers Tom Lupton has set out a series of points which go a long way - not far enough, as we shall see - towards meeting our demand for a further clarification of the problem of resistance or, this notion of dilemma. (27) He begins by suggesting the theoretical importance of an 'organic model' of the organisation i.e. one in which the firm is seen adapting to an environment and overcoming stresses within itself. As we suggested earlier this is not the model of the organisation which is often held by management.

He suggests that to conceive of the organisation adapting to an environment is also to conceive of the idea of a boundary and to recognise the importance of boundary roles (usually higher executives) which are invested with the function of deciding upon

appropriate organisational strategies in respect of that environment. He contends that strategic decisions at this level have major implications for how other organisational roles will be defined. He writes: *"When changing strategies are adopted this demands a change in the structuring of roles and in the functioning of the activities that go with them. Organisations encounter internal structural and functional stresses when they have to adapt to major changes in their environment."* (p 221) He goes on: *"The stresses and tensions in organisations arise from what one might describe as structural inertia, a built in tendency for structures appropriate to an irrelevant organisational strategy to persist."* (p 221) He carries on to point out that "It is not so much individuals who resist change as social structures. Individuals tend to welcome change if it meets their needs and aspirations. Social structures tend to inertia because persons see their needs and aspirations as embedded in them and in the relationships with other people which these structures involve. (p 222) *"Another contributory factor to the problem of structural inertia - a phenomenon we have already met within the work of Fensham and Hooper - is the tendency for informal structures or 'an organisation culture of customary and allowed ways of doing things to develop within the formal*

requirements of organisational strategy."

His concept of structural inertia is relevant at three levels of analysis - at the level of the organisation, the group and the individual - and Lupton conceptualises the problems of technological change as follows:- "Technological change brings changes in role and in the structuring of roles and in doing so threaten to affect established and customary groupings of persons in their relations one with another as stablised from previous adaptations." There are very valuable ideas especially since they shift our focus of interest away from the individual and on to the social system.

This notion of structural inertia, as used by Lupton serves, however to disguise the genuine conflicts of interests which technological change can throw up within an organisation. Specific interest groups can adopt certain <u>strategies of independence</u> either to consolodate and existing position (status, rewards etc etc) or to derive more from an organisational, or technological change than was, in fact, intended for them. Such behaviour, which may take the form of lower production rates, absenteeism or even threats of industrial action, all have the appearance of resistance to change; cumulatively they could be thought of as indicating structural inertia. In short, this

concept of inertia conceals what it has yet to explain and account for.

The valuable elements in Lupton's paper are twofold - his view that individuals tend to welcome change when it meets their needs and aspirations and his suggestion that the concept, structural inertia, can be applied at three different levels. These points are eminently suitable for further theoretical development. They can be developed in the context of the criticisms I have already suggested of socio-technical system theory that it (a) has inadequately conceptualised the nature of the worker's involvement in the organisation or, put differently, it has not clarified what it is that the worker expects of his work and (b) it has relied so far upon a unitary frame of reference for thinking about industrial relations questions.

I want now to put forward the view that the worker will resist (the way in which he may do so is not important at this moment) technical change if it seems likely that it will violate the expectations which he has of his total work experience. Moreover, these expectations can be regarded as extending over (a) his immediate job, his task and the ways in which this is likely to be changed (b) his social relationships at work and (c) the 'effort bargain' he has previously entered into with his

employers. Gouldner has referred to expectations of this nature as 'the indulgency pattern' and has further suggested that some of the expectations embodied in it can be either latent or manifest. (28) To the extent that important expectations in either 'area' are violated then it is to that extent that social and technical changes will be opposed.

A corrollary of this is the case in which a technical or organisational change can result in a situation in which these expectations. or some of them, can be more fully realised. In this situation we would expect, on the basis of this hypothesis, that change will be accepted as desirable and necessary.

To state the hypothesis in this way is to state it in its most simple form; further propositions are required if we are to be in a position to anticipate not merely whether the change will be accepted or rejected but also the kinds of response which will take place. As we have already indicated the resistance to an innovation can be expressed in many different ways ranging from the explicitly formal use of industrial relations machinery to the informal reliance on silent strategies of resistance such as decreasing output, absentteeism, low morale etc etc. It is probably true to suggest that the form which the resistance takes

will depend upon certain local conditions. In situations where trades union organisation is strong one might expect grievances to be channelled through legitimate bargaining procedures. Where the power differential between employer and employee has not been so effectively narrowed then we might expect a series of silent strategies to be pursued.

Whatever form resistance might take it must be recognised that the tendency on the part of workers to seek to control their own work situation for their own benefit or at least to modify the extent to which their work lives are to be controlled by managers represents one of the most elemental constraints which exist in industrial organisations on the behaviour of management. Also having recognised that the two actors in the situation seek to optimise their interests and expectations we must be lead to the conclusion that the form which an organisation takes after an innovation will also depend upon the balance of powe which exists between the major actors in the organisation and, by definition, upon the extent to which their expectations correspond or diverge and the extent to which each can modify the behaviour, of the other.

One of the strategies which management adopts to ensure that

change will be accepted is to ensure that those whose jobs will be changed will be adequately informed and provided for. An attempt is made to try and anticipate what problems are likely to arise with change and to plan ahead for them - explaining to people the reasons for change, explaining the benefits to be derived from change, inviting consultation etc etc. To the extent that these methods are successful then clearly changes will come into effect quite smoothly. It is equally clear, however, that not all managements would take pains to facilitate change in this way. Earlier in this chapter I spoke to two management theories - Theory X and Theory Y - and suggested that changes introduced and guided by the precepts of Theory Y would probably be more successful than changes based upon the assumptions of Theory X. There seems to be a significant degree of empirical confirmation of the validity of this hypothesis.

The work of Mumford and Banks into the introduction of computers into a commercial firm and a bank came to the conclusion that much of the anxiety which accompanied the change in both cases could have been avoided had the strategies of change adopted by the management been more sensitive with respect to the actual consequences of the change and the need to explain

these consequences to employees. (29) Walker in his study of the new seamless pipe mill in the book "Towards the Automatic Factory" was led to similar conclusions. If the management had been more aware of the variables which govern group cohesion and morale and more sensitive to the natural fears which must accompany and innovation then many of the financial and human costs of the installation of No. 4 Seemless Mill could have been avoided. (30) Both studies would lend support to the argument that consequences of change will depend to an important degree upon the ways in which change is introduced.

Other variable factors in the acceptance or rejection of change can be identified e.g. the traditions of the firm in relation to industrial relations questions and the attitudes and characteristics of the employees themselves. Emery and Marek have pointed out that a history of good industrial relations in a firm provides a sound backloth against which change can be effectively introduced. (31) Similarly, in a study of technical change in a steel mill Scott et. al. of Liverpool University were led to conclude that explanations for the changes they discussed having been smoothly accepted, must be sought in the framework of management-union relationships. They refer to the 'institutional'

security' of the unions (pp 165) and the acknowledged situation in which many of the problems raised by technical change - selection of men to be transferred and the establishment of seniority positions on new processes being two of the most important - are left to the unions themselves to decide upon. The firm's recognition of the union's rights in these respects served to decrease the level of conflict of interest between the two parties.

The extent to which change is accepted would also appear to be dependent upon the attitudes and characteristics of the employees. Mumford and Banks have proposed an interaction model of the many variables which in their turn influence attitudes. Constructed around four major dimensions the model lists at least fourteen different variables which will influence attitudes to change. The four major dimensions are (i) factors in the change situation e.g. propaganda, past policy of the firm etc. (ii) the change policy - whether or not to invite consultation etc. (iii) the change consequences - redundancy, transfers etc. (iv) the individual - social characteristics, age, level of job involvement, needs, aspirations etc. (32)

Clearly the variables which seem to govern the acceptance/ rejection or effectiveness of change, whether this be technological or organisational are extremely complex. To point

this out, however, is not in any way to diminish the importance of my earlier hypotheses. The variables which have just been outlined do not lead us to the conclusion that the hypotheses set out earlier are too simple for all of these variables could be taken into account in the hypotheses. Nor must we come to the conclusion that if my hypotheses are correct then all of these other points are somehow incorrect. The studies discussed do, in fact, lend further support to the hypotheses. I shall explain why this is so in a moment. At this point, however, it might be helpful to clarify what the differences appear to be. Two points are important. The model of the organisation being used in this study and from which these hypotheses have been derived is explicit in its reference to a conceptualisation of the worker as someone having expectations and who is prepared to translate his expectations into action. In this respect the differences are largely terminological but not entirely so. Secondly, the model being used here is more explicit in its interest in the possibility of conflict occurring during periods of change. One implication of this is that for our purposes it is important to focus on the means through which one actor in the organisation can enforce his will on the other and to examine the so-called 'strategies of independence' which are the means

through which industrial conflicts become apparent and fought.

A similar approach to the one being advocated here for conceptualising the problems of change is to be found in Touraine's "The Attitudes of Workers to Technical Change". (33) There is in this book a great deal of reported evidence which substantiates the view that the worker's expectations can be seen as extending over three areas - the job, the social relations of work, and the effort contract between himself and the organisation - and that it is in terms of these expectations that change will be evaluated and responded to.

In this book attitudes to change are discussed as the outcome of attitudes to work generally. Attitudes are considered 'at different levels of the work situation' (p 29) - at the level of job, the primary work group and the decision-making system. The scheme is imilar to the one I have outlined but certainly not identical. At the level of the job, so it is argued by Tourraine et. al. attitudes are expressed as satisfactions or dissatisfactions with work and with relationships with fellow workers. At the level of the organisation attitudes are expressed in certain types of labour action - 'dissatisfactions become formal labour claims ...' (p 30) One of their central theses is that in the evolution of modern manufacturing methods

the worker has lost his occupational autonomy and had come to be profoundly dissatisfied with tightly-controlled, fractionated work. Durand contends that the frustrations which such work produces has led to certain responses. Quoting from Walker and Guests's study, "Man on the Assembly Line" he argues that low morale, absenteeism, 'habituation' and a degradation of expectations are one set of responses.

The fractionation of work has its parallel in the disintegration of work teams. Attempts to reintegrate work tasks, to design socio-technical systems which produce satisfaction have, he claims, all largely failed. However, the worker and his unions do not accept these changes passively. At the level of the job every attempt is made to protect the skilled trade and its occupational autonomy. To substantiate this he quotes the work of Scott et. al. who discuss the negative reaction of older workers to technical change because it deprived them of their trade.

In a further chapter Alred Willener explores other dimensions of the worker's attitudes and the extent to which they will influence his attitudes to change. (4) He examines individual resistance considering the workers as being (i) occupants of roles and (ii) holding positions of authority and

status in the organisation. In his account here he appears to hold the view that as an individual a worker will accept change if he believes that, under new conditions, the reward he receives for working is greater than his contribution. As someone having an occupational role Willener, following the American behavioural scientist, Argyris, suggests that the extent to which a man accepts change will depend upon the extent to which he is identified with his job as it exists before the change.

Following Lenski, Willener suggests that, as an occupant of a status position, a worker will embrace change if he thinks that in his current position there is a discrepancy between his status and his rewards.

At the level of the group Willener quotes the research of Ronken and Lawrence into technical change. In their case study they found that the resistance which took place was not directed at the technical change itself but at the disruption in interpersonal relationships which the technical change entailed. Williner interprets this and other pieces of research as indicating that groups seek to protect their interests and that 'where similar methods of introducing change are used in similar types of organisation, the non cohesive groups will tend to react with anxiety while cohesive groups will accept or react negatively for

other reasons, for example to protect benefits that they have required.' (p 75)

As Durand points out elsewhere in this volume the attitudes which they see as having a reference at three levels are, in fact, part of an attitude system, that taken together they constitute reference systems in terms of which the worker's response to industrial change will be guided.

These are very important ideas and they should be developed further. They are certainly in line with a great deal of other thinking upon these matters although the assumptions made about work motivation are somewhat unique. Far from regarding the industrial worker as an homo-economicus who would respond to sufficiently high financial incentives and not care much about anything else (the classical school made these assumptions) or even as a seeker of security (the human relations school made this assumption) Touraine et. al. regard the worker as someone seeking 'self actualisation' in work. (35) He seeks to be able to control his own work life, to achieve fulfilment in work. In short, and without attempting to outline the philosophy upon which these assumptions are based, they hold that a great deal of industrial relations behaviour in work can be seen as an attempt on the part of the worker to transcend

the alienation which the technical system of work (industrialism) has forced upon him.

This model has several important implications. It would suggest again that common management model of the worker as either an automation or a carrot-chasing donkey is an entirely erroneous one upon which to base any generalisation about work behaviour. Such a model also forces us to extend our list of what it is the worker expects from his work and to reformulate our current ideas about the nature of work motivation.

The Touraine book has another very important feature. The worker is seen as a member of a community, as a householder and the suggestion is made that factors which lie outside the immediate work situation do, nonetheless, have an important bearing upon work behaviour. (36) Daniel Pecaut develops this point claiming that '*...attitudes towards change cannot be explained purely on the basis of a work situation, but they reflect a more complex system of expectations deriving from the individual's plan as a whole.*' (p 149)

It is not important for present purposes to discuss this work in depth. It is sufficient to say that these writers are very successfully widening out the focus of study of industrial attitudes. Put differently they are, though not so explicitly,

taking the conception of the organisation as an 'open system' to its logical conclusions. Once it is realised that such an approach is necessary a new light appears to fall on much industrial relations behaviour. Community expectations for higher affluence will spill over into the work situation as demands for higher levels of remuneration. Or, to take another example, it might be the case that a man will resist fundamental changes in his job because the status accorded to him in the community may be dependent upon the status of his job. If technical change threatens to decrease the status of the man's work he might interpret it also as a threat to his status outside work.

The view is emerging, therefore, of the worker as having certain attitudes and expectations of work (and of specific dimensions of the work situation) which are carried over from and reinforced by the nature of the community in which he lives. This point is in line with what David Lockwood has suggested. He claims to have been able to account for variation in the working class images of society, (i.e. how workers define situations and, accordingly, how they act in certain situations) by referring, in part of his analysis, to the nature of the

community in which the worker lives. Tightly-knit, homogenous working class communities are conducive to the development of collectivistic attitudes and a 'them-us' view of industrial relations. (37)

Clearly then the attitudes and expectations which the worker has of work and in terms of which he will evaluate technical change have extremely complex derivations and cover many different aspects of the work situation. This discussion has also established that in dynamic terms the extent to which a change industrial practice will be resisted will depend, apart from whether or not work expectations are satisfied, upon the balance of power between worker and manager. If the manager is the more powerful (or, at least, more powerful than he would be had there been a powerful trades union movement in his organisation) of the two he will succeed in introducing change as he wants it. If by doing so he violates firmly held attitudes and expectations he is likely to be faced with a period of silent industrial protest. If, on the other hand, there is a degree of power equalisation due to the existence of strong union organisation such resistance, if it is to occur anyway, will be of an overt nature.

Of course in reality the situations likely to be much more complex than this. A situation might arise in which technical change is introduced without raising any difficult problems of industrial relations yet the effectivenesss of the changes as they wereinitially planned is not up to expectation. It is for such a situation as this that Lumpton uses the term 'structural inertia' the tendency for people to hang on to past practices long after the need for them has gone. Fensham and Hooper similarly refer to the 'recalcitrance of attitude change' to account for this well-known phenomena. (38) Their formulations appear on the surface to be less radical than the ones I have been proposing. In fact, however, their analyses only account for one dimension of this overall problem of resistance i.e. the dimension of attitudes and group attachements. They have important things to say here on the ways in which attitudes are affected by membership groups and norms and values embodied in these groups. They have very little to say about the phenomenon of effort bargaining or industrial conflict generally. They have nothing to say about power and nor do they make any attempt to try and account for the nature of the worker's expectations which in the first instance create his attachement or disattachement to various industrial practices

which they are so closely trying to understand. In pointing this out I do not want to dismiss this type of analysis as irrelevant to the central problem. Their concern with the intricate webs of group affiliations and involvements as these amount to constraints upon management behaviour is entirely legitimate. It should be recognised, however, that this is only one part of a much more complex range of variables. This account of some of the variables which influence whether or not technical change (or industrial change generally) will be accepted is obviously incomplete; much more work need to be done in this area. However, when we take this account of what is implied in Emery's notion of 'dilemma' or Lupton's 'structural inertia' together with what was said earlier about (i) the reasons for technical and organisational change and (ii) the framework for understanding the structural consequences of change, it is clear that we have moved towards a much more comprehensive framework for thinking about the problems of organisational change than has hitherto been available. Moreover it is a framework which avoids all the difficulties inherent in an organisational model which relies upon a 'unitary frame of reference' for considering industrial relations questions. It is also a model which carefully avoids the tendency to account for

industrial behaviour in terms of psychological postulates. It is based upon the alternative view that industrial behaviour can be explained as an outcome of certain characteristics of the industrial situation itself.

Section Four

Some Socio-technical Consequences of Automation

In the last section the general outlines of the theoretical model with which this and the last chapter have been concerned was completed. In this final section it remains to show how this model can be of help in attempting to understand explain certain consequences of technical change. Moreover, it is important to try and identify what opportunities for the design of industrial social systems are presented with automation. As I have already pointed out our interest in the organisational consequences of automation is by no means merely academic. It is important that we should know the ways in which automation is likely to be accepted in industry since further economic growth is dependent upon the appropriate social adaptations being made. The blind and thoughtless introduction of a technological change as profound in its implications as automation can only lead to suspicion and industrial tension if careful plans are not laid to meet the problems which automation will present. Industrial planning of the sort which is required, however, can only be successful if people are aware of the ways in which technical change can produce social change. This same point has been made by Lupton in an article which attempts to introduce

management to the ways in which systems of technology articulate in significant ways with the social structure of industry. The purpose of his article is to show the ways in which the theoretical analysis of organisations can be of direct practical use. (39) This need to employ theoretical models to the problem of technical change has been one of the principal themes of this study.

In the recent past the empirical study of the consequences of technical change and of automation in particular has been hampered because satisfactory models have not been available to him. Consequently he has not been able to ask the most important questions. The theory of socio-technical systems which has been elaborated in this study goes along way towards meeting the need for an adequate theoretical model. As against great gains being made on the theoretical level, however, the number of structured sociological studies into the problems raised by automation is quite small and many of the studies which do exist have many weaknesses. These weeknesses were discussed in chapter three of this study. Not only are these studies few in number but they also suffered from too strong a reliance on empirical observation undirected with theoretical insight.

A situation now persists in which it is an extremely hazardous exercise to attempt to make firm generalisations about

the industrial consequences of automation. It is possible, however, to describe in general terms the type of changes which shall occur with automation and also to suggest the varieties of industrial social systems which could be designed for automation. Finally, through describing the opportunities which automation presents to us for innovating in the design of industrial social systems, it is possible to suggest under what conditions automation will be accepted or rejected.

Describing the consequences of automation presupposes that certain fundamental distrinctions have been made about the different types of autoamtion. As we were able to show in chapter one the meaning of this term was by no means unambiguous and in the discussion in chapter three it became clear that the consequences of different types of automation were clearly quite different in a whole range of areas. We were able to show variations with respect to the nature of jobs, the structure of work groups, the patterns of authority relationships and in degrees of job satisfaction. Also, as far as the organisation as a whole was concerned, apart from that segment of it which was run by automation, a great deal would seem to depend upon the extent of automation. Specifically, the consequences of automation varied with respect to the depth of penetration of

the machinery, its span across different work operations and the level of technical complexity of the system in question. These variations are not random; there is a predictable relationship between them over a wide range of industrial features. To mention a few:

(1) As the level of mechanised complexity increases throughout all work operations the number of direct production workers decreases; maintenance operations, for which different skills are required, become more important. Both of these changes are documented in the studies of process technology discussed in chapter three.

(2) With an increase in mechanised complexity and the corresponding reduction in direct production workers the skill requirements of the plant change in two significant respects. Firstly, a greater demand is placed upon monitoring and conceptual abilities. Secondly, a greater knowledge of the plant operations as a whole is required. As against these requirements for process technology the job requirements of less complex systems still resemble those for assembly line production. (see discussion of Detroit automation in chapter three)

(3) As the level of mechanical complexity increases new opportunities are created for the formation of cohesive work groups.

This opportunity does not exist where the level of automation is so primitive that it is almost indistinguishable from the assembly line. This opportunity arise because less is demanded of the operative in terms of direct production and more in terms of interpersonal communication and cooperation.

(4) As the plant approximates fully automatic production the consequences of breakdown become very severe. A premium is therefore placed on work scheduling geared to planned maintenance rather than 'crash maintenance'. This same feature has important consequences for the authority relationships of industry. Communication must flow both 'upwards' and 'downwards'. From a system of downward controls there emerges a system of consultation. This in itself follows from the break which high mechanisation makes between production and effort. With process technology the plant operators' are not engaged directly in production; there is little need for close supervision to ensure the correspondence of 'effort' and 'reward'.

(5) The close interdependence of different production operations which automation demands (see discussion of higher levels of Detroit automation in chapter three) places a premium on close interdepartmental cooperation. This can involve a process of centralisation in management functions.

Many more of these changes were discussed in chapter three. Insofar as responsibility and self determination are important factors in work satisfaction, and there are strong reasons for supposing that these are important elements, it is clear that the possibility of higher levels of work satisfaction being achieved with automation will depend a great deal upon the technical complexity of the system in question. What is important at this point, however, is not that these associations have been observed but that they can be explained as necessary outcomes of the characteristic features of advanced automation. A work organisation conducive to the emergence of these interesting features in the experience of work is clearly possible within the technological limits of process technology. The same conditions could not be supported by the more primitive types of Detroit automation.

If these are some of the more predictable consequences of automation can anything be said upon the likelihood of automation being retarded through industrial resistance? If the theoretical considerations discussed in the last section have any validity then a great deal will depend upon (i) the way in which automation is introduced by management and (ii) the extent to which it enhances or undermines what the worker, through his union, expects

of his job and its integrity, his social relationships at work and the 'effort bargain'. Moreover, his reaction will also depend upon the extent to which he is compensated for any deprivations he might have to suffer.

At this point the issue of unemployment becomes very acute although there is no necessity why the possibility of unemployment should lead to automation being opposed. J. D. Stanley has argued that "Fear of unemployment and fear of loss of status, which are common causes of resistance to technological change also cause resistance to organisational change". (40) This is a genuine fear but in the framework of current rates of technical change and economic growth it may be an unnecessary one. The report of the Ministry of Labour Manpower Research Unit "Computers in Offices" came to the conclusion that office automation would not lead to clerical unemployment but would only go a little way towards meeting the ever increasing demand for office workers. It is almost impossible to legislate on this issue but what is certain a great responsibility is placed upon management, in cooperation with the unions, to evolve means by which the employment consequences of automation can be made less severe.

Leaving the overall issue of unemployment aside, however, the extent to which automation will be accepted will depend upon

what arrangements can be made in respect to wages; in respect to the 'effort bargain'. The study by Walker is a classic in this respect for he shows what happened to management labour relations over the questions of bonus and incentive payments with a new seemless pipe mill. A great deal of industrial unrest was caused by management's failure to evolve an incentive system which would suit (a) the operating conditions of the mill and (b) the men's assessment of what was appropriate to those operating conditions. A whole series of actions - low output, threatened strike - were taken up in the effort bargaining process. Walker concluded that had management been more ware of the importance of the incentive system then these conflicts could have been avoided. (41) Taking a more general viewpoint in relation to the many local factors which might affect the workers' attitudes to change what much of the work on automation points to is the need to employ well worked out change strategies, to inform people, train them, plan ahead and always play close attention to the relationship between technical and sound change.

It is quite clear that automation will place many strains upon labour relations but it is also quite clear that the more technically complex the system the greater are the benefits to

be derived from working with it. In some cases the introduction of automation will meet with resistance; certainly the T.U.C. report on 'Automation and Technical Change' and the A.E.U. Conference expressed their concern for the need for strict supervision and consultation and a greater share of the benefits of production so that, in any case, automation will be a closely watched development.

As for the direct consequences of automation on the nature of industrial roles and for the structure of the work situation generally it seems unlikely that there are, apart from questions of wages, any real reasons why technical change will not be accepted. But a great deal will depend upon the ways in which it is introduced. Men need to be adequately and systematically trained for their new jobs. They need to be informed well beforehand of impending changes and be brought increasingly into the planning of technical change. What is particularly exciting at the present time is that automation, at least in its more sophisticated forms, could lead to the final emancipation of the worker from degrading work. It could lead to new skills and responsibilities, to more democratic management of industry, to a great many things which most people would regard as improvements

in their working conditions. But if these things are to be achieved much more needs to be known of the principles of organisational structure; there needs to be a greater awareness of the fact that industry as we know it today is not something which cannot be redesigned, a structure frozen to immobility by the forces if its technology. There is room to change and these is certainly a need to change. The opportunities inherent in this situation should not be missed.

The structural morphology of automation is becoming clear and with further research the potentialities for organisational change associated with it will be fully understood. These potentialities, briefly mentioned above and extensively examined in chapter three, are easily established, at least in principle. What is not so clear are the ways in which people will respond to automation. The onus of this chapter has been to describe the terms in which such responses can be understood and to argue unequivocably for an open systems model of the structure and processes of organisational behaviour.

Notes to Chapter Five

1. From an Address by B. C. Roberts to the British Automation Conference 1965.

2. P. Carter and B. Williams "Science in Industry: Policy for Progress"
O.U.P. 1959 pp 82

3. Frank Cousins, Speech in House of Commons Debate on Education and Technology April 25th 1966.
See Hansard No. 685 18th April - 28th April 1966 pp 384

4. P. M. Blau and W. R. Scott "Formal Organisations: A Comparative Approach"
Routledge Kegan and Paul 1963 chapter nine pp 223

5. R. H. Guest "Organisational Change"
Tavistock 1962

6. C. Sofer "The Organisation from Within"
Tavistock 1961

7. R. H. Guest op cit note (5) p 7

8. Warren Bennis. See his "A Typology of Change Processes" in the very valuable book of readings, "The Planning of Change" by Bennis, Benne, and Chin. Holt Rinehart and Winston N.Y. 1962 pp 153. Bennis is largely concerned in a series of other publications to examine the role which behavioural science consultants can play as change agents in organisations. The notion of the training group or T-group is more closely associated with the work of Herbert A. Shepard. The techniques - involving analyst and group - are designed to improve interpersonal communication and thus aid problem solving. See H. A. Shepard "The T-Group as Training in Observant Participation" in Bennis, Benne and Chin op cit p 637.

9. L. Coch and J. R. P. French "Overcoming Resistance to Change" in Human Relations 1948 p 512-532.

10. T. Burns and G. M. Stalker "The Management of Innovation"
Tavistock 1961

11. Joan Woodward "Industrial Organisation: Theory and Practice"
O.U.P. 1965.

12. Trist E. L. and Bamforth K. W. "Some Social and Psychological Consequences of the Logwall Method of Coal Getting"
Human Relations 1951 4. 3-38

13. A. K. Rice "Productivity and Social Organisation The Amhedabad Experiment"
Tavistock 1958

14. Tom Lupton "The Practical Analysis of Change in Organisations"
in The Journal of Management Studies May 1965 pp 219

15. Tom Lupton op cit see note (14) p 221

16. The phrase 'situational logic' is that of Karl Popper in his "Poverty of Historicism". It refers to a methodological position in which systems of explanation are always couched in terms of the action of individuals in specific situations. The researcher is told that he must always take into account the structure of the situation into which the behaviour pattern he is interested in fits. It is only in this way that he can unravel the logic underlying it.

17. Amitai Etzionni "Modern Organisations"
Foundations of Modern Sociology Series, Prentice Hall, Inc. 1964 pp 7-8

18. See chapter four of this study for a fuller discussion of this concept.

19. Fensham and Hooper "The Dynamics of a Changing Technology"
Tavistock 1965.

20. R. Blauner "Alienation and Freedom: The Factory Worker and His Industry"
University of Chicago Press 1964

21. For an historical account of managerial ideologies R. Bendix's "Work and Authority in Industry" is invaluable.

22. Charles Myers "Management and Enterprise Efficiency"
quoted by J. H. Smith "The Organisation as a Social System"
in Nancy Seear (Ed) "Personnel Management"
I.P.M. London.

23. Douglas M. McGregor "The Human Side of Enterprise"
in Bennis, Benne and Chin op cit note (8) pp 422-431

24. See E. Mumford and Olive Banks "The Clerk and the Computer"
Routledge 1966

25. Herbert Simon's review of Olive Banks
"The Attitudes of Steel Workers to Technical Change"
Liverpool University Press 1960.

26. P. Selznick "Foundations of the Theory of Organisation"
A.S.R. 13, 1948.

27. Tom Lupton op cit note (14)

28. Alvin Gouldner "Wildcat Strike"
Yellow Springs Ohio 1954 Antioch Press.
Also "Cosmipolitans and Locals: Towards an Analysis of Latent Social Roles"
ASQ 2 1957-8

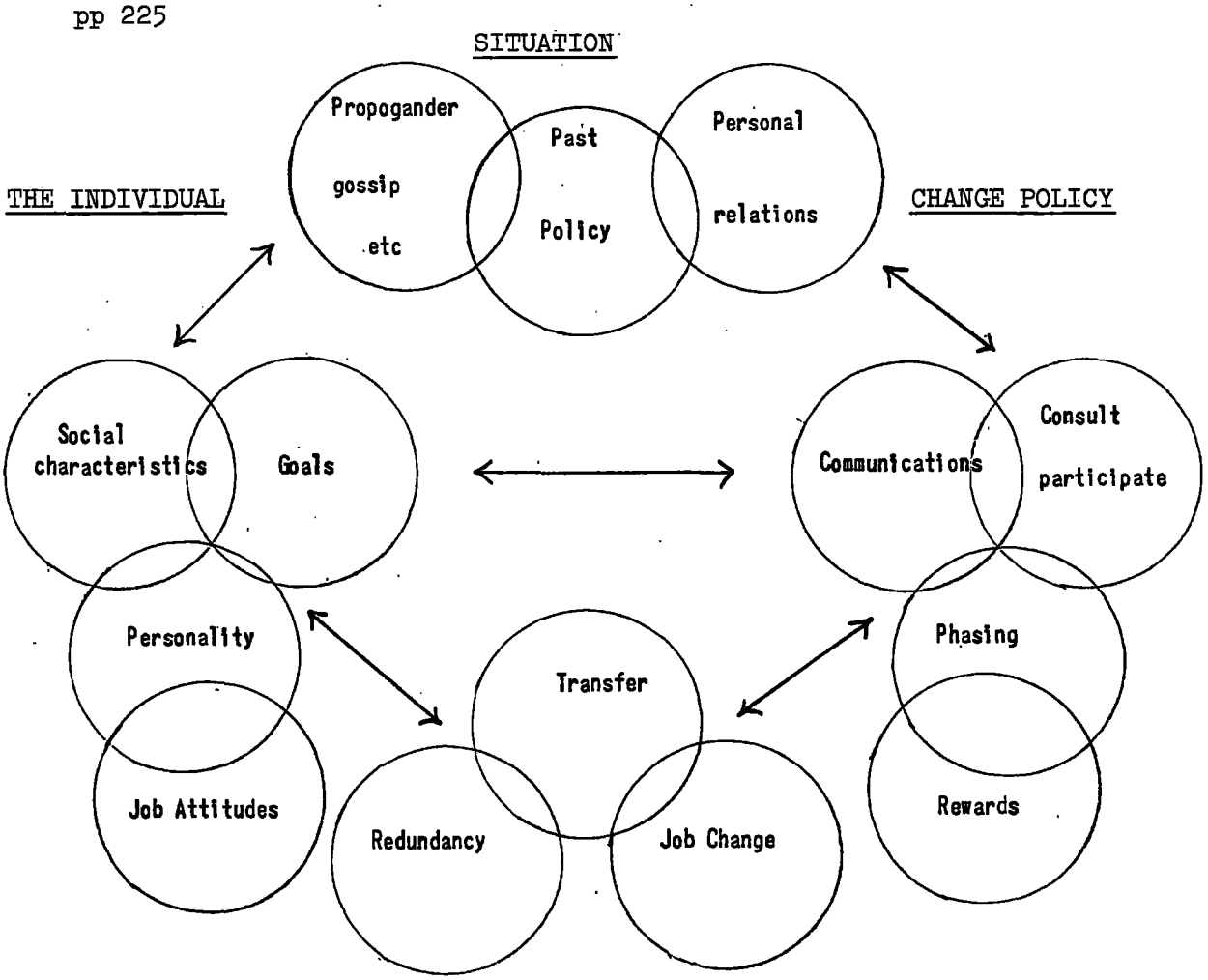
29. Enid Mumford and O. Banks op cit note (24)

30. C. R. Walker "Towards the Automatic Factory"
New Haven Yale 1957

31. F. E. Emery and J. Marek "Some Socio-Technical Aspects of Automation"
Human Relations vol XV 1962

32. Enid Mumford and Olive Banks
"The Computer and the Clerk"

summarise their list of variables with the following diagram pp 225



33. A Touraine and associates "Workers Attitudes to Technical Change"

O.E.C.D. Paris 1965.

34. Alred Willener "The Worker and the Organisational System"

in Touraine op cit note (33)

35. A. Touraine op cit

36. Daniel Pecaut "The Worker and the Community"

section 4 of Touraine op cit note (33)

37. David Lockwood "Sources of Variation in the Working Class Image of Society".

Sociological Review No. 3 vol. 14 1966

38. Fensham and Hooper "The Dynamics of a Changing Technology"

op cit

39. Tom Lupton op cit

40. J. D. Stanley. "Group Influences on Technical and Organisational Change"

in Karsh (Ed) Industry and Human Relations

41. C. R. Walker op cit note (30)

42. The use of the sentence '... automation will be closely watched development' although true nevertheless fails to stress that automation <u>is</u> a closely watched development. It is difficult to get information on the ways in which Trades Unions are responding to innovation in the actual work place but if their behaviour is at all a function of their resolutions then they will be behaving very guardedly indeed.

The TUC report "Automation and Technological Change" laid down seven points which trades unions should attend to. In outline they were:

1. A demand that a schedule should be drawn up well before the introduction of a technological innovation so that workers can be given time to realistically appraise the development.

2. Measures should be taken to 'minimise threats to a workers security and status'. The T.U.C. has in mind here the concept of attrition i.e. that the employment effects should be offset by natural wastage and through financial aids to retirement and facilities for finding new jobs.

3. Rules should be drawn up and agreed upon well beforehand so that the problems of selective discharge can be put into effect efficiently and justly.

4. Given that automation requires numerous adaptations facilities should be made available for adequate retraining.

5. Provisions should be made to safeguard the level of earnings and to ensure that 'financial incentives for workers are adequate to gain their support for the changes'.

6. Consideration should be given to the effects of the proposed changes on working arrangements and the conditions of work.

7. Lastly, the T.U.C. puts foreward the general principle that: 'Close consultation with Union reprentatives should be maintained at all stages'.

Similarly, the Annual Conference of the A.E.U. in 1966 came up with six main points which ought to guide their response to automation. After calling for a study of the extent, progress and social implications of automation, the Union resolved to

1. No introduction of automation without previous consultation and agreement.

2. No redundancy arising from the introduction of automation; labour so displaced to be retained on pay roll pending alternative work without loss of earnings.

3. The increased productivity resulting from these processes to be reflected in increased earnings and reduced hours without loss of pay.

4. Technical training in automation for all engineers.

5. Retraining to be the responsibility of the Government.

6. That District Committees and Shop Stewards should insist on discussions with separate employers to ascertain plans extent of proposed introduction of automation methods into various establishments.

The resoltuion then called for a tripartite - consisting of representatives of the unions, employers and Government, to 'control the introduction and scope of automation".

Perhaps we should contrast these two resolutions with the more bouyant attitude of some union leaders. In this way we might place the possibility of Trades Union resistance to automation into a much more meaningful perspective. Speaking to the Industry 1965 Exhibition Conference on Productivity Les Cannon of the E.T.U. said: "The problems that this country is beset with are not those arising from a poor industrial relations system incapable of absorbing the consequences of technological change because, as I say, they have never really been put to the test ... In my view the problem of industrial relations in this country arise from the absence of technological change".

POSTSCRIPT AND CONCLUSIONS

A great deal is known about automation but the significance of what is known remains obscure. It is obscured by the failure of sociology to state clearly the relationship between technical and social change. As a consequence neither the industrialist preoccupied with the management of technical change nor the liberal academic concerned with its consequences can feel satisfied with the achievements of research in this area. For the one research findings are not a good guide to practice for the other they are irrelevant to the most urgent issues. Such responses reflect neither on the volume of research nor its empirical sophistication but its aims.

In "The New Utopians", Robert Boguslaw criticised social theory for being "a very conservative intellectual force on the contemporary scene" (1) And the point has recently been re-emphasised by Ben Seligman(2). He feels, with some justification, that since modern societies are on the brink of a new renaissance it is important that social scientists should attempt to tell people what will happen or, at least, what could happen if the 'new utopians' - systems analysts and system designers - are allowed to pursue their technical visions without powerful social

constraints. It is only in this way that modern societies can avoid the very real danger of being "wagged increasingly by their technological tails" (3). Whereas the old utopians - Plato or Sir Thomas More, for instance - tried to construct societies free from human imperfections on the basis of the perfect human beings or perfect principles, the new utopians 'are concerned with non-people and with people substitutes (4). He says they lack the 'humanoid orientation' of the classical writers (5). What is worse, whereas the impetus behind the new renaissance is a desire to extend man's control over nature, "Its greatest threat consists precisely in its potential as a means for extending the control of man over man". (6)

We may legitimately doubt whether Boguslaw's arguments have any basis in contemporary experience but we cannot doubt that the unintended consequences of automation may be more far reaching than we have previously realised. It is clearly possible that whilst we expand automation in the interests of profit and efficiency we might fail to realise other equally important social values and economic ends. Basic rights and freedoms could be jeopardised and full employment might become an unattainable ideal.

Problems such as these ought to be at the heart of the sociology of automation and it is the relative neglect of such

questions that prompts Boguslaw to castigate social theory for its conservatism.

In a sense, however, Boguslaw overstates his argument. Research into the sociology of automation is of a recent origin and the methodological requirements of staging research in this area have yet to be clearly established. I have been concerned to show in this study that it is not so much a lack of sensitivity to the far reaching possibilities of change associated with automation which is absent from the literature but an adequate theoretical framework for studying its consequences.

The central concern of this study has been to clarify what the methodological requirements of research in this area are and to show, perhaps only implication, the importance of Paul Lazarsfield's dictum that: "Nothing is so practical as a good theory".

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Notes

(1) Robert Boguslaw "The New Utopians: A Study of System Design and Social Change" Prentice Hall 1965

(2) Ben. B. Seligman "Most Nototious Victory: Man in an Age of Automation" Free Press 1966

He says of his book: "My book seeks to analyse the condition of man in an era in which technology has seized control of his fate" and, earlier, "Seldom is the question asked, 'why?'".

(3) Boguslaw R. op cit pp 4

(4) Boguslaw R. op cit pp 2

(5) Boguslaw R. op cit pp 5

(6) Boguslaw R. op cit pp 204.

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