MASS COMMUNICATIONS AND 'INFORMATION TECHNOLOGY'

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Eighteen hundred thirty-four, the year of Büchner's
Hessian Courier
Charles Babbage, obsessive-compulsive, Fellow
of the Royal Society, founder of operations
analysis
conceived the punch card.

H.M. Enzensberger 'C.B. 1792-1871'

I

This article aims to provide an overview of recent developments in mass communications made possible by the micro-electronics 're-volution'. It sets out to assess the impact of these new technologies on social relations — or, more correctly, to analyse the technologies *as* social relations. Thereby it intends to treat them as forms assumed by the capital relation as it seeks to impose itself ever more firmly and extensively on social life.

It is today possible to discern a process of convergence and integration of once disparate technologies. At one level, hitherto independent products are merging into systems within particular sectors of society. Word processors, telecommunications equipment and computers are becoming key elements of integrated systems in the business sector. And video cassettes and discs, television games, home computers and viewdata services form key components of systems in the home. At a more general level even these systems are merging into what may be seen as an over-arching communications industry which incorporates, most importantly, computing and various forms of telecommunications. This is identified, but not conceptualized, by the recently coined term 'information technology'. In consequence, corporations once unchallenged within their own sphere are being thrown into confrontation with each other. Although this process is still embryonic the impact is already being felt, most notably with the introduction of word processors. It is

clear that this impact will increase, not just on employment, but on all social relations, permeating many aspects of everyday life.

However, it is necessary to begin with some brief theoretical observations. Because assessments of technological innovation all too easily result in futuristic utopian — or dystopian — scenarios, we feel it essential that analysis of such developments be conceptually informed by more adequate principles than we have yet found within the theoretical framework of current Marxist cultural and media research. Such work is particularly restrictive when trying to understand mass communications phenomena which are only in their emergent phases. Indeed, it is our contention that recent developments in 'information technology' are calling into question many aspects of this research. A re-examination of theoretical positions is required, especially a rethinking of the interrelations between social and economic forms and theory and (historical) reality.

The history of Marxist cultural and media theory is inextricably linked with the history of the base/superstructure metaphor. This metaphor, universally criticized in its cruder and mechanistic incarnations, has nevertheless proved singularly irrepressible. Such a conceptualization is indeed part of everyday consciousness: it does indicate the spontaneous perceptions of members of society. It is an element of commonsensical modes of thought which make it difficult to think the interpenetration of different aspects of society in any other way. This phenomenon, which has discernable historical origins, has been accepted by and theoretically refurbished by that school of thought which now exercises 'hegemony' over Marxist cultural studies. This movement gravitates around the early texts of Althusser and draws upon particular concepts ('determination in the last instance', 'overdetermination', etc.) to pose anew the relation of base and superstructure (now called the 'economic' and 'ideological' levels).

The base/superstructure metaphor, in any of its guises, reflects the way in which society ***appears*** as fragmented and divided, in which culture ***appears*** as external to the economic infrastructure, thereby reproducing the surface appearances of society.

On the one hand, the effect on media studies has been to isolate from the social totality the 'level' of ideology or culture. Specialists in cultural analysis are able to examine this as the sphere in which social relations are produced and reproduced, the sphere in which ideology is effective, and in which hegemony is secured. On the other hand, this 'culturalism' is complemented by recent analyses

which examine the economic infrastructure of mass media. This work concedes the study of social relations to the 'culturalists', contenting itself with the description of ownership and control of the media, the business and economic aspects, which are now devoid of all social relations.

'Economism' and 'culturalism' complement—and moreover necessitate—each other, reflecting just how insidious is the permeation of that strained metaphor into both everyday consciousness and theoretical elaborations. This permeation is effective—or rather subversive—for negative rather than positive reasons. That is, because it precludes an understanding of the social whole and of the central importance of Marx's concept of the relations of production. Unable to respond to 'the relations of production in their totality' (Marx), the metaphor becomes reified, and the attempt to permutate the possible relations between base and superstructure assumes priority. 'That is to say, the analytic categories .. have, almost unnoticed, become substantive descriptions, which then take habitual priority over the *whole social process* to which, as analytic categories, they are attempting to speak'.'

The dynamics of social production are obscured by those concepts which are currently used to theorize the 'superstructure', notably by 'ideology' and 'culture'. Called upon to explain more than they are capable of, these concepts have become transfixed, ossified and ahistorical. They no longer illuminate reality, but rather use the reality itself to substantiate the validity of the concepts. It is precisely such deductivism that has resulted in the relation between theory and historical reality being obscured.[2]

It is essential that we overcome such fixities of concept, for concepts are social constructions; having no claim to exist as definitive entities in their own rights, but serving rather as heuristic instruments for research, they are shaped by their existence in the real historical world. Historical reality is likely to subvert our concepts, demanding in consequence that we constantly reassess, debate and reshape them in order to respond to emerging phenomena. For these reasons it is essential to pose the question of history within theory itself.

Our work on 'information technology' focuses upon emerging phenomena, upon new technologies and industrial configurations, and the social relations they embody. 'Information technology' is decidely not a new recruit to the 'Ideological State Apparatuses' just as it is not a desocialized entity belonging to some

autonomous economic or technological realm. Rather it is a new phase of capital accumulation, situated in a particular historical time, which expresses both the social and economic moments of the relations of production.

Potentially, 'information technology' provides the basis for an upsurge in productivity,[3] but also—and necessarily—for the re-composition of social relations. This will occur through new forms of production, new forms of the labour process, but also through new patterns of consumption resulting from new capital and consumer goods. Satellite communications, video and cable television and information banks will create changes in leisure and work patterns, in processes of human interaction and communications, in aspects of centralization and decentralization, in sensibility and consciousness.

Processes of convergence in communications have already been noted by mass media researchers. Most noteworthy is the work of Armand Mattelart and Herbert Schiller. The latter has boldly observed that 'the mass media, advertising, public relations, market surveys, public opinion polling, and even the school system are inseparable components of a communications apparatus fashioned to accommodate a privatized production and consumption economy'? In a complementary manner, Mattelart has described the integration of the electronics, telecommunications, mass media, space and defence industries: showing how culture can no longer (if it ever could) be treated as an autonomous sphere since the border-lines between political, economic, military and cultural affairs are weakening.6 These indices of convergence, when combined with the technological integration taking place within these sectors, point towards an unprecedented concentration of powers.

Both Schiller and Mattlelart focus primarily on the relation between advanced capitalist communications organizations and the Third World. It is on this international scale, in what has been termed 'cultural imperialism', that the significance of recent developments is perhaps most perceptible. Mattelart himself views these trends as indicators of 'the contours of the ideological offensive by the dominant classes in this stage of international capital accumulation'.'

Today the significance is becoming more clear on the domestic scene. Especially important to the future of advanced capitalist societies are the telecommunications and data processing industries from which have developed so much of the new 'information technology'. The sphere of information processing, storage and distribution has been assigned a priority role in assuring the

dominance of, particularly, American corporations. The likes of GE, IBM, ITT, Xerox, ATT&T, Exxon and RCA have massively invested in the production (and use) of the new technologies. US interests are pursued by Japanese and Western European organizations. These powerful forces present a formidable, perhaps even overwhelming, obstacle to any alternative strategies for change. 'The fusion of economic strength and information control or image-making, public opinion formation or call it what you will, is the new quintessence of power, international and domestic'?

An emphasis on information has gained currency in wide circles. There is much talk nowadays of the 'Information Age', the 'information Revolution'. In recent months, following the 'discovery' of micro-electronics, there has been a new boom in futurology. Once it was grasped that the 'chip' is a device whose function is to hold and act upon information, that these integrated circuits are cheap and capable of application in a whole battery of specific 'information technologies', then forecasts about a new era flourished.

The discussions, predictably, are not posed, in Schiller's terms, as a question of power, but instead are seen as the rise of a new information-based service economy or a future 'wired society' which will provide information on tap. Extravagant claims are made that 'information technology' provides the basis for another industrial revolution, a panacea which will solve political, ecological and Third World industrialization problems.

The academic underpinning for such positions is provided by the tenets of 'post-industrial' theorists, the most significant of whom is Daniel Bell, which suggest that we are living in a 'knowledge society'.[9] Bell's claim, first offered almost a decade ago, that 'if capital and labour are the major structural features of industrial society, information and knowledge are those of the post-industrial society',[10] has been given renewed vigour and edge by developments in 'information technology'.

Misguided by his conservative optimism, Bell ignores the fact that information is now treated as a commodity in the way capital handles the motor car or any other saleable product. At the same time, he seems unaware that 'information technology', used in its present form, while it may extend the quantity of 'knowledge' in circulation, provides no necessarily qualitative improvement, but rather leads to the mechanization of 'knowledge'. It routinizes and downgrades much mental labour. Nevertheless, despite the inadequacies of Bell, his provocative theses have provided a guiding light for many enthusiasts of the future 'Information Age'.

For James Martin, the ideologue of the 'wired society', 'Man will have the opportunity to once again become civilized in a "post-industrial" society."' In this 'satellite age democracy' it will be possible to 'build a world without pollution, without massive destruction of nature's beauty, without human drudgery'.[12] Martha Williams claims that it is now feasible 'to couple information research with high technology to help us to utilize the world's information resources to solve the pressing problems of science and society'.[13] For John McHale we are on the verge of post-industrial society, one based on technologies of a 'Third Industrial Revolution', which are relatively 'non-resource depletive, extremely economical in their energy uses and have correspondingly low impacts on the environment'. In this society there will also exist 'the possibilities of widening participation in decisions and policies through more direct citizen interaction via information systems'.[14]

All this, of course, is based upon a rather naive estimation of 'information technology'—indeed of technology tout *court.* It is reminiscent of the belief in the efficacy of the 'technological fix' so popular in the sixties. On the premise that 'the collection and exchange of information underlies all that we do, and the structures and functions of industrial societies depend absolutely on its prompt and ample supply'[15] it is possible to see quantitative increases in the provision of 'information technology' as a solution to the world's problems. However, such a vision simply overlooks the reality that information is inseparably connected to the distribution of social, economic and political power.

If we may reject the claims made for a post-industrial 'knowledge society' we must nevertheless still seriously examine the issue of information. Bell correctly emphasizes that information today is a strategic resource, that 'post-industrial society is organized around knowledge, for the purpose of social control and the directing of innovation and change'.[16] Irrespective of his misinterpretations, Bell has identified an important phenomenon. His emphasis on the transforming power of the service sector, the number of 'knowledge workers', expenditure on research and development, etc.,[17] is mistaken. Against this, we would argue that the significance of information lies in directions other than those delineated by Daniel Bell, that what is central is the increasing subsumption of knowledge/information under the capital relation, which is facilitated by the new electronic means of storage and distribution. This represents an extension of the separation of mental and manual labour to society as a whole; it is a question of the *form* being

assumed by information as an aspect of the social relations of power.

That information will become an overriding social and political issue is clear from a recent Conservative Party draft policy document which declares that 'Britain needs to profit from information just as one and two centuries ago we created wealth from the agricultural and industrial revolutions'.[18] It continues:

> The battle lines are already being drawn for the struggle to control information in Britain. Government administration, worker collectives, corporations, police and security forces, and foreign corporations and Governments all seek to preserve their own privacy while finding out as much as possible about every one else. Information is the commanding height of tomorrow's economy.

2

We argue, in the following, that apparently disparate technologies —teletext, viewdata, electronic mail, data banks, word processors or cable television—must actually be considered as components of an extensive communications network, as yet only in the early stages of its formation, which is being brought about by the process of integration and convergence referred to above. By its advocates this has been called the 'wired society', a term ,which obscures and neutralizes the social and economic logic of what is a new phase of accumulation, entailing new forms of production and consumption, and a new role for communications in the organization and definition of social relations. This phase will develop through the struggles between IBM, AT&T, Xerox, etc., to define the contours of the new communications system, thereby to control it; and it will develop through struggles between these corporations and those producers and consumers who will have to come to terms with these new technologies. The outcome of these struggles can scarcely be predicted. But they will be intense, for at stake is the establishment of what Daniel Bell appropriately calls an 'infrastructure'.

The Director of the Japan Computer Usage Development Centre has outlined the growth of'information technology' in four stages. A period of innovatory and pure research with space and defence applications (1945-70) was followed by a second, 'management-based stage' (1955-80) in which government and private enterprise seek to rationalize management. In the third, 'society-based stage',

the objectives are to develop the social usages of 'information technology' (e.g., telemedicine, computer-aided learning) (1970-90). Finally, the 'individual-based stage' (1980-2000), sees the installation of home terminals and thereby private applications of the technology.[19] In this article we consider the second and fourth stages, business systems and home systems, as being central. For the purposes of analysis we discuss them separately, beginning with business systems, which have, for obvious reasons, taken off first, laying the infrastructure within which home system<—and indeed the mass media—will be recomposed as parts of a more extensive (mass) communications and information network. It must be borne in mind, of course, that the technological and chronological precedence of business systems is by no means absolute, that home and business systems increasingly influence one another, as they, increasingly, seem to be fusing into a single network.

It is also important to stress two further points both of which we lack the space to develop here.[20] First, it must be emphasized that these new technologies have a history. Secondly, these origins are integrally related to the history of micro-electronics, which is the enabling technology for recent developments.[21]

Business Systems

This section begins by looking at some of the central business services and products being developed. The discussion will be followed by a survey of the struggles being waged by rival corporations to develop and gain acceptance for their own information systems.

Business services will primarily consist of computer/communication systems which use a range of telecommunications equipment (cable, satellite, microwave, etc.) and a range of computer time and equipment sharing techniques in order to provide services to customers relating to information, data processing and, of increasing importance, text handling. In the words of a Department of Industry report,

> the running of even a moderately industrialized economy requires the collection, storing, retrieving, processing and generally moving around of a great variety of information, numerical or otherwise, often in large volumes and often very quickly. The computer makes the first four of these activities possible on a scale which was unthinkable a generation ago … The telecommunications system makes the transportation of information possible on the scale required …[22]

Among such services offered by 'information utilities' are time-shared remote computing, computer-aided learning, message delivery, information retrieval from remote data bases, and funds transfers.[23]

The Automated Office

Central to the economic development of 'information technology' is the office, which, it is projected, will evolve on the basis of new developments in micro-electronics towards the 'paperless' or 'automated' office. The rationale for automation of the office lies in the attempt to increase productivity in this sector which is characterized by high labour-intensity in handling huge volumes of information. This 'economic' goal is inseparable from the 'social' question of control over work and the Labour process in offices. That this is a strategic market, and potentially a lucrative one, is made clear by the prominence of such corporations as Philips, 3M, Burroughs, Eastman Kodak, Exxon[24], IBM and Xerox—with the latter two having already fully developed strategies for the 'office of the future'. In Britain GEC has recently acquired the American office equipment manufacturer, A. B. Dick, and the NEB has now formed Nexos Office Systems in order to attack the integrated office system market.

At present the main component and cornerstone of office automation is the word processor (WP), by which is meant electronic equipment for the preparation, editing, storage and retrieval of text. WP equipment exists in various degrees of complexity, the simplest being merely an electric typewriter with a magnetic storage device (e.g., the IBM 'selectric' typewriter), which allows the operator to correct, add, delete and modify information electronically without erasing it. This is, and will remain for some time, the most prevalent form of WP precisely because it bestows greater 'efficiency' upon secretarial and typing work.

More complex WP systems are computer-based, being either 'stand alone' (mini-computer) devices or connected to in-house or remote mainframe computers. The more sophisticated machines have a visual display unit (VDU) for text entry and editing, increased memory capacity, a micro-processor unit for more elaborate editing facilities, and a high speed printer for producing hard copies.[25] It is only when WPs have access to large memories and when they have communications capabilities that their full potential is realized; they become then the basis for electronic memos and files, and for an alternative inter-office message system (i.e.,

electronic mail). When WPs are linked to each other and to computers by means of a telecommunications system they become true communicating word processors (CWPs).[26] They cease to be elaborate typewriters and become computer terminals within a complete office automation system.[27]

As yet CWPs have not been developed systematically, and even in the United States less than 10 per cent of WPs have communicating facilities. However, it is evident that the evolution of text processing systems into communication networks is only a matter of time. Many PTTs are exploring an advanced text-communication service, named Teletex, which is designed to supersede telex and integrate with developments in CWPs. Already West Germany and Sweden are planning CWP (or Teletex) networks'under PTT auspices.[28] And the CCITT, the international standards organization for telephony and telegraphy, is attempting to establish standards for a Teletex system that will allow the message and data facilities of CWPs to operate over public data networks.[29]

Electronic *Mail*

CWPs clearly provide one strong basis for an electronic mail service (EMS), but the term in fact refers to a much broader range of electronic message communications. The most common at present is facsimile transmission, which, along with enhanced telex, forms an intermediate step towards true electronic mail, i.e., computer to computer communications. The British Post Office is now planning to lease facsimile machines, whilst the French government has made a much more positive commitment to facsimile. The US Postal Service is negotiating with several European PTTs over the possibility of introducing an international facsimile service called Intelpost, whilst within the United States it is planning a more advanced service, Electronic Computer-Originated Mail (ECOM), in which 'letters' are electronically generated and transmitted to a destination post office, where they are converted to hard copy and delivered.[30]

True EMSs—those which operate an end to end electronic service—have their origin in message dialogues between experienced users of data communications networks such as the Arpanet system. Such systems, which remain internal to one particular network, have, however, also been made available by Tymshare, with its On Tyme message-switching service, and by the Telenet data network with a similar service. It is the establishment of data networks that in fact offers an infrastructure for EMSs, and the Post Office's

decision to go ahead with its public packet-switched data service (PSS) is a step in the direction of computer mail. The logical extension comes when this is the infrastructure not only for CWPs, but also for Prestel terminals, in which case electronic mail can be directed straight to the home.

As yet EMSs are in their embryonic stages, though it has been estimated that computer mail should be cost competitive with postage by the mid 1980s. A report by Communications Studies and Planning, and Mackintosh Consultants, claims that annual EMS sales will rise from $180 million in 1978 to $1100 million in 1987 in Europe, and during the same period in the United States from $350 million to $1400 million.

Electronic *Funds* Transfers

(EFT) refers to the electronic implementation of financial transactions, or, as James Martin puts it, 'EFT recognises that money is merely a form of information.'[31] Martin goes on to delineate four types of EFT, 'representing successive steps towards an EFT society'. The first involves transfers of money between banks, and is by far the most common. Examples of this are the Bank Wire II network in the United States, which transmits funds transfer messages, miscellaneous reimbursement messages and administrative messages, and, on the international level, the SWIFT network.[32] The latter leases private communication lines to offer high speed transmission of money, messages and bank statements between banks in North America and Western Europe. One obvious advantage of such systems, beyond the reduction of paper work, is that they speed up the circulation of money, such 'high velocity money' making it possible to utilize capital that would otherwise be idle.[33]

Martin's second type of EFT refers to transfers between the computers of other corporations and bank computers, whilst the third describes banking terminals for cash dispensing. The fourth type, least developed but potentially of greatest significance, is the electronic point of sale (POS) terminal, which would allow customers in shops and restaurants to directly debit their accounts in payment for goods.[34] A logical consequence of this would be the use of domestic Prestel terminals for the same purpose.

Data Banks, remotely accessed via telecommunications links, are now becoming major elements within communications networks. The first commercial applications were those providing rapidly changing information of value to business, such as rail and airline reservation systems and stock market quotation services. Through initiatives by

governments and large corporations, applications are extending inexorably to such specialized forms of information as credit reports, market research information, legal and medical files, health and demographic information, police records, etc.[35]

It is at this corporate level that one can see the power invested in the organization of and access to information—for this information, important because of the commercial and political uses to which it may be put, is treated as proprietary and sold only to those with large resources, i.e., business, governments and scientific establishments.[36] The inaccessibility of such information has created what is becoming a major political issue. The readiness of large corporations to violate 'data privacy' and their ability to convey information across national borders[37] led Sweden, for example, to pass a Data Act (1973) to control the export of data files. This example has been followed by eighteen more countries. Such electronically conveyed information is, of course, extremely difficult to monitor.

A second kind of data bank is that which 'helps a scientist, technician, administrator, librarian, information specialist or other intermediary locate information rapidly and precisely ...'[38], namely that which stores bibliographical and scientific-technical academic information. It is this kind of system that has been used to generate the ideology of free and unbounded access to information for all scholars. The 'on-line information revolution' began in the United States in the early seventies, reaching Britain in 1976 when American systems were relayed via international networks such as Telenet and Tymnet. Most of the world's fifteen or so major on-line retrieval services are in fact situated in the US, the pre-eminent ones being Lockheed Information Systems and Systems Development Corporation (SDC).[39]

In view of the European dependence on American telecommunications, computers and data bases (with about 100 available on the major systems) the Council of Ministers of the Commission of the European communities initiated in 1975 an action plan to establish a data transmission network providing access to databanks within the EEC. The packet-switched data network, now called Euronet, and the array of data banks, designated DIANE, are due to commence operations in late 1979, providing what has been called 'a common market in the field of scientific, technical, economic, legal and social information'.[40]

The two kinds of data bank referred to so far are aimed at the commercial and government markets, but there is a third kind, the data bank accessed to a domestic viewdata terminal (see below)

which is oriented towards the private consumer. Such a system will offer less sensitive information, being primarily concerned with forms of electronic publishing and with advertising and sales functions. Such is the disparity between Departments I and II of the economy.

The services we have described—and those to be discussed in the following section—are transmitted through various telecommunication channels, most notably telephone cables, co-axial cables, microwave radio, communication satellite channels and optical fibres. These channels could coexist and reinforce one another, but are in fact becoming the vehicles in a struggle between the giant electronics corporations for control of the 'information infrastructure'. It is the American experience that shows most dramatically the way in which the communications aspect has come to the fore in the struggle to capitalize on 'information technology'. Competition has become acute in the 1970s with the arrival of new kinds of common carrier in competition with the telephone companies (i.e., mainly AT&T). In August 1969, the US Federal Communications Commission (FCC) allowed Microwave Communications Inc. (MCI) to set up a public microwave system between St Louis and Chicago, a system which soon extended nationwide. And the now defunct Datran was also permitted to develop a microwave data communications system. In 1972 the FCC initiated its 'open skies' policy, authorizing common carriers to construct and operate satellite systems for domestic telecommunic~tions. At present, there are five satellite carriers: the American Satellite Corporation, RCA Americom, SBS, Comsat General, and Western Union.

In the United States, James Martin distinguishes five different kinds of organization providing data networks.

1. Established Telephone Administrations—an example being AT&T's Dataphone Digital Service (DDS), which was developed as a result of competitive 'innovations by specialized common carriers;
2. Specialized Common Carriers (e.g., MCI, Datran, the satellite companies);
3. Value-Added Common Carriers (VACCs), which add computers to existing links in order to enhance the services which can be offered to end users (e.g., Telenet, Tymnet, Graphnet);
4. Private corporations;
5. Service corporations (e.g., SWIFT).[42]

Since the importance of the last two has already been made clear we

shall here concentrate on the first three types, where the battle to establish a public data network architecture is being waged.

This struggle took off in 1968 when the regulatory climate began to favour competition and thereby to open up the question of whether data communications would operate through the telephone network or through a separate infrastructure. During this period there has been a continuous erosion of AT&T's monopoly position over the phone system, initiated by the 1968 Carterfone decision which permitted the connection of terminal equipment to AT&T's lines.[43] Also of significance were the above mentioned decisions to allow specialized common carriers to compete with the phone company.

The major protagonists in the data communications war are AT&T and IBM, with Xerox, ITT and the VACCs playing important supporting roles. Standing at the frontier where telecommunications and data processing meet, IBM and AT&T are now preparing to invade each other's hitherto sacrosanct territory and defend their own. AT&T is trying to enter the data processing business, and to keep all but carriers out of the telecommunications field, whilst IBM feels the need to ensure that its products have a communications link on which to operate and thereby guarantee the viability of its planned 'office of the future'.[44]

AT&T launched a major assault in July 1978 when it announced a projected Advanced Communications Service (ACS), still in the planning stage, but intended to provide for a shared data communications network, the interfacing of incompatible terminals and computers, various data communications' facilities, and overall maintenance and management of the network. This would create a national communications facility on the same scale and model as the phone service, giving also the possibility of text transmission, electronic mail and electronic office functions. Through its system, which uses relatively standard techniques and aims at a large marketplace, AT&T is seeking to take network protocols and architecture out of the hands of computer vendors and put them into the telecommunications network.[45]

The major obstacle in AT&T's way is that as a common carrier it is precluded by law from providing data processing services. AT&T is arguing that its system does not qualify as data processing because the substantive content of messages is unchanged. But clearly AT&T—forced into a defensive position within its own telecommunications sphere and involved in massive anti-trust legislation—is taking the offensive. As IBM's Lewis Branscomb has

observed, ACS 'moves far down the path toward the offering of data processing services by a monopoly carrier'.[46] In so doing it is clearly on a collision course with IBM. A recent commentator has noted that ACS 'marks the long-awaited declaration of commercial war between IBM and Bell IBM recognizes the challenge and sees itself as able to respond across the board—in computing, in telecommunications, and in office automation'.[47]

IBM's response has been to enter the satellite communication market through the formation of Satellite Business Systems (SBS) which it jointly owns with Comsat General and Aetna Casualty and Surety Co. Facing competition in its traditional market, IBM is eager to get into new businesses and aims through SBS to provide a communications service for the few hundred large US corporations and government departments with high data transmission rates and dedicated satellites. SBS is due to be launched in the 1980s and will offer such services as teleconferencing, inter-computer communications and high-speed facsimile transmission. The major obstacle for SBS is, however, the same as for ACS—legislation.[48]

In November 1978 Xerox launched its challenge when it disclosed plans for a data communications network, to be available in the early 1980s, which would use leased satellite capacity combined with local microwave radio links. The service, named Xten,[49] will provide document distribution, data communications and teleconferencing facilities. This system, which represents a diversification away from Xerox's traditional business and a move towards the 'office of the future', is aimed, like ACS, at a broad market, but will operate with high speed transmission like SBS.

Finally, it is important to keep in mind the challenge from the VACCs, such as Tymnet and Telenet, which provide enhanced services through the existing telephone network. Significantly, Telenet has recently been merged with General Telephone and Electronics Corp. (GTE) in order to strengthen its hand in the oncoming struggle with ACS, SBS and Xten.

The example of the United States provides, then, an indication of the real struggles and upheavals, only now beginning to take shape, which underpin the convergence of computers and telecommunications. In Britain developments have been more muted, largely due to the monopoly position and legislative powers of 'the most important single business in Britain'[50], the Post Office. There is, however, a strong lobby aimed at relaxing the Post Office monopoly, notably from the Conservative Party which wants to permit 'the establishment of "value added services" on lines leased from the Post

Office by private companies'—such services would include facsimile, teleconferencing and message collection and distribution.[30] What is certain, though, is that in Britain and the US the development of electronic business systems is on the agenda, and that this development will be structured and guided by corporate rather than democratic processes. It is in this context of the ongoing convergence of telecommunications and computers that we must now look at domestic systems.

Domestzc Information Systems

The invasion of the consumer electronics field by 'information technology' is still at an early and tentative stage. However, just as computing and telecommunications are converging with various types of office equipment to form business systems, so too are they converging with domestic electronics equipment to create 'home entertainment systems' which will incorporate television, video equipment, home computers, television games, teletext and viewdata. As yet these two types of system are distinct, but it is seemingly inevitable that they will tend increasingly to integrate, with the manufacture of consumer systems being one division within an integral 'intelligent' electronics (i.e., computer/communications) industry. The extent to which this happens rests on the outcome of the impending struggles between existing consumer electronics companies, particularly television manufacturers and other sectors of the electronics industry which are seeking to penetrate the lucrative consumer markets—notably computer, (micro-)electronics components and telecommunications interests.

Just as the pivot for the electronic office will be the (communicating) word processor, so that for the 'electronic home' will be the television set, enhanced to become a 'video entertainment centre' and, eventually, a form of computer terminal. The whole strategy for bringing 'information technology' into the home is premised on the fact that television sets are already installed in most households. It has been estimated that 97 per cent of British homes have televisions, that there are some 24 million sets currently installed, of which two-thirds are colour, and that there will be about 80 per cent colour television penetration by the early 1980s.[31] Because even the market for colour sets is approaching saturation, and because sales have been in decline since 1975, television manufacturers have been trying to find ways to enhance television sets. As the first generation of colour sets, bought in the early seventies, comes up for replace-

ment, customers are now being offered additional features such as teletext and remote control.

But is is not just the television manufacturing industry that is aiming to amplify the capabilities of the television set. Microelectronics component manufacturers see television as the basis for developments that will supersede the pocket calculator and digital watch markets—video games and teletext decoders being obvious applications for 'chip' technology. The Post Office is aiming to extend its telecommunications services by using the television console as a computer terminal. Teletext services provide the foundation for using television as a channel for 'electronic publishing'. It has been said that 'in its forty year history, the role of the domestic television receiver has not changed at all. Its sole function is to show programmes distributed from a central point for mass consumption ... essentially television is as it was when the BBC first started broadcasting from Alexandra Palace.'[32] The development of viewdata, video equipment and new cable television services is bringing this phase in the history of television to a close.

In our view the key element for initiating a new phase will be the viewdata service, transforming the TV set into a computer terminal linked to a very extensive data network, and becoming increasingly the centre around which other new products and services will cohere. Important in this context is the fact that it is viewdata that will form a bridge between business and domestic information systems. We have already suggested that electronic message services, EFT and data banks find their domestic extension with the viewdata terminal. The implications of this are that the 'viewdata terminal of the future will not be an adapted television set but an "all-purpose" computer terminal linked to the user's own network for word processing and the like, and possibly also to international data networks'.[33]

Of the other products that we discuss, personal computers will absorb video games, and then probably enter into competition with viewdata systems, which will be seeking to fulfil a similar function. The extent to which they will compete—or even become integrated—remains uncertain. Cable television is significant in so far as particular developments in the United States, where telephone companies are legally barred from providing data processing services, show that cable may well provide an alternative transmission channel to telephone wires for a viewdata service. Finally, we see video equipment as augmenting the traditional role of television as an entertainment medium, but also, through the dense

information storage capacity of the video disc, developing into an alternative medium for the dissemination of information. The extent to which all these new products coexist or compete with each other rests on many variables. We can be sure, though, that television is being restructured as an aspect of 'information technology'. As a Philips representative has commented: 'We're on the edge of an information explosion which is going to give a big boost to the electronics industry, because' audio and TV will have to become part of the home information system.'[54] Such systems aim to provide a range of information and entertainment services that will intensify media consumption.

Viewdata and Teletext

There are three major channels for dissemination of electronic information. The first is the use of wide-band cables, such as is used by cable television services, and we discuss this below. A second method is that of narrow-band broadcasting, usually called teletext, in which graphic and textual information is inserted into the spare lines of broadcast television signals. An early version of this was the RCA Home Facsimile System, developed in the mid 1960s, which broadcast data in a television signal for hard-copy reproduction by an electrostatic printer associated with a TV receiver. More recently the BBC and IBA have introduced full teletext services, called Ceefax and Oracle respectively, which transmit digitally encoded information to be picked up by a special decoder in the television set, stored in an electronic memory, and generated as words and symbols on the screen. The success of establishing teletext as a full public service rests on the early agreement between the BBC and the IBA to unify teletext standards, and upon the willingness of set manufacturers to develop silicon chip decoders. Although in early 1978 there were only 8000 teletext sets in operation, it is estimated that by 1985 7 million households will receive the teletext service.[55] Further success will depend upon such innovations as a printer for copying teletext pages, and the development of 'telesoftware', by which is meant the capability to broadcast computer programmes to a receiver modified to function as a domestic computer.[56]

Teletext, however, does have limitations, the most important of which are that the number of 'pages' of information that it can broadcast is restricted and that it is only a 'one-way' service with no facility for interaction with the information bank. Such limitations do not apply to the third kind of channel for data dissemination, the narrow-band cable system, known as videotex or viewdata, which

uses the telephone cable network to allow an interactive service. Besides allowing a more sophisticated use of a central data bank, viewdata also permits such extra 'active' functions as message transmission and EFT services. As such it threatens to make teletext redundant.[57]

The first and best know viewdata system is that pioneered by the British Post Office and now registered as Prestel. It was inaugurated as an experimental system in September 1975, and opened as a public service in London in March 1979. The Post Office has now spent £17 million on development, and plans to spend another £18 million over the next two years. Prestel, which was designed to be compatible with teletext protocols, is intended to be cheap, standardized and easy to operate.[58] Information for Prestel's data bank is supplied by independent 'information producers', ranging from educational institutions to retail companies, and from news media to charity organizations, for whom the Post Office acts as a common carrier. Unlike teletext, there is no technical limit to the amount of data Prestel can handle, and even at this early stage its present 163 competing suppliers of information are providing 122,000 'pages'.[59]

As yet Prestel has not taken off in any big way, with sets still costing £1200, and there are only an estimated 1000 viewdata sets installed. Mackintosh consultants calculate that there will be about 300,000 installations by 1985, but stress that viewdata is a product for the 1990s rather than the 1980s.[60] The main objective for the Post Office at present is to gain international acceptance for Prestel, both by selling it abroad—which it has done in Germany, Holland, Hong Kong and Switzerland—and by having it accepted as the international standard for viewdata equipment. Already other countries are developing similar systems, notably Canada, France, West Germany, Japan and Sweden. The French system, Antiope, represents a particular threat to Prestel, in that it combines teletext and viewdata into one system and could also integrate easily with business systems such as CWPs and the data bases to be linked by Euronet.[61]

The flexibility and potential of viewdata is illustrated by the variety of services it will provide. The major function is to provide information (topical, reference, professional, commercial, etc.) which, because Prestel is interactive, can be tailored to the particular needs of individual users. Secondly, viewdata is a message communication medium. Although at present the message service is rudimentary, it could provide the basis for an electronic mail service between subscribers. Thirdly, it can provide the basis for domestic

EFT services, allowing users to make purchases of goods sold through viewdata networks. A fourth possibility is that the viewdata computers could be used for providing a calculations service—although the development of 'telesoftware' is a more likely prospect. A UK firm called CAP has produced a form of computer software that can be transmitted down telephone lines and stored in suitably adapted Prestel receivers. This endows the Prestel terminal with 'intelligence', turning it into a personal computer.[62]

Although Prestel was originally aimed at the general public it would seem that its emphasis has now shifted to the commercial environment. It would seem that its business applications will lead increasingly to its incorporation into business information networks. Recently the Post Office waived the rule that only TV receivers could link with Prestel; in consequence firms other than television manufacturers can make equipment for the viewdata system. Now electronics firms are also manufacturing private viewdata systems specifically for the business market—Philips has already produced a system, and Pye, STC and GEC are working on such equipment. It seems probable that computing and telecommunications interests will see viewdata as a profitable field for investment, and that initially the business market will be the target for exploitation.

Video Games and Personal Computers

The progress of video games reflects the rapid changes in micro-electronics technology in the 1970s. The first consumer video games were marketed (by Magnavox) in the United States in 1972. By 1975 the development of special purpose integrated circuits made possible the incorporation of several games into one package. We have now reached the third generation of games, which are based on micro-processors (i.e., very small computers), and can be programmed to play many different games by inserting 'software' packages. The success of video games is illustrated by the rise in UK sales from 95,000 in 1976 to 625,000 units in 1978, with programmable games taking a growing market share.[63]

What is most important in the context of this article is the fact that the upmarket video game is becoming indistinguishable from the personal computer. Commodore's PET home computer, for example, is based on a micro-processor similar to that used in Fairchild's video games unit. Personal computers, first marketed in March 1975, represent the replacement market not only for electronic games but also for pocket calculators. Launched initially as enhanced video games, the personal computer will be aimed not

only at the domestic market, but increasingly at the business and professional sector. In 1978 250,000 were sold and this figure is expected to rise to 500,000 in 1979. Given such an expanding market it is not surprising that companies like Hewlett-Packard, Sharp, Siemens, Texas Instruments and Toshiba are establishing their positions, whilst General Electric, IBM and RCA have plans to enter the field.[64]

In the attempt to bring 'information technology' into the home, personal computers present a serious rival to viewdata systems (particularly in America). Developments are under way to link them to television screens and to provide them with communications facilities. The FCC, indeed, intends to encourage the use of personal computer networks for electronic mail services. As viewdata systems and personal computer networks come to look increasingly alike,[65] we can be sure that there will be a long period of conflict in which each will attempt to assert its supremacy in the single long-term market for which both are competing.

Cable Television

James Martin has said that 'few media have a greater potential for changing the culture of a society than the co-axial cables being laid into homes by the cable television companies'.[66] Since the early 1950s, when cable television was first developed in areas with poor broadcast reception, ambitious claims have often been made for its potential. Here we are restricted to looking at cable television only in so far as it converges with developments in 'information technology'. What is so important about the co-axial cables used in wired television is their enormous information-carrying capacity. This permits not only many extra programme channels (currently up to thirty with more to become available with improvements introduced by optical fibre cables), but also additional services such as telephone and viewphone facilities, meter reading, electronic mail delivery, fire detection alarms, and access to computers.[67] The nature of the cable, as opposed to broadcasting, also allows it to operate in both directions, and thus to provide an interactive service. It is such versatility that gives cable an undisputed long term potential, and, moreover, makes it a rival to viewdata.

This applies particularly to the United States, which has some 4000 cable systems reaching over 13 million homes. Since 1968, when regulatory restrictions on cable TV began to be lifted, there have been indicatons that some of cable's potential, including a viewdata service, may well be fulfilled. This would, of course, be in

the hands of the large conglomerates now controlling cable systems. The most developed example, which also highlights the corporate aspect of cable, is the Warner Communications' QUBE system located in Columbus, Ohio. This system provides thirty channels: ten television stations, ten pay-TV channels and ten 'community channels' providing local programmes and text information. The subscriber is provided with a hand-held control unit with which he is able to select programmes for which he pays at differential rates. His request is processed by one of four computers, which also prepares a monthly bill. QUBE also allows viewers to 'talk back' to the studio by pushing buttons on their control units—in this way they can vote on programmes or make bids in televised auctions. In addition to this pseudo-participation, Warners are planning to add such facilities as fire and burglar alarms linked from subscribers' houses to the central computers.[68]

What such a system could become is foreshadowed in the Osaka suburb of Higashi-Ikoma, where a cable system using fibre optic cables has a camera and microphone installed in subscribers' homes to permit 'true' two-way television. This project is in fact a test-bed for the 'wired city', and is actively supported by such companies as Matsushita, Fujitsu, Toshiba, and by the Ministry of International Trade and Industry. Additional services, for instance electronic text transfers, will be added by the 1990s.[69] Another project, begun as early as 1972 at Tama, a satellite town of Tokyo, uses co-axial cables to offer subscribers reception of video programmes, computer-aided learning, data retrieval, seat reservation, tele-metering, facsimile and other services.[70]

Video

Cable and video are the most recent entertainment media, and as such, will be components in the evolving domestic information/entertainment systems. Although they may come to coexist, they are in many ways rivals in the attempt to bypass broadcasting and supply commercial entertainment to television owners. Video may well have the edge in that its means of dissemination is especially simple and requires no expensive infrastructure. This is both the strength and weakness of video. Lacking any need for a foundation on a telecommunications network (though utilizable within one) it is operable without massive capital investment. At the same time, precisely because it does not possess this telecommunications element probably limits its long-term role in an area where the latter is a critical prerequisite for the integration which will

allow the production of comprehensive systems for the home.

Despite this, video is currently taking off rapidly. Video tape/cassette recorders are at present being extensively marketed as a logical complement to the television. These extensions of traditional T V are limited in what they offer. They allow chiefly the manipulation of viewers' time along with the opportunity to purchase pre-packaged video materials (e.g., golf tuition, soft pornography).[71] As such, they are of less significance than the more versatile video disc.

Throughout the 1970s there have been attempts to develop and market a videodisc. Except for the unsuccessful Telefunken-Decca (TelDec) disc launched prematurely in 1975, the first commercially viable disc first went on sale in Atlanta, Georgia in December 1978. This Philips MCA disc may well come into fierce competition with any of the forty or so discs now being developed world-wide.[72] Because these videodiscs all have different systems and standards, and are therefore incompatible with each other, a race is now on to establish a product that will become the industry standard. That the stakes are high[73] is testified by the presence in the field of such major corporations as Philips, RCA, Sony, Thomson-CSF, JVC and Mitsubishi.

There are several important points to be made about the videodisc. The first is that is is a significant new entertainment medium. It will be a cheap complement to the L P record: currently a disc version of Jaws costs as little as £7. The second, and more important, point is that the disc is also an instrument for publishing and information storage. The Philips optical-laser videodisc is able to provide a freeze-frame facility with, at present, the capacity for 54,000 still frames. This means that it could develop as an electronic book. The production of cheap throwaway discs could make it an electronic form of journalism and advertising.[74] Moreover, this dense information storage capacity makes the disc a very promising information medium. IBM and Xerox, for example, are reported to be working on videodisc systems, probably for the purpose of storing commercial and industrial data.[75] Already the US Department of Defence is making use of the Philips/MCA disc for purposes of information collection.[76]

The videodisc is thus more than an entertainment medium. Potentially it is a new communications medium. As such it stands alongside viewdata, personal computers and cable television as one of the new media which are competing in the race to produce domestic information/entertainment systems. While it may lack the long-term potential of other technologies which draw more on telecommunications and computing facilities the videodisc is a

powerful medium. The prospect of its eventual integration into home information systems, wherein it will serve as a video library, is real.

3

> Machinery is accomplishing in the world what man has failed to do by preaching, propaganda, or the written word.
>
> Henry Ford

This article has deliberately taken a broad and sweeping perspective in order to point to the convergence and integration of what might otherwise be taken for disparate products. It has tried to interpret the significance of developments in 'information technology' in a way that is opposed to the idealism of futurists and post-industrialists who seem oblivious to the real relations of power underpinning their 'information age'. We can agree with these thinkers that information is becoming an increasingly important phenomenon: but there will be no society ***based*** on information. Analyses which suggest such a scenario do so only by overlooking the practical social contexts from and in which information is produced and situated.

On the other hand, it is our belief that these newly emerging phenomena cannot be adequately thought out if it is assumed that they can be pigeon-holed in different 'levels' of the 'social formation'. Are business information systems a part of the 'economic' level, while domestic systems belong to some 'ideological' (or 'cultural') sphere? What in the past has been called base and superstructure are now tightly interwoven, an organic unity. To define, a *priori*, 'culture' and 'economy' as external to each other, to assume the structural autonomy of culture, is to close one's theory to a reality that is subverting it.

Recent developments in 'information technology' need to be historicized, that is, put into social and historical context. What is especially important is that, although they have a complex prehistory, it is now, in the period of crisis and recession of the 1970s, that they are really beginning to take shape. In our view this is primarily because 'information technology', and more generally the micro-electronics technology on which it is based, represents a possible solution to the present crisis. Potentially 'information technology' could provide a foundation for a new cycle of production, a new phase of accumulation. Moreover, it is by theorizing

'information technology' in relation to this process of accumulation that one is able to situate it in a substantive context. Thereby it becomes an integral component of a real social process which is the history of capital, rather than being related to some abstraction called the 'economic' or 'capitalism'.

'Information technology' will play a central role in generating a new cycle of capital and consumer goods. But this process cannot be taken to be merely an 'economic' activity. Accumulation is a 'real life process' which expresses all social relations (those of both work and of leisure). It is that 'organic set of social relations whose evolution is the condition for perpetuating the wage relation'.[77] It embraces the labour process (ways of working, structures of authority, etc.). the kinds of consumption it requires (in recent years most obviously in the form of mass consumption), and the social relations and lifestyles that support it. Aglietta has stressed that Fordism—the phase of accumulation now in crisis—cannot be regarded as merely a technical form of the labour process, but it is in fact 'an articulation between process of production and mode of consumption'.[78] This is of course to take up the insights of Gramsci on *Americanism and Fordism*. Gramsci recognized that accumulation is a total social process, arguing that if Fordism is to be established, then 'a long process is needed .. during which a change must take place in social conditions and in the way of life and habits of individuals'.[79] The history of accumulation is not an economic record, but the history of a whole series of social changes.

It is not by chance that we mention here the name of Henry Ford. For the phase of accumulation that is presently taking shape will supersede, yet extend and elaborate, that initiated by Fordism. That is, against those post-industrialists who argue that 'information technology' marks the end of a certain kind of society, we see it as actually a continuation of capitalist organization. In particular it extends and refines the Fordist variant. Central to this continuity with Fordism is the question of machinery, by which is meant 'the historical reshaping of the traditional, inherited means of labour into a form adequate to capital'.[80] Machinery, especially since the days of Fordism and increasingly today, is the means of mediating the social relations of production.

As we have said, technology which adopts micro-electronic devices will provide a major contribution to a new phase of accumulation. The reason for this is that it is a 'heartland' technology which will give 'leverage' to almost all industrial sectors.[81] A central part in any attempt to restructure production

will be played by 'information technology'. The latter is axiomatic for many reasons. One factor is that it constitutes a massive potential market for suppliers of 'information technology', recent estimates predicting as much as a 30 per cent annual growth in sales for particular products.[82] Also very important will be the ability of 'information technology' to introduce mechanization into areas that have not previously been characterized by automation. Technological 'efficiency' introduced into offices, libraries, government and administration will necessarily incur similar sorts of reorganization, deskilling, routinization, rationalization, and alienation that have become a feature of productive industries such as manufacturing.

Above all, perhaps, the integration of computers and telecommunications at the heart of 'information technology' will extend and intensify the already advanced separation of mental and manual labour. If Taylor attempted the 'deliberate gathering in on the part of those on the management's side of all the great mass of traditional knowledge which in the past has been in the heads of the workmen ...'[83]; and if Henry Ford refined this principle by investing machinery, rather than managers, with this knowledge; then we may say of 'information technology' that it will carry this principle to new sectors of industry and administration. And we can even go further, to suggest that potentially 'information technology' is tending towards the imposition of a similar principle beyond the limits of the factory and office and on to the scale of society as a whole. That is, we can perhaps say that we are moving towards a situation in which 'general social knowledge' is being absorbed into the machinery of 'information technology'. As we witness the enroachment of the control culture, government information and private data banks on to an increasingly observed public we are perhaps experiencing a shift to 'rationalized' practices far beyond the workplace.

We have shown that 'information technology' will also develop in the domestic sector. Products originating as enhancements of the television will provide a new generation of electronics consumer durables, facilitating an extension and intensification of media consumption. Inevitably these products will provide electronic channels into the home for advertising, consumer information, electronic selling and electronic publishing. On this basis the speed and efficiency with which commodities and capital circulate will be increased. And so too will domestic information/entertainment systems extend that 'mobile privatization' that, for Raymond Williams, characterizes the present broadcasting media. The roseate

picture of the consumer participating in politics, education, etc., from the comfort of his living room ought not deflect us from the fact that this 'interaction' will take place in a context which forms part of a growing privatization of life, Moreover, this process itself must be gauged against the increasing centralization of information ushered in by the organizations and interests which are developing and exploiting 'information technologies'.

Domestic and business information systems will tend to converge. It is clear that such convergence will develop under the dominance of business systems, which will assimilate consumer systems (e.g., Prestel) and extend their own networks (e.g., EFT, electronic mail) in so far as it is to their advantage. This convergence will do little to break down the separation of, on the one hand, increasingly centralized private and governemt data networks handling 'sensitive' and 'valuable' police, military, or business information, and, on the other hand, publicly accessible networks which handle commercial and comparatively less important information.

Finally, it is worth emphasizing that the success of 'information technology' as a resolution for the current crisis is not assured. It will depend on a number of factors, not least capital's ability to co-ordinate the possibilities for developing productivity and strengthening control over social relations. IBM for one acknowledges that the successful implementation of this technology is not guaranteed. They not only have to contend with fierce competitors, but also—and in the long term much more problematical—with an unpredictable public which can be awkward in matters of social control.

Recognizing this, IBM have started offering history lessons. Anticipating and addressing suspicions and fears felt about the introduction of 'information technology' a recent advertisement tells us that 'Between the years 1811 and 1816, a band of textile workers had just the answer to the threat of technology. They literally threw spanners in the works.' We are told that 'the action of the Luddites carries a very instructive lesson' as regards recent technological innovation.

Such a public relations campaign undermines opposition (and potential opposition) by asserting that the choice is a stark one between an unconstructive dismissal of invention or acceptance of 'progress'. Defining this 'progress' IBM distorts both past and present: the vista becomes one of neutral technology, inevitable advance, harmony ... In short, no choice at all. A first step in opposition is to lay bare the real interests which are disguised by the

rhetorics of 'progress'. Our article, we hope, has added to the analyses which probe the rationales behind the introduction of 'information technology'. Much more difficult will be the transition from theoretical accounts to practical encounters with the new technologies in everyday situations.

NOTES

1. R. Williams, *Marxism and Literature.* OUP, 1977, p. 80-81. (our emphasis).
2. It is to Raymond Williams and E. P. Thompson especially that we are indebted for historicizing Marxist concepts, providing a basis for by-passing sterile debates which merely polish and refine abstract concepts.
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4. H. I. Schiller, 'Authentic National Development versus the Free Flow of Information and the New Communications Technology' in *Communications Technology and Social Policy,* [G. Gerbner et al (eds.)] New York, Wiley-Interscience, 1973, p. 475.
5. A. Mattelart, *Multinationalinales et systèms de communication,* Paris, Anthropos, 1976.
6. A. Mattelart, 'Cultural Imperialism in the Multinationals' Age,' *Instant Research on Peace and Violence,* 6, 4, 1976, p. 160.
7. Mattelart, *Multinationales ...* p. 2; 'the strategy that the dominant classes have adopted to thwart popular movements', A. Mattelart. 'Les appareils idéologiques de L' "Etat multinational" ', *Politique Aujourd-'hui,* January-February, 1975, p. 65.
8. H. I. Schiller, *Mass Media and American Empire,* New York, Augustus M. Kelley, 1969, p. 1 cf. H. I. Schiller. 'Computer Systems: Power for Whom and for What?' *Journal of Communication,* 28, 4, Autumn, 1978.
9. 'the new role ascribed to knowledge is the culminating and convergent point of all post-industrial theorists', K. Kumar, *Prophecy and Progress: The Sociology of Industrial and Post-Industrial Society.* Allen Lane, 1978, p. 221.
10. D. Bell, 'The Coming of Post-Industrial Society; *Dialogue,* 11, 2, 1978, p. 4. Daniel Bell has updated his thesis to take account of new technologies. See: 'Teletext and Technology', *Encounter,* (XLVIII), June 1977, p. 9-29. 'Communications Technology—for better or for worse?', *Harvard Business Review,* May-June 1979, p. 20-42.
11. J. Martin, *Future Developments in Telecommunications,* Prentice-Hall, 2nd edition, 1977, p. 17.
12. J. Martin, *The Wired Society,* Prentice-Hall, 1978, p. 6.
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14. J. McHale, *The Changing Information Environment,* Elek, 1976, p. 21, 38.
15. M. Laver, *Computers, Communications and Society,* OUP, 1975, p. 1.
16. D. Bell, *The Coming of Post-Industrial Society,* New York, Basic Books, 1973, p. 20.
17. For a critique of Bell on these grounds see K. Kumar, 1978, *op. cit.*, esp. p. 219-30.
18. Conservative Party, ***Proposals for a Conservative Information Technology Policy,*** Provisional Draft Report, mimeo, 1979, p. 6.
19. Y. Masuda, 'A New Development Stage of the Information Revolution', ***Applications of Computer & Telecommunications Systems,*** Paris, OECD, 1975.
20. We cover these issues and areas with the necessarily detailed historical reconstruction in a forthcoming book ***The Social Meanings of Information Technology.***
21. See E. Braun and S. MacDonald, ***Revolution in Miniature,*** 1978, ***CUP,*** 1978. The micro-electronic device is aptly seen by C. Freeman as a 'heartland' technology—i.e., as a technology in the manner of steam power and the electric engine. See his paper *Government Policies for Industrial Innovation,* The Ninth J. D. Bernal Lecture, 1978, p. 12.
22. ***Report of the National Committee on Computer Networks,*** Dep. of Industry, London, 1978, p. 1.
23. I. de Sola Pool. International aspects of computer communications. ***Telecommunications Policy,*** December 1976, p. 33.
24. On the significance of the entry of oil concerns like Exxon, Sun and Gulf into office automation see L. McCartney, 'Exxon: Another Computer Giant?' *Datamation,* July 1978; and Exxon's new tactics for diversification. ***Financial Times,*** 22 May, 1979.
25. See *Office* ***Technology: The Trnde Union Response,*** APEX, March 1979.
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28. 'Post Office Thinks about Electronic Letterboxes', New ***Scientist,*** 7 December 1978, p. 770.
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31. J. Martin, ***Future Developments ...*** *op.cit.*, p. 240.

32. E. Meyers, 'EFT: Momentum Gathers; *Datamation,* October 1978.
33. See S. Rose, 'More Bang for the Buck: The Magic of Electronic Banking', *Fortune,* May 1977.
34. See, for example, Barron and Curnow, 1979, *op.cit.,* p. 154-9.
35. See *Computers and Telecommunications,* Paris, OECD, 1973, p. 67.
36. C. Martin, 'Computer Systems: Prospects for a Public Information Network', *Journal of Communication,* Autumn, 1978, p. 173.
37. See *Report of the Committee on Data Protection,* Cmnd 7341, HMSO, 1978; J. Eger, 'Transborder Data Flow', *Datamation,* 15 November 1978.
38. C.A. Cuarda, 'Commercially Funded On-line Retrieval Services —Past, Present and Future' *Aslibproceedings,* January 1978, p. 2.
39. See C. A. Cuarda, *op.cit.* p. 7-8; D. Magrill, 'Information at the Touch of a Button', *New Scientist,* 12 January 1978.
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41. W. White and M. Holmes, 'The Future of Commercial Satellite Telecommunications', *Datamation,* July 1978.
42. J. Martin, *Future Developments ... op.cit* p. 162-3.
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