1968

A HISTORICAL PERSPECTIVE OF INDUSTRY

17
ACIATE

A HISTORICAL PERSPECTIVE OF INDUSTRY

With Special Emphasis on Methods of Industrial Production and Their Inter-related Social and Economic Systems

17th Yearbook

American Council on Industrial Arts Teacher Education

1968

J. Kirkwood

JAMES J KIRKWOOD

A Historical Perspective of Industry

A HISTORICAL PERSPECTIVE OF INDUSTRY

With Special Emphasis on Methods of Industrial Production and Their Inter-related Social and Economic Systems

Joseph F. Luetkemeyer, Jr., *Editor*
Department of Industrial Education
University of Maryland
College Park, Maryland

17 th Yearbook of the

AMERICAN COUNCIL OF INDUSTRIAL ARTS TEACHER EDUCATION

A Division of the American Industrial Arts Association
and the National Education Association

1968

Lithographed in U.S.A.

Yearbooks of the American Council on Industrial Arts Teacher Education are produced and distributed by the McKnight & McKnight Publishing Company, Bloomington, Illinois

Orders and requests for information about cost and availability of yearbooks should be addressed to the company.

Requests to quote portions of yearbooks should be addressed to the Secretary, American Council on Industrial Arts Teacher Education, in care of the publisher, for forwarding to the current Secretary.

Foreword

If there exists any one fairly universally accepted objective of industrial education, that objective would include some direct reference to modern industry as the major source from which to draw instructional content. When questioned in depth about this, most teachers would probably state that they believe industrial arts experiences are useful in helping boys and girls become better informed about modern industry.

Among teachers, the objective would differ somewhat in detail, but not in essence; they would contain these kinds of expressions:

> "Students in my classes become acquainted with the major areas of production, distribution and consumption of products and they get first-hand experiences in designing, producing, servicing and caring for products in common usage."
>
> "Younsters in my classes develop some general basic skills, knowledges and problem-solving abilities while manipulating things mechanical and technical."
>
> "We learn about tools, materials, products, processes and design as these are associated with modern industry."
>
> "Students in my classes get first-hand experience in using wood, metal, plastics, ceramics, textiles, paper and other common industrial materials in construction activities which are typically found in modern industry."

Excellent — so far. *However, one essential element to the effective study of industry or industrial evolution rarely appears among industrial arts objectives.*

What are the historical roots — the antecedents of modern industrial development? How can teachers develop an adequate understanding of the nature of modern industry without giving comprehensive attention to the factors and circumstances which have brought about its development?

This, the 17th Yearbook, has been written to provide a preview of the history of industry and man's emergence as a toolmaking, tool-using individual. It provides rich materials for a thorough understanding of how man has exercised his ingenuity in developing productivity to serve his needs. The Yearbook provides for insight into the relationship of production and economic systems and gives significant attention to social systems related to industry as exemplified in organized labor and management. In short, this Yearbook provides the essential historical content to "round out" a study of modern industry through industrial arts.

Once more, the ACIATE gratefully acknowledges the work of eleven writers whose effort and dedication have given the organization another significant foundation text for industrial arts. Its quality is scholarly, its coverage comprehensive, its publication timely. Council members are appreciative of the efforts of the present team of writers for adding this fine new resource to the professional literature represented in the Yearbook series.

Howard F. Nelson
President

Yearbook Planning Committee

Terms Expiring 1968
Joseph Luetkemeyer
University of Maryland, College Park, Maryland
Ethan A. T. Svendsen
Indiana State College, Terre Haute, Indiana

Terms Expiring 1969
Walter E. Burdette
Arizona State University, Tempe, Arizona
Robert R. Randleman
University of Minnesota, Minneapolis, Minnesota

Terms Expiring 1970
John R. Lindbeck
Western Michigan University, Kalamazoo, Michigan
Joseph A. Schad
Virginia Polytechnic Institute, Blacksburg, Virginia

Terms Expiring 1971
Ralph O. Gallington
Southern Illinois University, Carbondale, Illinois
Donald G. Lux
The Ohio State University, Columbus, Ohio

Terms Expiring 1972
Charles B. Porter
Illinois State University, Normal, Illinois
Lawrence Wright
Stout State University, Menomonie, Wisconsin
Ralph C. Bohn, *Chairman and Past-President of the Council*
San Jose State College, San Jose, California

Officers of the Council

Howard F. Nelson, *President*
University of Minnesota
Minneapolis, Minnesota

Rutherford E. Lockette, *Vice-President*
Trenton State College
Trenton, New Jersey

Frederick D. Kagy, *Secretary*
Illinois State University
Normal, Illinois

William T. Sargent, *Treasurer*
Ball State University
Muncie, Indiana

Contributors to Yearbook Seventeen

Joseph Abromaitis
Faculty Development
University of Maryland

Fred Broadhurst
Associate Professor
East Carolina State College

Edmund Crosby
Assistant Professor
University of Maryland

Kenneth Guy
Associate Dean
Harford Junior College

Paul E. Harrison
Professor
University of Maryland

Clois Kicklighter
Assistant Professor
Eastern Michigan University

Joseph F. Luetkemeyer
Associate Professor
University of Maryland

George R. Merrill
Associate Professor
University of Maryland

Robert Schacht
Assistant Professor
Indiana State University

Kenneth Stough
Instructor
University of Maryland

William Tierney
Associate Professor
University of Maryland

Previously Published Yearbooks

1. *Inventory-Analysis of Industrial Arts Teacher Education Facilities, Personnel and Programs,* 1952. Walter R. Williams, Jr. and Harvey Kessler Meyer, eds.
* 2. *Who's Who in Industrial Arts Teacher Education,* 1953. Walter R. Williams, Jr. and Roy F. Bergengren, Jr., eds.
* 3. *Some Components of Current Leadership.* Roy F. Bergengren, Jr. *Techniques of Selection and Guidance of Graduate Students.* George F. Henry. *An Analysis of Textbook Emphases.* Talmage B. Young. 1954, three studies.
* 4. *Superior Practices in Industrial Arts Teacher Education,* 1955. R. Lee Hornbake and Donald Maley, eds.
* 5. *Problems and Issues in Industrial Arts Teacher Education,* 1956. C. Robert Hutchcroft, ed.
* 6. *A Sourcebook of Readings in Education for Use in Industrial Arts and Industrial Arts Teacher Education,* 1957. Carl Gerbracht and Gordon O. Wilber, eds.
* 7. *The Accreditation of Industrial Arts Teacher Education,* 1958. Verne C. Fryklund, ed., and H. L. Helton.
8. *Planning Industrial Arts Facilities,* 1959. Ralph K. Nair, ed.
* 9. *Research in Industrial Arts Education,* 1960. Raymond Van Tassel, ed.
10. *Graduate Study in Industrial Arts,* 1961. Ralph P. Norman and Ralph C. Bohn, eds.
*11. *Essentials of Preservice Preparation,* 1962. Donald G. Lux, ed.
12. *Action and Thought in Industrial Arts Education,* 1963. Ethan A. T. Svendsen, ed.
13. *Classroom Research in Industrial Arts,* 1964. Charles B. Porter, ed.
14. *Approaches and Procedures in Industrial Arts,* 1965. G. S. Wall, ed.
15. *Status of Research in Industrial Arts,* 1966. John D. Rowlett, ed.
16. *Evaluation Guidelines for Contemporary Industrial Arts Programs,* 1967. Lloyd P. Nelson and William T. Sargent, eds.

* Out of print yearbooks can be obtained on microfilm and in Xerox copies. For information on price and delivery, write directly to University Microfilms Inc., 313 N. First Street, Ann Arbor, Michigan 48107.

Contents

	13	Preface
Chapter One	15	Introduction to the Yearbook
Chapter Two	31	The Origin of Man and His Dependency on Technology
Chapter Three	59	Handicraft Technology
Chapter Four	89	The Industrial Revolution
Chapter Five	114	Machine Technology
Chapter Six	130	Capitalism as an Economic System
Chapter Seven	161	The Role of Management
Chapter Eight	175	Organized Labor and the Production Worker
Chapter Nine	209	Automation and Cybernetics
	235	Index

Preface

Yearbook Seventeen is the culmination of several years of research directed toward a consideration of industry as the major source of educational content for Industrial Arts Education. This yearbook is in agreement, therefore, with one of the accepted, primary objectives of Industrial Arts: to "develop an insight and understanding of industry and its place in our culture."

Extensive evidence both from professional literature in this field and from curriculum projects underway in Industrial Arts indicate that the content derived from this study of industry (technology) should be based on some form of theoretical construct: that is, that the body of knowledge reflecting industry (technology) should have a logical, meaningful structure (taxonomy, matrix, morphology, etc.). This current trend within the field of Industrial Arts towards developing its own logical structure moves Industrial Arts Education towards the possession of a theoretical structure — one of the basic characteristics inherent in an academic discipline.

It has been accepted that every discipline has two distinct unities in operation within itself. First, every discipline has a systematic unity which is the logical, highly structured, abstract knowledge unique to the specific discipline which always operates in the present. In the case of Industrial Arts, this structure is evidently still in the emerging process. Second, every discipline has a historical unity which gives understanding and meaning to the systematic logic of its present state. It is therefore apparent that one could not become an expert in a discipline without also acquiring an understanding of its historical unity. Thus if the Industrial Arts profession considers its primary purpose to be the study of contemporary industry, it must (in order to acquire a comprehensive understanding of industry) also acquire an understanding of its historical development.

The primary purpose of this yearbook is to review historically the three forms of industrial production (handicraft, machine, and automation) as well as their inter-related social and economic systems. (The theory underlying the entire yearbook is based on the assumption that the primary function of industry is the production of goods and services.) The yearbook will also explore both the unique characteristics of an academic discipline and its implications for curriculum development within the field of Industrial Arts.

The Editor wishes to express his appreciation to his colleagues in the Department of Industrial Education and to his former graduate students for their contributions in making this yearbook possible. He wishes also to thank Professor Donald Maley for his encouragement and understanding cooperation and the secretarial staff and personal friends for their generous assistance. Finally he wishes to acknowledge the help and understanding of his wife in the long process of editing this yearbook.

JOSEPH LUETKEMEYER

CHAPTER ONE

Introduction to the Yearbook

Joseph F. Luetkemeyer
University of Maryland

Industry: The Dominant Social Institution

Social scientists have described our society as one in which industry "has emerged as the decisive, the representative and the constitutive institution"[1] — a society, therefore, in which industry stands out as the dominant social institution. For unlike other social institutions, industry permeates "our culture as a whole."[2]

Industry has a direct impact not only on man's own social and personal (family) life but to some degree determines even the basic class structure of modern society. One of the identities given a worker in industrial society is his job. He may be a truck driver, a salesman, or a doctor; but whatever his job might be, it will be that position he fills in society which will largely determine his annual income, his mode of living, and the social status he will maintain (both on the job and in his home environment). Industry also exerts a strong influence on molding an individual's personal or family life, for millions of workers depend on industry not only for their own livelihoods, their economic and social positions, but also for the corresponding opportunities and places in society of their families and others who may be dependent on them.[2]

Besides its place in man's social and family life, industry has altered man's physical and social environment. Physically, the growth of modern urban manufacturing centers has led to the

[1]Peter F. Drucker, *The New Society* (New York: Harper and Brothers Publishers, 1950), p. 27.

[2]Eugene V. Schneider, *Industrial Sociology* (New York: McGraw-Hill Book Company, Inc., 1957), p. 1.

necessity for extensive housing developments, expanding means of transportation, and the complex financial systems resulting from these industrial advances. Thus industry may be cited as the indirect cause of the social and physical problems created by urban living: the problems of unemployment; slum areas; smog, air pollution, sanitary, and other health conditions. Socially, it is industry which has established the distinctions between the working class, the professional middle class, and the financially affluent upper class. Industry is indeed "like the center of a web whose strands reach out to embrace almost every aspect of society, culture, and personality."[3]

However, this importance industry commands in modern society as well as its impact on other social institutions are but indirect results of its primary function or goal — that of production of material objects and services. Fairchild noted that "the goal of all industry is production, in order that human wants may be satisfied."[4] And Moore wrote that "in the most general sense, industry may be thought of as coextensive with the production of goods and services — practically synonymous with 'economic organization.' "[5] Thus from the crude workings of Stone Age man to the complex industrial enterprises of today, all industries have had production as their primary and unchanging goal.

Man has admittedly introduced new *modes* of production through the years: to handicraft has been added the use of machines (mass production), and to the use of machines has recently been added automated units of control. But these new modes of production have not changed the goal of industry; they have rather been introduced only as a means of increasing the efficiency and effectiveness of production.

In order to perform the ordinary functions of his daily routines, the average person must be aware of at least the products and results of industry. To provide a livelihood for himself and for those dependent on him, a worker must have a certain degree of understanding of modern technology, some training in a technical skill, and some ability to handle technical tools and machines. Housewives and children must also have a limited knowledge of the products of industry. To be able to drive a car, operate household appliances, or draw water from a faucet; a housewife must understand the technical operations of these products. Even a child's

?

[3]*Ibid.*; p. 3.

[4]Fred R. Fairchild *et al, Elementary Economics* (New York: The Macmillan Company, 1927), p. 89.

[5]Wilbert E. Moore, *Industrial Relations and the Social Order* (New York: The Macmillan Company, 1951), p. 5.

control of a tricycle or his success with flying a kite depend on how well he understands the operations of these child-oriented results of industry.

While a widespread acquaintance with the products of industry is evidently important for man's intelligent existence in a modern, technical society, this common-sense knowledge of so dominating a social institution is inadequate. For personal knowledge of this kind is limited to an individual's environment and experiences (and may thus be influenced by his personal bias or interests).

Formal knowledge of industry, on the other hand, would provide a factual, objective understanding of industry as a social institution. It seems, therefore, that a study of industry (including both its nature and its impact on society) should be an integral part of every student's formal program of studies. Schneider, an industrial sociologist, has observed that "whoever would understand the nature of modern society must first understand the nature of its industrial institutions."[6]

A review of the literature in Industrial Arts indicates that its curriculum has, as its unique function in the formal school, the transmission of a knowledge of industry to the young. By its very definition, as developed by such recognized leaders in the field as Bonser, Fales, Wilber, Hostetler, and Schmidt, Industrial Arts embodies two important principles: "that industrial arts is part of general education" and that industry is "the source of its content."[7] Further evidence of the prominent role of industry in Industrial Arts may be found in two recent studies made of the historical evolution of objectives in Industrial Arts Education.[8] Both studies, after reviewing many national, state, and local bulletins on Industrial Arts Education, concluded that the objective to "develop an insight and understanding of industry and its place in our culture"[9] was one of the major Industrial Arts Education objectives

[6]Schneider, *op. cit.*

[7]Clois E. Kicklighter, "An Exploratory Taxonomy Based on the Common Elements of Industrial Enterprises for Industrial Arts Content Identification" (unpublished Ed.D. dissertation, Industrial Education Department, University of Maryland), p. 22.

[8]Ivan Hostetler, "What Objectives should be Emphasized in Industrial Arts?" *Improving Industrial Arts Teaching — A Call to the Profession,* U. S. Department of Health, Education and Welfare (Washington, D.C.: U.S. Government Printing Office, 1960).

Hal Massey, "A Research Instrument for Measuring The Unique Contributions of Industrial Arts to the Goals of General Education" (unpublished Ed.D. dissertation, Industrial Education Department, University of Maryland, 1965).

[9]*Ibid.,* p. 87.

emphasized. And in the words of Professor Ethan Svendsen, "the chief purpose of Industrial Arts Education must be the acquisition of industrial understanding and insight. Other objectives may contribute to it, but they will always be subservient."[10]

Since objectives are the guides towards content selection and an understanding of industry is recognized as one of Industrial Art's major objectives, it seems logical to assume that a knowledge of industry should be an integral part of the unique content of Industrial Arts.

A problem arises, however, in discerning the specific content of Industrial Arts. For while Industrial Arts educators generally agree that industry is the source of their field's content, their opinions concerning the actual nature of industry are in conflict. Thus, while each of these different schools of thought has evolved its own concept of industry — with corresponding methological principles — the dilemma of discerning a specific content for Industrial Arts has become more apparent.

A large part of this curriculum confusion is due to the influence of two of this field's historical antecedents: the Manual Training Movement (with its analysis technique of technical subject matter) and the Progressive Education Movement (with its child-centered approach to learning.)

The Manual Training Movement

The Manual Training Movement in America was heavily influenced by the pedagogical innovations of Victor Della Vos and his associates at the Imperial Technical School in Moscow. Because Della Vos considered the existing apprenticeship system to be inefficient and expensive, he, together with his associates, developed new approaches to teaching the mechanic arts. Their program provided

> an instruction shop for each distinctive art or trade — one for joinery, one for blacksmithing, one for carpentry, and so on; they analyzed each trade into its component skills and arranged these in pedagogical order, and they combined drawings, models, and tools into a series of graded exercises by which a student could, under supervision, progress toward a requisite of standard skill.[11]

It was this instruction shop, with its analysis technique, which later became the framework upon which educators within the

[10]Ethan A. Svendsen, "Industrial Arts: A Total Program," *Journal of Industrial Teacher Education,* IV (Summer, 1967), p. 17.

[11]Lawrence A. Cremin, *The Transformation of the School* (New York: Alfred A. Knopf, 1961), p. 25.

Manual Training Movement in America developed their content and related methodology.

The Manual Training Movement in American schools operated originally within a general education objective. But with the advent of federally subsidized vocational education, the analysis technique of the Manual Training Movement was adopted by Trade and Industrial educators and was modified to meet their own vocational objectives.

The same industrial educators of this period were the leaders in both movements(Manual Training and Vocational Industrial Education). In viewing the two movements, these educators concluded that their content area was the same and that the only difference between them was one of objectives (general versus vocational). The basic premise accepted by these industrial educators was that "industrial understanding and insight" could be taught through technical skill and knowledge without the necessity of identifying any separate, distinct knowledge of industry.

The designation "Manual Training" was later changed to "Industrial Arts," but the source of the movement's content (technical knowledge with related tool skills) remained the same.

Because of the influences of both the Manual Training Movement and the Trade and Industrial Education Movement, Industrial Arts did not concern itself, except for a few isolated instances, with evolving a structured body of knowledge of industry which could be used in curriculum development.

The Progressive Education Movement

The Progressive Education Movement came into prominence in America during the last two decades of the nineteenth century. It was but one of many humanitarian efforts to cope with existing social conditions that had resulted from the country's complex and rapidly expanding industrial-urban society.

The movement pointed out weaknesses in the existing public school program. It noted that in the program's rigid format of subject-matter orientation the entire school system was keyed primarily to the affluent, academically capable student. The existing emphasis on subject matter was, in fact, so pronounced that the student was given almost no individual consideration. He was thought qualified to attend public school only if he were capable of fitting a rigid, formalized set of educational standards.

As possible solutions to the social ills created by industrialism, the Progressive Education Movement advocated extensive and radical reforms within the program of the formal school. It viewed the function of the American school as that of providing a universal, democratic education and held that the school should meet the needs of every child, regardless of his academic ability or social background. The movement advocated educational programs specifically designed to fit the needs of every child in America. Some of these programs included vocational education, health, family and community living, and other new curriculum developments. It was intended that the various curricular programs would, within the school's teaching methodology, reflect the latest research findings in psychology and in the other social sciences on child development. The primary and dominant focus in the proposed school setting was the individual child — with the concomitant emphasis on his physical and social development.

The proposed objectives were to be accomplished in the school through the use of the "project method." In this method of learning a purposeful activity would be pursued by the students in a social environment. Leaders in this movement believed that only when children would see "purpose" in an activity would they pursue it. Subject matter would, therefore, never be planned in advance, but would evolve as the children realized a need for it in order to solve problems related to the "purposeful" activity they were engaged in. By working together on various projects, the children would presumably gain "social insight" (a concomitant learning)) in addition to the direct learning fostered by the purposeful activity. Rather than relying on organized subjects as did former programs in education, the progressive education curriculum was to be composed of a succession of projects.[12]

However, this almost complete shift in emphasis from subject matter to the individual proved to be an inherent and serious weakness in the Progressive Movement in American education. In attempting to correct weaknesses in the existing educational system, the Progressive Education Movement revealed in its program a parallel weakness — each movement failed to give due consideration to the importance which both subject matter and the development of the child must have in education. While the existing movement's dominant emphasis on subject matter made it insensitive to the needs of the individual student, so also did the Progressive Education Movement's emphasis on the child make it overlook the importance of subject matter.

Schwab pointed to this lack of concern for content as one characteristic of the era:

> Of the four topics of education — the learner, the teacher, the milieu, and the subject matter (that which is intended to be taught or

[12]*Ibid.*, pp. 215-220.

learned) — none has been so thoroughly neglected in the past half century as the last. We have had more than enough scrutiny, discussion, and debate about the learning and teaching processes, thanks to the popularity of psychological investigations. Class, community, the political state, and school organization have similarly been defined and redefined, studied and reexamined. Only subject matter, among the four has been relegated to the position of a good wife: taken as familiar, fixed, and at hand when wanted.[13]

Industrial Arts has many of its roots in the Progressive Education Movement and has, therefore, been heavily influenced by the movement's educational philosophy. From the work and influence of such great educators in the Progressive Movement as William Heard Kilpatrick (with his "project method)[14] and John Dewey (with the "occupations" and "industrial history" aspects of his curriculum);[15] Frederick Bonser and James Russell developed their "industrial social theory" of Industrial Arts Education.[16] It was due to the work and leadership of these educators (especially that of Frederick Bonser) that many tenets of the Progressive Education Movement are now accepted as an essential part of Industrial Arts. For example, Kilpatrick's concept of the project method (with its concomitant social objective) has been modified by Industrial Arts in order to meet its own objectives and has become an accepted and essential part of its curriculum. The child-oriented approach of the Progressive Education Movement has also exerted an influence on Industrial Arts. The literature of Industrial Arts is continually filled with references to the importance of the child's development and the necessity for Industrial Arts to meet his individual needs.

The field of Industrial Arts Education has therefore been strongly influenced by both the Manual Training Movement and the Progressive Education Movement. And in recognizing values in both approaches to learning (the former movement's recognition of a need for technical knowledge and skills and the latter's awareness of the importance of child-centerd approaches to learning), Industrial Arts educators face an evident dilemma. They are uncertain that by combining the educational techniques of both move-

[13]Joseph J. Schwab, "Problems, Topics, and Issues," *Education and The Structure of Knowledge*, ed. Stanley Elam (Chicago: Rand McNally and Company, 1964), I, p. 4.

[14]William H. Kilpatrick, *Foundations of Method* (New York: The Macmillan Company, 1925).

[15]John Dewey, *Democracy and Education* (New York: The Macmillan Company, 1916), pp. 228-255.

[16]David Snedden *et al.*, *Reconstruction of Industrial Arts Courses* (New York: Bureau of Publications, Teachers College, Columbia University, 1927), p. 7.

ments they will have a program capable of meeting their major objectives — an industrial understanding and insight. On the other hand, they are faced with the possibility of disregarding both movements and of organizing a new and different structured knowledge of industry. This dilemma has been responsible for the evolution of many different programs within Industrial Arts Education. These programs have, in turn, been responsible for a fragmentation of interests and diverse schools of thought within the field.

The last two decades have witnessed a curriculum reform movement which has as its major effort the attempt to redefine the role of the academic disciplines in the curriculum. This movement has been influenced by the work of such men as Bruner, Piaget, Ausubel and others. These men have concentrated their research on clarifying the structural features of the disciplines and developing possible modes of classifying knowledge for instructional purposes. The purpose of their research was to determine if instruction could be organized in such ways as to include both the logical order of the disciplines and the psychological aspects of the cognitive development of the student.

As a social institution the formal school has, as one of its prime responsibilities, the transmission of the organized bodies of knowledge to future generations. As the school is the most capable and deliberately equipped institution to fulfill the obligation of instructing the young, organized knowledge is its stock-in-trade. In this era of knowledge explosion, the school cannot underemphasize either the importance of the disciplines or the school's concurrent obligation to continually evolve in its curriculum meaningful ways to transmit this knowledge.

The Nature of an Academic Discipline

This major responsibility of the formal school raises an important question as to the precise nature and essential elements of a discipline. Foshay defines a discipline as "an organized way of making knowledge," as "an organized way of inquiring."[17] A more detailed definition of a discipline may be cited from Tykociner as

> a collection of parts of systematized knowledge arbitrarily selected and bound together in a manner suitable for learning, mental training, and preparation for more advanced study and research.[18]

[17]Arthur W. Foshay, "Education and the Nature of a Discipline," *New Dimensions in Learning*, ed. Walter B. Waetjen (Washington, D.C.: Association for Supervision and Curriculum Development, 1962), p. 3.

[18]Joseph T. Tykociner, "Zetetics and Areas of Knowledge," *Education and the Structure of Knowledge*, ed. Stanley Elam (Chicago: Rand McNally and Company, 1964), p. 123.

A close scrutiny of the definitions cited above indicates that a discipline is more than just a collection of facts or information. It is, rather, a body of organized (or systematized) knowledge which possesses several distinct characteristics.

Professor John B. Carroll, an educational phychologist, identified four criteria possessed by a discipline:

(1) A specifiable scope of inquiry
(2) The possession of structured subject-matter
(3) A recognized set of procedures for gaining new knowledge (including criteria for stating the validity of new knowledge), and a set of procedures for ordering new knowledge
(4) Accepted techniques and tools for applying knowledge in specific cases to specified practical ends.[19]

The following six elements were listed by Professor Harry Broudy, an educational philosopher, as being contained in every logically organized subject matter:

> Every science, and indeed every logically organized subject matter, contains the following elements:
> 1. A set of entities or units that are described or defined.
> 2. These entities are related to each other in some fashion.
> 3. There are facts or data. That is to say, there are statements that are taken as proved or proved sufficiently to spare them any further questioning.
> 4. There are hypotheses that purport to account for certain facts.
> 5. There are well-established hypotheses that are accepted by the leaders of the discipline as being warranted on evidence already adduced for them.
> 6. Each discipline has its own method of investigation.[20]

In approximately the same format as that of Broudy, Shermis considered a discipline as having the following characteristics:

(1) a rather impressive body of time-tested works,
(2) a technique suitable for dealing with their concepts,
(3) a defensible claim to being an intimate link with basic human activities and aspirations,
(4) a tradition that both links the present with the past and provides inspiration and sustenance for the future,

[19] John B. Carroll, "The Place of Educational Psychology in the Study of Education," *The Discipline of Education*, ed. John Walton and James L. Kuethe (Madison, Wisconsin: The University of Wisconsin Press, 1963), p. 104.

[20] Harry S. Broudy, *Building a Philosophy of Education* (2d ed.; Englewood Cliffs, New Jersey: Prentice-Hall, Inc., ©, 1961), p. 323.

(5) a considerable achievement in both eminent men and significant ideas.[21]

The Project on Instruction, sponsored by the National Education Association, was also vitally concerned with curriculum reform in the schools. The report of its National Committee *Deciding What To Teach* identified three components of a discipline:

Each discipline has a content, structure (or structures), and method (or methods), but none of the three components can be fully understood in isolation from the other two. Specific data take on different meaning as the basic concepts of the discipline are revised or as the methods and levels of inquiry shift. The "what" of the discipline — its content and conceptual structure — can be interpreted only in the light of the "how," the method and level of inquiry. The latter, in turn, must be appropriate to the content and concepts under investigation.[22]

In another publication, *New Dimensions of Learning*, sponsored by the Association for Supervision and Curriculum Development, a Department of the National Education Association, Professor Arthur Foshay wrote:

A discipline can be defined as a way of knowing, a way of making knowledge. As such, a discipline is characterized, first, by a domain, an area of human experience, or an area of phenomena for which a person in the discipline takes responsibility; second, as a set of rules that has to do with how truth is established and how truth is conceived of and stated, within the discipline; and third, as having a history that may be described and that, presumably, ought to be known.[23]

Although the authors cited varying numbers of elements inherent in a discipline, a careful examination of their different lists reveals that the actual, determining characteristics of an academic discipline can logically be grouped into four major categories: (1) a specific scope, content, domain, or area of investigation, (2) a conceptual structure, (3) a known history, and (4) a unique method of inquiry. Its known history is not always explicitly cited in establishing the characteristics of a discipline, yet it is inherently implied as a necessary means of understanding the content and structure of an area of study. For, as Professor Meyer-Abich pointed out, "any science (branch of knowledge) represents a historical period and

[21]Sherwin W. Shermis, "On Becoming an Intellectual Discipline," *Phi Delta Kappan*, XLIV (November, 1962), p. 84.

[22]Dorothy M. Fraser, *Deciding What to Teach* (Washington, D.C.: Project on Instruction, National Education Association, 1963), p. 23.

[23]Foshay, *op. cit.*, p. 5.

develops itself historically."[24] In instances where an author listed more than four elements, a review of his list indicates that two or even three elements cited could be categorized under one of the four commonly recognized characteristics. For example, the first, fourth, and fifth characteristics listed by Shermis (1. a rather impressive body of time-tested works, 4. a tradition that both links the present with the past and provides inspiration and sustenance for the future, and 5. a considerable achievement in both eminent men and significant ideas) can all three be considered as integral parts of the history of an academic discipline. It would therefore seem imperative that in order for any area of study to be considered a discipline, it must embody these four commonly recognized characteristics.

Implications for Curriculum Development

As cited previously, many contemporary curriculum studies (including those by Bruner, Piaget, and Ausubel) are concerned both with the nature of the disciplines and with proposed methods to make the disciplines cognitively meaningful to the student.

> Contemporary efforts to redefine the role of knowledge in the curriculum place emphasis on the logical order inherent in knowledge itself, on the structure of concepts and principles of inquiry that characterize the various fields of learning. Whereas formerly factual and descriptive content was stressed, now the emphasis is on basic concepts and methods which scholars use as intellectual tools to analyze and order their data.[25]

Curriculum experts are concerned with an identification of the structure of organized knowledge which, because of man's need to understand his environment, should be included in the curriculum. For it is man's ability to organize conceptual models (structured knowledge) that not only brings order and meaning to his experiences but also enables him to understand physical phenomena and, in some instances, to predict future events. Since this conceptualization (structure of knowledge) gives meaning to what we learn it should, therefore, be the major emphasis in the curriculum.

> Knowledge is a model we construct to give meaning and structure to regularities in experience. The organizing ideas of any body of knowl-

[24]Arthur H. Moehlman, *Comparative Educational Systems* (Washington, D.C.: The Center for Applied Research in Education, Inc., 1963), p. 5. quoting Professor Meyer-Abich's lectures on the "Historico-Philosophical Definition and Classification of Biology."

[25]Arno A. Bellack, "Knowledge Structure and the Curriculum," *Education and The Structure of Knowledge*, ed. Stanley Elam (Chicago: Rand McNally and Company, 1964), p. 264.

edge are inventions for rendering experience economical and connected. We invent concepts such as force in physics, the bond chemistry, motives in psychology, style in literature as means to the end of comprehension.

The history of culture is the history of the development of great organizing ideas, ideas that inevitably stem from deeper values and points of view about man and nature. The power of great organizing concepts is in large part that they permit us to understand and sometimes to predict or change the world in which we live. But their power lies also in the fact that ideas provide instruments for experience. . . . The structure of knowledge — its connectedness and the derivations that make one idea follow from another — is the proper emphasis in education. For it is structure, the great conceptual inventions that bring order to the congeries of disconnected observations, that gives meaning to what we may learn and makes possible the opening up of new realms of experience.[26]

The curriculum designer, in cooperation with experts in the specific discipline, must develop a "theory of instruction." This instructional plan must provide "structures" of knowledge which will be cognitively acceptable to the learner.

A theory of instruction must specify the ways in which a body of knowledge should be structured so that it can be most readily grasped by the learner. "Optimal structure" refers to a set of propositions from which a larger body of knowledge can be generated, and it is characteristic that the formulation of such structure depends upon the state of advance of a particular field of knowledge . . . the merit of a structure depends upon its power for simplifying information, for generating new propositions, and for increasing the manipulability of a body of knowledge, structure must always be related to the status and gifts of the learner. Viewed in this way, the optimal structure of a body of knowledge is not absolute but relative.[27]

Another important consideration in curriculum development is the concept "structure of a discipline." Professor Schwab considered the structure of a discipline as having two components: (1) "a body of concepts — commitments about the nature of a subject matter, functioning as a guide to inquiry"[28] and (2) the syntax of of the discipline or "the pattern of its procedure, its method, how it goes about using its conceptions to attain its goals."[29] Each

[26]Jerome L. Bruner, *On Knowing* (Cambridge, Massachusetts: The Belknap Press of Harvard University, 1962), p. 120.

[27]Jerome L. Bruner, *Toward a Theory of Instruction* (Cambridge, Massachusetts: The Belknap Press of Harvard University, 1966), p. 41.

[28]Joseph J. Schwab, "The Concept of the Structure of a Discipline," *Educational Record,* (July, 1962), p. 203.

[29]*Ibid.*

component of the "structure of the discipline" has its own substructure: the first part or body of concepts is composed of the substantive structures of the discipline; the second part or syntax also has its own unique syntactical structure or principles of inquiry. The important significance of "structure" for curriculum planners is the inter-relatedness of the substantive structure and the syntax. The mode of inquiry (syntax) is necessary for evaluating, interpreting, and reordering the substantive structures (if necessary); while the substantive structures function as guides to inquiry, thereby also controlling the results of this inquiry. Without including the syntax of the "structure," therefore, our present knowledge imparted in the school would become dogmatic and absolute rather than relative and changing.

Curriculum Implications for Industrial Arts

Several research or curriculum studies in Industrial Arts have been influenced by this contemporary, "disciplines-approach" movement in education. These studies accepted either industry or technology as their source of content and later developed classificatory systems or taxonomies as a means of rendering industry (or technology) intellectually meaningful.[30]

It is assumed that in order to use this "*disciplines*-approach" in curriculum development, the course content selected would be that of an academic discipline. A question must arise, therefore, concerning the nature of industry (or technology). For while they are accepted by recognized leaders in the field as the source of content for Industrial Arts, neither industry nor technology has, at this period of their development, been considered as academic disciplines.

The two areas of study should not, however, be disregarded as potential academic disciplines. For in examining their nature, it is evident that both industry and technology do embody three of the four characteristics essential to an academic discipline. Both possess "a domain of study," the first characteristic; an identified "conceptual structure" (taxonomies), the second characteristic; and a long, recognized "historical tradition," the third characteristic essential to an academic discipline. It is the fourth characteristic, a "specified method of inquiry," which is seemingly lacking at this stage of their development. This absence of a single, specific method of inquiry is made graphic by the diverse taxonomies with their differing interpretations of industry (or technology) that have

[30]*Addresses and Proceeding of the 29th Annual Convention* (Washington, D.C.: American Industrial Arts Association, 1967).

evolved from contemporary curriculum studies. Yet even now technology is emerging as a distinct area of study *and investigation:* The nascent development of a philosophy of technology — with a method of inquiry — is currently underway and may eventually supply this missing characteristic of a discipline.[31] Therefore the possibility cannot be overlooked that industry and technology may some day be recognized as academic disciplines.

While industry cannot, at the present time, be accurately referred to as an academic discipline studied in its own right, it might be thought of as at least a form of inter-discipline: that is, as a social institution studied by areas of various disciplines. Because it is the dominant social institution in modern society, industry is a source of study for experts from various disciplines, especially from those within the social sciences. The very prefix "industrial" applied to the disciplines of sociology, psychology, anthropology, and other social sciences indicates that in these disciplines there are accumulations of knowledge concerning industy — knowledge researched, developed, and studied, however, within the characteristics of these *external* disciplines.

It would seem in summary, therefore, that at the present stage of its historical evolution, Industrial Arts Education (dependent on industry for its content), might be described as an area of study just entering the formative period of its development as an academic discipline. For other areas of organized knowledge in their primary stages of development assume an encyclopedic structure, or the format of a catalog — the stage of development into which Industrial Arts now seems to be evolving. It is only as a discipline matures that a method of inquiry emerges from its conceptual structure as a means of evaluating, refining, or eliminating its established knowledge. For as Shemis pointed out, marginal studies "become intellectual disciplines by first addressing themselves to immensely significant questions and then developing the tools for answering them."[32]

Purpose of the Yearbook

The purpose of this yearbook is to provide a review of the history of industry. The yearbook will include man's evolution as a tool-making animal; the forms of production man has developed to supply him with material goods and services; the inter-relation

[31]Henryk Skolemowski, "The Structure of Thinking in Technology," *Technology and Culture*, VII (Summer, 1966), 371-383.

[32]Shemis, *op. cit.*, p. 85.

of production and economic systems; and the unique social systems related to industry of organized labor and management.

It is hoped that, as an underlying purpose, this historical review will, in some small way, provide those in the profession of Industrial Arts with a deeper insight and clearer understanding of the nature of industry as well as of its place in our culture — the primary objective of Industrial Arts.

Selected Bibliography

Addresses and Proceedings of the 29th Annual Convention. Washington, D.C.: American Industrial Arts Association, 1967.

Bellack, Arno A. "Knowledge Structure and the Curriculum," *Education and The Structure of Knowledge.* Edited by Stanley Elam. Chicago: Rand McNally and Company, 1964.

Broudy, Harry S. *Building a Philosophy of Education.* 2nd ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1961.

Bruner, Jerome L. *On Knowing.* Cambridge: The Belknap Press of Harvard University, 1962.

———. *Toward a Theory of Instruction.* Cambridge: The Belknap Press of Harvard University, 1966.

Carroll, John B. "The Place of Educational Psychology in the Study of Education," *The Discipline of Education.* Edited by John Walton and James L. Kuethe. Madison, Wisconsin: The University of Wisconsin Press, 1963.

Cremin, Lawrence A. *The Transformation of the School.* New York: Alfred A. Knopf, 1961.

Dewey, John. *Democracy and Education.* New York: The Macmillan Company, 1916.

Drucker, Peter F. *The New Society.* New York: Harper and Brothers Publishers, 1950.

Fairchild, Fred R., *et al. Elementary Economics.* New York: The Macmillan Company, 1927.

Foshay, Arthur W. "Education and the Nature of a Discipline," *New Dimensions in Learning.* Edited by Walter B. Waetjen. Washington, D.C.: Association for Supervision and Curriculum Development, 1962.

Fraser, Dorothy M. *Deciding What to Teach.* Washington, D.C.: National Education Association, 1963.

Hostetler, Ivan. "What Objectives should be Emphasized in Industrial Arts?," *Improving Industrial Arts Teaching — A Call to the Profession.* U.S. Department of Health, Education and Welfare. Washington, D.C.: U.S. Government Printing Office, 1960.

Kicklighter, Clois E. "An Exploratory Taxonomy Based on the Common Elements of Industrial Enterprises for Industrial Arts Content Identification." Unpublished Ed. D. dissertation, Department of Industrial Education, University of Maryland, 1966.

Kilpatrick, William H. *Foundations of Method.* New York: The Macmillan Company, 1925.

Massey, Hal. "A Research Instrument for Measuring The Unique Contributions of Industrial Arts to the Goals of General Education." Unpublished Ed. D. dissertation, Department of Industrial Education, University of Maryland, 1965.

Moehlman, Arthur H. *Comparative Educational Systems.* Washington, D.C.: The Center for Applied Research in Education, Inc., 1963.

Moore, Wilbert E. *Industrial Relations and the Social Order.* New York: The Macmillan Company, 1951.

Schwab, Joseph J. "Problems, Topics, and Issues," *Education and the Structure of Knowledge.* Edited by Stanley Elam. Chicago: Rand McNally and Company, 1964.

————————. "The Concept of the Structure of a Discipline," *Educational Record,* XLIII (July, 1962), 203.

Schneider, Eugene V. *Industrial Sociology,* New York: McGraw-Hill Book Company, Inc., 1957.

Shermis, Sherwin W. "On Becoming an Intellectual Discipline," *Phi Delta Kappan,* XLIV (November, 1962), 84.

Skolemowski, Henryk. "The Structure of Thinking in Technology," *Technology and Culture,* VII (Summer, 1966), 371-383.

Snedden, David, *et al. Reconstruction of Industrial Arts Courses.* New York: Bureau of Publications, Teachers College, Columbia University, 1927.

Svendsen, Ethan A. "Industrial Arts: A Total Program," *Journal of Industrial Teacher Education,* IV (Summer, 1967), 17.

Tykociner, Joseph T. "Zetetics and Areas of Knowledge," *Education and the Structure of Knowledge.* Edited by Stanley Elam. Chicago: Rand McNally and Company, 1964.

CHAPTER TWO

The Origin of Man and His Dependency on Technology

Kenneth Guy
Harford Junior College
Robert C. Schacht
Indiana State University

Introduction

The study of man's origin (and biological and cultural evolution) is a kind of mystery play, acted out years ago in many scenes and in different geographical locations. The participants have long ago departed the stage, and have left their brittle bones widely distributed and buried deep in rocks and caves. In many cases, the bones have remained locked in various rock formations waiting for someone to unfold the story they tell. Archeological and fossil evidence that has been uncovered, together with careful measurement and observation of living human population, presents new insights into man's deepest mystery — his own origin.

The accumulation of facts from the fields of biology, geography, and anthropology demonstrates that the earth and all living forms upon it have been and are still undergoing a continuing process of evolution. According to E. Adamson Hoebel, "life began something more than a billion years ago in the activation of protoplasm in unicellular form."[1] "Yet just how life began or where this momentous and mysterious event occurred is still unknown."[2] The evolu-

[1]E. Adamson Hoebel, *Man in the Primitive World* (2nd ed. New York: McGraw-Hill Book Company, Inc., 1958), p. 29.
[2]*Ibid.*, p. 23.

tion of living organisms has resulted in the continuous development of greater and more complex cell organisms.

> The term *evolution,* commonly associated with the work of Darwin, is still much maligned but little understood. Darwin is responsible for the concept of natural selection but not evolution. Evolution means nothing more than change — change in the morphological characteristics of an organism over a period of time.[3]

The evolution of life continues to this day, and there is every reason to believe that it will continue as long as life exists. New forms come into being, and old ones sometimes disappear. Many forms of life develop to fit into a particular environment, only to disappear when these life conditions change. By changing his environment, man has not only created new forms but he has also been responsible for the disappearance of others.

"The process is the result of genetic variation and adaption to specific environments through natural selections."[4] An understanding of the concepts of natural selection and adaption are important in the study of the emergence of man.

> The natural selection concept presently initially by Darwin and subsequently modified by genetic researchers maintains that in every generation of animals there will be a struggle with the environment with the prize being survival. . . . Animals struggle with the cold by developing heavier pelts. . . . Plants struggle with the arid climate by developing deep roots.[5]

The important key to natural selection is reproduction. The organism that is capable of maintaining a longer life span and is able to reproduce will influence the form of future generations. The one incapable of maintaining a long life span will not. The constant struggle of the organism with its surrounding environment and with other organisms will, over a period of generations, be responsible for a change in form and habits.

> We still often read a good deal . . . about . . . "adaptation to environment" . . . together with the expressed or implied suggestion that animals in some mysterious way become "adapted" to surroundings. . . . There is . . . no evidence for such an inheritance. . . . Apes do not have long arms because they live in trees, they live in trees because they have long arms.[6]

[3]Lowell D. Holmes, *An Introduction to Anthropology* (New York: The Ronald Press Company, 1965), p. 57.

[4]Hoebel, *op. cit.*

[5]Holmes, *op. cit.*, p. 58.

[6]Alan H. Brodrick, *Man and His Ancestry* (Greenwich, Connecticut: Fawcett Publications, Inc., 1964), pp. 33-34.

It is important to remember that systems of classification are developed by the men who use them and do not exist in nature.[7] Clean-cut classifications are unjust to biologically and culturally borderline cases and are causes of disagreement among anthropologists. It is then easy to see why many traits form a variable continuum, and are at some point in between with movement toward an end.

"Man's position among the creatures of the animal kingdom is clear and concise — he is a primate."[8] But what is not clear is the route of primate development that was followed to attain the present state of man. As far as anthropologists know today, there was no magic moment when our ancestors crossed the line from pre-man to man.

One of the most persistent theories of man's development holds that both he and the great apes evolved from a common ancestor.

No modern scientist believes that man's forebears were apes . . . for these animals are much too specialized for tree life to be ancestral to a generalized creature like man. . . . The usual interpretation is that man developed from a *proto-hominoid* (hominoid is a term that includes all fossil and living men and apes, but not monkeys). In other words man's ancestor is believed to have been something more advanced than a monkey but less developed and less specialized than any modern ape. The creature is assumed, however, to have been somewhat apelike in its general physical characteristics and intelligence.[9]

The evolution of modern man may be analyzed in terms of five development stages:

1. Early pre-human stage — Proto-hominoids
2. Late pre-human stage — Australopithecines
3. Early human stage — Homo habilis
4. Human stage — Homo erectus
5. Modern human stage — Homo sapien[10]

Early Pre-Human Stage

Many anthropologists have speculated as to the characteristics of our proto-hominoid ancestors. With only a few fossil discoveries upon which to base their conclusions, the following characteristics are presented by Hockett and Ascher.

1. Keen vision, movable arms with manipulative hands, and brains larger than the average land mammals.

[7]Hoebel, *op. cit.*, p. 32.
[8]*Ibid.*, p. 43.
[9]Holmes, *op. cit.*, p. 62.
[10]*Ibid*, p. 63.

2. Band organization; group of ten to thirty individuals, but with no permanent form of family.
3. Mixed arbored and ground life. On the ground they could stand or run with a semi-erect posture but bipedal walking was not their usual habit.
4. Ability to use objects of nature as tools, but unable to make tools to meet their needs.
5. Largely vegetarian.
6. No power of speech, but a crude call system was used.[11]

Geological evidence suggests that climatic changes converted the African tropical forests into vast grasslands with but a few trees. This evolution forced the proto-hominoids to spend more time on the ground. And in order to meet the challenge of their new environment, these proto-hominoids experienced gradual physical changes and corresponding changes in their living habits.

Late Pre-Human Stage

In looking for a link between the proto-hominoid and man, Boule and Vallois state that "the Australopithecines may present us with our best example of a 'missing link.' "[12] Because these pre-humans may possibly be the intermediate form that man has eagerly sought, it makes little difference whether you call them "man-ape" or "ape-men."

In 1924, the incomplete skull of a young individual was discovered in a quarry at Taungs, a location eighty miles north of Kimberly, South Africa.[13] The incomplete skull belonged to a young individual estimated to be about six years old. "There is much evidence that this little fellow walked upright, . . . used bones and stones for tools, had a humanlike face and teeth and was equipped with a brain midway between that of the ape and man in size."[14] These specimens were named Australopithecines — southern ape.

It appears that Africa may have been the birthplace of man with two man-like humans living side-by-side. Even after examining all this evidence, one can only operate, however, on a theoretical basis. Anthropologists are left simply to infer if they had a culture, and if so what it was like.

[11]Charles F. Hockett and Robert Ascher, "The Human Revolution," *Current Anthropology*, Vol. 5, No. 3, pp. 137-138.

[12]Noel Korn and Harry R. Smith (ed.), *Human Evolution* (New York: Henry Holt and Company, Inc., 1959), p. 231.

[13]Alfred L. Kroeber, *Anthropology* (2nd ed.; New York: Harcourt, Brace and Company, 1948), p. 91.

[14]Pertli I. Pelto, *The Study of Anthropology* (Columbus, Ohio: Charles E. Merrill Books, Inc., 1965), p. 50.

As is a characteristic reaction to new discoveries, some anthropologists were skeptical and felt the findings and observations were not sufficiently conclusive to be considered the intermediate form between man and the proto-hominoids. Additional discoveries between 1936 and 1948 tended to revive the question of their authenticity and their relationship to man. According to Korn and Smith, "the Australopithecinae are a group of anthropoids in the process of evolution toward humanity, but . . . vanished without having become truly human."[15]

Early Human

A series of discoveries by Dr. L. S. B. Leakey in East Africa, have been estimated to be 2,000,000 years old. General Electric researchers, using recently developed methods, calculated the figure of 2,000,000 for the age of lava at the bottom of Oldwai Gorge, where the remains were found.[16] A number of fossils have also been found in the same general area, and some of these creatures were found with crude stone tools. To some anthropologists these findings provide clear evidence of a human-like culture. Leakey named his discovery Homo habilis — man with ability.

> Experts from England and South Africa have examined parts of seven individuals and have concluded that Homo habilis was about the size of modern pygmies. They walked completely erect on feet in which the arrangement of the big toe and arch system resembled that of modern man.[17]

Evidence has recently been uncovered which indicates Homo habilis spent a great amount of time in hunting and toolmaking.[18] The remains of small mammals and fish, as well as tools fabricated out of stone and crude structures constructed from stones, were discovered with the bones of this early variety of man. These remains give some indication of the ingenuity of this early man.

Late Human

The links between the African fossil men (2,000,000 years old) and the early Homo sapien (100,000 years old) are based on a series of fossils found in East Asia. The remains of both Java Man and Peking Man were found and with them was evidence of their use of tools and fire.

[15]Korn and Smith, *op. cit.*, p. 234.
[16]Holmes, *op. cit.*, p. 65.
[17]*Ibid.*
[18]Pelto, *op. cit.*

The partial remains of Java Man, Pithecanthropus erectus, were found in 1891 along the Solo River in north central Java. Eugene Dubois, a Dutch surgeon, discovered the top part of a skull, a thighbone and two molar teeth. While the thighbone and the teeth have been seriously challenged, the skull has been authenticated by additional finds. This was the first primitive human or pre-human fossil discovered anywhere outside Europe.

"All in all, Pithecanthropus — whether he was all erectus or also of robustus species — was hominid and not an ape."[19] It is generally inferred by fossil finds that he possessed speech and made and used some tools.

Peking Man is the second primitive species to attain importance and also comes from the Far East. These traces of fossil remains were taken from caves forty-two miles from Peking and were named Sinanthropus pekinensis. The differences between Java Man and Peking Man are slight and they are usually classed in the same genus and species.

> The skulls of these ape-men are heavy and have prominent brow bridges. Although the jaw has no chin, it can positively be stated that the skull is more manlike than apelike. . . . The representatives of this fossil type walked completely erect. They produced stone tools of a hand axe variety and Peking specimens are known to have used fire.[20]

Traces of charcoal, charred bones, and remains of ancient hearths infer that Peking Man made use of fire. Because of both the animal and plant remains that were found in the caves, it also appears that he made use of vegetables and meat foods.[21]

Modern Human

Neanderthal Man, the first fossil human form discovered, represents a full and reliable man but one not quite a member of our species sapiens. While Neanderthal remains have been found at about twenty different sites in Europe, the first recognized discovery was made in a cave near Dusseldorf, Germany, in 1856.[22] Technically, this form is known as Homo neanderthalensis and is believed to have lived approximately 100,000 years ago.

The behavior of the Neanderthal Man seems to have been thoroughly human. He took refuge in caves from inclement weather and used skins to keep himself warm. He practiced magical rites

[19]Kroeber, *op. cit.*, p. 83.

[20]Holmes, *op. cit.*, p. 68.

[21]Ralph L. Beals and Harry Hoijer, *An Introduction to Anthropology* (New York: The Macmillan Company, 1953), p. 131.

[22]Korn and Smith, *op. cit.*, p. 258.

and prepared his dead for another existence by placing food and weapons with him in his grave. Many activities of modern man are not unlike the activities of Neanderthal Man.

> He fashioned tools with precision and skill, hunted in organized groups, and had a rudimentary religion. When this variety of man disappeared during the Upper Paleolithic, it is quite likely he was absorbed by Cro-Magnon populations rather than exterminated by them.[23]

The Upper Paleolithic period in Europe which began approximately 50,000 years ago gave rise to the species known as Homo sapiens. Of all the groups known to exist at this time, the Cro-Magnon group has gained the most prominence.

> Cro-Magnon men were tall and robust with erect posture and straight necks. Their heads were domed and featured high foreheads. Their faces were delicate and they had prominent noses and chins.[24]

The Cro-Magnon men lived in well-organized societies and engaged in such communal activities as hunting and fishing. Their tools were carefully fashioned from antler, bone, and stone and were used for tailoring, painting, and social activities.

Even though Cro-Magnon was discovered in France and is the best known of the early sapiens, other varieties are equally as important. Combe Capelle, discovered in Czechoslovakia; Chancelade, discovered in France; and Grimaldi, discovered in Monaco are varieties of Homo sapien which have helped to reveal his early development.

Fossil evidence of fully modern Homo sapien is abundant in Europe, Asia and Africa. These fossils are only 10,000 to 30,000 years ago; therefore, many anthropologists argue that Homo sapien evolved in recent times. Some fossil finds suggest that early Homo sapien groups were living in parts of Europe over the same time period as the Neanderthalers — 100,000 years ago.

On the other hand, Dr. Leakey argues that his new East African discovery, Homo habilis (man with ability), is quite modern in brain size and jaw structure. He suggested that Homo sapiens really was nearly fully developed over a million years ago.

> The problem of deciphering the ancestry of man is difficult at best. In many cases the antiquity of fossils is uncertain and therefore their relationships to others cannot be ascertained. . . . Also, there is the difficulty that the fossils that have been discovered are not "missing links" in a direct linkage of individuals, but are rather representatives of popula-

[23]Holmes, *op. cit.*, p. 70.
[24]*Ibid.*

tions in which there undoubtedly was a great deal of variation. We do not know therefore how typical these fossils are of their species.[25]

It is is impossible to say at precisely what point in prehistory protoculture evolved into a genuine culture, for the transition must have been very gradual. It was when the brains of our ancestors had developed sufficiently to enable them to make possible permanent habits of toolmaking and lasting social invention that the long process of cultural development was underway.

All along the evolutionary line man's ancestors remained unspecialized, except for those physical characteristics that prepared them for human living; and specialization is the key to survival and success in competition with other animals. When man first evolved into the world, he developed five special features which gave him the chance to become master of the earth. All of these he shared to some extent with other animals, but the total combination of all five features was unique and belonged only to man. The five features included an erect posture, free-moving arms and hands, sharp-focusing eyes, a brain capable of fine judgment and decision as well as of keen perception, and the power of speech.

According to Carlton S. Coon:

> The five gifts that man received from nature during his early formative period gave him superior powers of transportation, in his legs and feet; of communication, in his brains and organs of speech; and of work, in his hands, eyes and brains. During man's entire history his steady progress in transportation, communication, and handling of materials has let him rise to the mastery of the world.[26]

While most animals within a given species reveal the same patterns of behavior, man does not. The species Homo sapiens, though its members function with psychological mechanisms, demonstrates definite variations in patterns of behavior. There are few, if any, ways of behaving which hold for all men at all places and at all times.

A partial reason is that man learns a greater proportion of his behavior than any other animal. Man is born into the world a helpless infant and is subject to a learning process which eventually provides him with certain ways of living appropriate to the society into which he is born.

Culture is a uniquely human phenomenon. Keesing wrote that culture,

[25] *Ibid.*, p. 71.

[26] Carleton L. Coon, *The Story of Man* (New York: Alfred A. Knoft, 1958), p. 19.

in its broadest sense is cultivated behavior . . . the totality of man's learned, accumulated experience which is socially transmitted.[27]

"Culture is a total lifeway, not just a superficial set of customs. It largely shapes how man feels, behaves, and perceives as he adapts to his world."[28] Culture is concerned with actions, ideas and artifacts which individuals in the tradition concerned learn, share and value. These elements of a culture have a function. To understand any element of culture, both form and function must be explored within the context of the culture.

Man lives in organized clusters which are called societies. A society is people — an organized group of individuals. According to Keesing:

"A society" refers correspondingly to a specific and usually localized population with distinctive customary ways of aggregation. It will consist of a definable number of individuals, whether large or small, with given age and sex patterns, birth and death rates, community distribution or settlement pattern, degree of mobility, and other characteristics which have an intimate relation . . . to the culture concerned.

* * * * * * * * *

The process of learning and being trained in a culture from infancy is often called enculturation, i.e., entering into a culture. When the emphasis is on becoming a member of society, the corresponding term is socialization. By definition, . . . the first emphasizes the acquisition of cultural habits, the second the assumption of a place within a social system.[29]

A culture as a whole seeks to provide answers to all the needs of a society and of the average, individual members in it. "Emerging anthropological theory is based on the general postulate that different customs and behaviors with a given society are funtionally interrelated."[30] While a given element of the culture may have multiple functions, the same element may bear a significant relation to several different needs. 25 min.

The function of any culture as a whole is to assure the survival and well-being of the society with which it is associated. The most immediate and pressing problems are those providing food and shelter and safeguarding the physical survival of the members of the society. Unless these problems can be solved adequately, the society is doomed.[31]

[27]Felix M. Keesing, *Cultural Anthropology* (New York: Holt, Rinehart and Winston, 1963), p. 18.

[28]Pelto, *op. cit.*, p. 68.

[29]Keesing, *op. cit.*, pp. 31-35.

[30]Pelto, *op. cit.*, p. 60.

[31]Ralph Linton, *The Tree of Culture* (New York: Alfred A. Knoft, 1955), p. 34.

Culture must also provide the members of a society with techniques for living together and engaging in cooperative activities. A social system is that part of a culture which provides solutions to the problems of group living. The culture provides techniques for the training of individuals so they can function as members of society. As functioning members of society, the individual is able to meet his psychological needs.

While racial characteristics are genetically transmitted, cultures are learned. We learn to speak, think and act as we do because of our daily relationships; when these change, our habits of speaking, thinking and acting also change. Children have no culturally based ways of behaving at birth, but acquire them through the long and complicated process of growing up.

Animals learn by direct experience and by observing and imitating the actions of others. But men learn not only by experience, observation, and imitation but also by having an experience created for them in symbols, usually linguistic symbols.

Leslie White stated that

> All human behavior originates in the use of symbols. It was the symbol which transformed our anthropoid ancestors into man and made them human. All civilizations have been generated, and are perpetuated, only by the use of symbols. It is the symbol which transforms an infant of Homo sapiens into a human being . . . All human behavior consists of, or is dependent upon, the use of symbols. Human behavior is symbolic behavior; symbolic behavior is human behavior. . . . A symbol may be defined as a physical phenomenon . . . which has a meaning bestowed upon it by those who use it. This meaning is arbitrary in the sense that it has no necessary relation to the physical properties of the phenomenon which bears it.[32]

There are two principal ways in which symbolizing is necessary to the development and continuation of culture. Symbolizing enables man to transmit his learning, and also makes it possible for man to make his discrete experiences continuous. Thus culture is an accumulation of learned patterns of behavior originated and developed by means of symbols, and it came into being when man learned to symbolize.

The use of language and other techniques of symbolizing enables men to summarize and transmit their learned ways of behaving to each new generation. The creation and use of symbols also enables man to make his experience continuous, thereby permitting him to bring to a particular problem all the procedures acquired from similar experiences he has undergone in the past. With these

[32]Beals and Hoijer, *op. cit.*, p. 223.

experiences, man was increasingly able to solve more complex problems.

> Most of human existence revolves about the inter-relations and interactions of society, culture, and the individual. . . . The individual is a living organism capable of independent thought, feeling and action, but with his independence limited and all his responses profoundly modified by contact with the society and culture in which he develops.[33]

All human beings have certain experiences which predispose them to group living. "Anthropologists know of no people in the world who do not have some form of family."[34] According to Pelto, "anthropological research shows that the conjugal family — man and wife, plus children — is a fundamental unit in nearly all human societies."[35] In a conjugal family, greater importance is placed on the marital bond than on the blood relationship.

There are many different forms of the family, but they all perform the same basic functions essential to the survival and perpetuation of the human species. Holmes wrote that the minimum functions a family must perform in this respect are seen by anthropologists to be the following:

1. The family must make provision for legitimate sexual outlets for adults.
2. The family must perpetuate the species through controlled reproduction.
3. The family must educate the children.
4. The family must serve as a unit of economic cooperation.[36]

The early human populations consisted of a great number of small groups; the members of each group might be called a family relationship. The members of such a unit normally camped and travelled together. As with any other species the population density of early man probably varied from one region to another in direct relation to the region's food supply.

> It is improbable that any of the early human bands exceeded 200 to 300 individuals, while most of them were certainly much smaller. . . . Rather than one group attempting to drive another out of its territory to provide room for increasing numbers, the pattern seems to be for the population to stabilize in relation to its food supply.[37]

A look at all the economic systems that have existed will reveal a great number of things in common. While these common or similar

[33]Linton, *op. cit.*, p. 29.
[34]Holmes, *op. cit.*, p. 191.
[35]Pelto, *op. cit.*
[36]Holmes, *op. cit.*, p. 194.
[37]Linton, *op. cit.*, pp. 22-23.

elements are called universals, this term does not imply the existence of identical elements in all cultures. The institutions and values making up the various elements of an economic system vary from culture to culture.

According to Holmes, no economic system in the world is without

(1) an organized system of production
(2) an economic value system
(3) methods of product distribution
(4) common monetary symbols
(5) a concept of property.[38]

No society can long exist without a traditional formula for what kind of work will be engaged in for its support and who is going to do that work.[39] As a man learns to expand his producing resources through cultural devices, he lays the base for the expansion of society. While food was the primary resource in man's early development, additional items assumed importance when food became more abundant. This quest for other resources prodded man into developing an economic process for the production and consumption of goods and services.

Every known culture has had some form of division of labor. While this may be based upon such factors as age, family connections, rank, class, caste or special skills, the most basic organization of productive labor is a sex division. In our own society, with the influence of the machine age, specialization along sex lines have tended to become hazy, with women engaging in work activities never before known to them.

The status of craftsmen of various kinds will also differ from culture to culture. An activity assuming a high value in one culture may assume a low value in another. The concept of reward or payment for services may be encouraged or minimized and assume different meaning in the form of food, ceremonial gifts, reciprocal services or a monetary payment.

> True specialization and division of labor occurs only when the society is so organized that some individuals may devote part or all of their time to particular occupations which serve as their means of making a living.[40]

In modern world societies like our own, technology requires even more coordination and organization of labor. The labor force

[38]Holmes, *op. cit.*, p. 171.
[39]*Ibid.*
[40]Beals and Hoijer, *op. cit.*, p. 363.

is so large and complex that it is difficult to comprehend it as an entity or to understand its working parts. Any disruption in one segment of the working force tends to affect almost every member of the society.

"Every society . . . has a traditional set of economic values. Every people must decide how best to direct their efforts . . . in order to derive the maximum satisfaction."[41] The ultimate goal in each society is determined by its value system; this ultimate goal may, however, differ in varying societies.

Why do men or women work? Some people work because it provides them enjoyment, profit, self-respect, prestige — or because it is the thing to do. In many primitive cultures, the chief of the tribe achieved prestige by giving away the most property. In our own American way of life, prestige is often of greater importance than profit. The goals in most societies are different, and means of attaining these goals differ also. The distribution of goods, either for direct consumption or in terms of exercising control over their use, is a bridge between production and consumption. Consumption refers to the utilization of an object for the purpose for which it was designed. We call the economic system the total system of production, distribution, and consumption of goods and services.

Every economic system must of necessity include methods or means of product distribution. This distribution . . . may be based on status considerations or it may involve markets and money.[42]

Patterns of culture which govern the system of exchange tend, like the division of labor, to be influenced by the degree of which a society produces an exchangeable surplus. In societies where little or no surplus is produced, the means of distributing goods and services are simplified. The unit which produces the goods also uses them. Where there is a surplus of goods and services, a more elaborate means of distribution is found. How far having an exchangeable surplus is a casual or a planned matter would have to be looked at for each society.

Accumulation of surpluses over immediate needs provides an insurance against possible emergencies. It may also serve personal and social ends beyond the economic end. Every society appears to have a distinction between subsistence goods and ceremonial goods. What they are and what they do must be viewed in the proper cultural perspective.

According to Keesing, "the concept of property is a cultural universal. Rules regarding the possession, handling and disposition

[41]Holmes, *op. cit.*, p. 177.
[42]*Ibid.*, p. 179.

of property are found in all cultures."[43] These rules are necessary for using natural resources with some degree of security and continuity for the welfare of the total group.

A study of the cultural scene shows all degrees of emphasis from an extreme stress on individual private property rights to communal or collective holding of property.[44] Among most cultures, landholding is a source of social prestige and importance. Thus the title to property is cherished apart from any direct use in the form of goods produced.

> Having a $40,000 home, two cars, and a multifigure bank account is a major goal for many Americans but, . . . for the Kwakiutl Indian, prestige and recognition come from giving property away rather than hoarding it.[45]

Since material property may survive the death of its owner, every society has a special set of rules dealing with inheritance. Some stress primogeniture (first-born); some consider only sons or daughters; or some are based on material goods which may go to different heirs. Whatever method is used, it must be examined in the proper cultural setting.

An examination of the economic system of any people reveals that behaviors relating to production, economic value, distribution, monetary symbols and property all tie in functionally with social organization and with the political, religious and legal attitudes of the culture. There are many differences in social structure that go along with different economic systems, from the small hunting band to the metropolitan center. Among most people religious rituals or magical practices are counted essential if their economic enterprises are to be successful. In most societies, there is a functional relationship between the system of economics and other phases of the culture. People do not live in economic stages, but they do possess economies.

In his early stages of development, man was probably a vegetarian. His subsistence depended upon the fruits and berries available in the trees from whence he came. Eiseley considered the early form of man to have been "a somewhat omnivorous creature who only by degrees, as his numbers grew and his wit increased, turned to meat-eating in any extensive sense."[46] Thus man was at first a

[43]Keesing, *op. cit.*, p. 233.

[44]*Ibid.*, p. 234.

[45]Holmes, *op. cit.*, p. 189.

[46]"Reprinted from *Yearbook of Anthropology*, ed. William L. Thomas, 1955, by permission of the Wenner-Gren Foundation for Anthropological Research Inc., New York."

gatherer. It wasn't until he discovered how to use fire to "unlock" the protein-rich food source represented by the swarming herds of the grasslands[47] that man could utilize both the carbohydrates of the fruits and the proteins of the meats. So in his early stages man was both a hunter and a gatherer.

Beals and Hoijer summarized certain general characteristics common to all or almost all food-gathering societies.

1. Population density is usually low in food-gathering societies. Exceptions to this rule occur only in societies, like those of the North Pacific coast or the Great Plains of America, that live in areas especially favorable to collecting, hunting, or fishing.
2. Food-gathering societies are usually small and isolated, and often move continuously or at frequent intervals from place to place in search of wild plants and animals. They tend, in brief, to be nomadic, in contrast to the more sedentary food producers.
3. Food-gatherers are organized primarily as self sufficient family groups, or, more often, as loose confederations of families. Accordingly, their mechanism of social control and interaction are based more on kinship than on political organization.
4. Finally, the food-gatherers of today are found, for the most part, in remote or marginal areas, to which, presumably, they have been driven by the larger and more powerful food-producing societies. As a result, the food-gathering societies of the world tend to be slow to change and so retain certain patterns of culture which have long disappeared elsewhere.[48]

Hunting and gathering require a certain mobility and adaptability. Man had to pursue wild game, and he probably did so in groups or individually. Once having adapted to the use of meat, man's powers of rationalization inspired tools and techniques suited to the pursuit and thus insured his survival. Man became less dependent on nature and more dependent on his ability to solve problems.

During most of his existence man has lived as a hunter and gatherer. Hunting and gathering as a way of life set a limit on man's cultural and economic development. "The population that can concentrate in a small area is small even where the resources are richest, and rarely rises above two or three per square mile."[49] The potential for developing an efficient, structural community is nearly im-

[47]*Ibid.*

[48]Ralph L. Beals and Harry Hoijer, *An Introduction to Anthropology*, (2nd ed.; New York: Macmillan Company, 1959), p. 331.

[49]Daryll C. Forde, *Habitat, Economy and Society* (5th ed.; New York: E. P. Dutton and Company, Inc., 1961), p. 377.

possible for those persons who depend on hunting and gathering for their existence.

No people that lives entirely by hunting animals and gathering wild fruits and berries can possibly grow into a crowded community. It takes too much ground to feed a man under such conditions.[50]

To live supported by hunting and gathering challenged man's ingenuity. Man had to devise tools and techniques to help him live. Howells wrote that

it is one thing to catch and kill a meat-bearing animal if you have blunt, short canines, small front teeth, and no claws; it is quite another thing to eat it. The animal is enclosed in tough, living leather and opening it up demands something sharper and stronger than your natural equipment. You have no idea until you have tried, how helpful even a crude, blunt tool can be in butchering.[51]

As hunters and gatherers increased in numbers, their ability to cope with the problem of survival became more efficient and more diversified. The use of special tools and weapons became more important. Man discovered that flint could be shaped into cutting tools and arrow heads.[52]

The use of flint for tools brought about some changes in the habits of early man. Although flint is rather common in nature, it is not everywhere available.

In the Neolithic stage he learned to follow good quality flint underground and sank mines into the chalk in search of it . . . the Neolithic and Bronze Age miners dug up to 40 feet deep to reach the best seams of flint which they worked by galleries. They used picks and wedges made of red-deer antler.[53]

In acquiring flint, an early form of trade and barter, a limited amount of division of labor was required.

More skill and ability during the hunt produced more food, but, at the same time reduced the supply of food. As hunting parties had to range further in search of meat, women and children could not keep up with the hunters. Thus women became the collectors of fruits and berries while men pursued the animals.

The hunters developed specialized tools and learned to use them proficiently. Among the most important missile weapons em-

[50]Samuel C. Schmuker, *Man's Life on Earth* (New York: The Macmillan Company, 1930), p. 171.

[51]W. W. Howells, *Back of History* (Garden City, New Jersey: Doubleday, Inc., 1954), p. 144.

[52]*Ibid.*, p. 78.

[53]Kenneth P. Oakley, *Man The Tool Maker* (Chicago: University of Chicago Press, 1957), p. 31. (Copyright, British Museum of Natural History).

ployed in hunting are the spear, harpoon, and bow and arrow. Of more limited occurrence are such implements as the sling, bola, boomerang, spear-thrower, and others. These types of weapons require considerable skill, and the hunter must get within range to make a kill. This caused man to become expert in stalking and patient in his waiting. His powers of thought enabled him to create techniques of disguise (using animal skins to resemble his prey) and to master techniques for simulating mating calls to attract his prey.[54]

Communal hunting excursions provided an effective means of killing large numbers of game: the Solutreans of the Upper Paleolithic apparently drove wild horses over cliffs. Even small game was hunted communally. "The Indians of the American Southwest often hunt rabbits by surrounding an area and beating the brush so as to drive the rabbits into the open where they may be clubbed as they attempt to escape.[55]

As a hunter, man had to adapt to changes in environment. Schmuker, talking about Cro-Magnon (at the time of the last glacial period), suggested that some men followed the glacier in its retreat to the north.

Cro-Magnon was increasing in numbers. His best food, the reindeer, was withdrawing to the North. There were two ways to meet the difficulties successfully. One is to migrate with the reindeer, the other is to change the habits of life to fit the new surroundings. The first plan takes imagination — it requires courage. It involves abundant hardship. Doubtless the best of these men took just this plan and moved as far north into regions as cold as the old glacial times in the old home. . . . Perhaps a less venturesome people, those more attached to the home, tried the alternate plan. Instead of migrating with the food, they learned a new trick . . . to the streams the people turned in this lack of reindeer food — stags they still hunted but stags never went in such herds the reindeer did and hence could not form so abundant a supply.[56]

Beals and Hoijer added that

the fact that fish are available does not always mean that they are used. The Tasmanians, although they collect and eat molluscs, taboo the eating of fish. . . . In fact, relatively few people build their subsistence around the use of fish, although many use fish to supplement the diet.[57]

Those who do fish employ various techniques for catching them, including hooks, harpoons, nets, weirs, and poisons.

[54]Beals and Hoijer, *op. cit.*, p. 332.
[55]*Ibid.*, p. 336.
[56]Schmuker, *op. cit.*
[57]Beals and Hoijer, *op. cit.*, p. 339.

Man has lived as a hunter and gatherer for most of his life on earth. He should be considered as a "really primitive hunter and gatherer . . . for all but one per cent of his known existence, that is, one per cent of the whole time since the beginning of the Pleistocene period."[58] It must be realized, however, that near the end of that hunting and gathering stage man was an intelligent being, capable of considerable thought and problem solving. Nevertheless, it was probably by accident that man learned to plant crops in anticipation of the harvest.

Nature had provided the initial requirements for a division of labor, that is between man and woman. For much of woman's mature life she was pregnant or raising children. The young had to be carried and nursed. Man, however, could be free to roam and explore without biological handicaps to his physical capabilities. Thus man became the hunter, pursuer, wanderer, and woman remained near the campsite where she could labor at child raising and at collecting wild vegetables and fruits. While her mate learned the ways of animals, she learned about growing plants.

> The collectors . . . do not have a simple technology. Actually, collecting involves not only great knowledge of the environment and the characteristics of plants that grow in it, but it requires as well special implements and methods of preparing wild foods. Often plants of great importance are inedible without special treatment or are too difficult to gather without special tools. If lower Paleolithic Europeans were primarily collectors, they probably relied on a limited number of plants, for they apparently lacked most of the special devices of contemporary collectors.[59]

Schmuker suggested that

> doubtless, before man was man he had learned to eat the fruits and the berries; they are large, are lucious and are easily eaten. It was much later he learned to eat the fruits of the grasses. These were not pulpy. Men doubtless, early learned that these greens were rich and sweet and long-chewing, the saliva turning their starch to sugar. Perhaps like the American Indians of the Southwest, they took baskets and went through the ripe grass beating the heads with sticks over the baskets which they held beneath them to catch the heavy grain.[60]

The origin of farming is connected with the domestication of plants. Direct evidence of the mode of domestication probably will never be found, but some fairly reliable deductions may be made. An intimate knowledge of the habits of growing plants would seem

[58]Howells, *op. cit.*, p. 143.
[59]Beals and Hoijer, *op. cit.*, p. 343.
[60]Schmuker, *op. cit.*, p. 199.

a necessity to domestication. Not only are women usually the farmers among simple horticulturists, but they always play a leading role in collecting; consequently, it seems a reasonable surmise that they first began the planting of seed and the cultivation of the soil.[61]

It is interesting to note that "a wheat was cultivated in Egypt fifty centuries before historic time began and ten centuries later Babylonia and Egypt were both using cultivated barley and millet as well as wheat."[62] Scientific studies by botanists and geneticists are revealing that early domestication of the wild plants may have occurred in many areas and with many varieties of plants.[63] Once man had reached a certain level of culture he was ready for the domestication of plants, and he probably domesticated a great variety of them. However, until man had domesticated an adequate starch-producing plant he remained primarily a gatherer.[64]

As previously stated, women were responsible for gathering wild plants, and it is reasonable to assume that women were the first horticulturists. (Horticulture is the term usually applied to the cultivation of domesticated plants for food and other purposes without the use of the plow.)[65]

Probably by the time man had domesticated plants, he had also domesticated animals. Anthropologists tend to agree that the dog was the first animal to be domesticated. The dog, derived from the wolf family, probably travelled in packs and followed hunting peoples in search of food scraps. Wild dogs aided man by warning him of danger from other beasts or other man.

The earliest evidence of the domesticated dog is from the Mesolithic in the Baltic region of Europe about 10,000 years ago. However, the dog seems to be derived from the Asiatic wolf, and hence the first actual domestication must have taken place much earlier.[66]

Howells observed that

dogs are affable beings, and the chances are good that they took to hanging around the human camps hoping for scraps, and were tolerated in this way and later allowed to come along to make themselves useful in the hunt, long before they were actually "domesticated" and bred.[67]

[61]Beals and Hoijer, *op. cit.*, p. 345.

[62]Henry L. Lucas, *A Short History of Civilization* (2nd ed.; New York: McGraw-Hill Book Company, Inc., 1953), p. 254.

[63]Beals and Hoijer, *op. cit.*, p. 346.

[64]*Ibid.*, p. 347.

[65]*Ibid.*, p. 348.

[66]*Ibid.*, p. 355.

[67]Howells, *op. cit.*, p. 115.

Other animals were soon domesticated. When man killed a cow which had a half-grown calf by her side, it seems natural that he should have tethered the calf in anticipation of a time when meat would be scarce. Some of those calves, if kept in numbers, would have reached maturity and have mated, thus producing more calves. "This procedure was more reliable than hunting and the meat would be ready when it was wanted."[68]

Another immediate advantage of keeping certain animals penned up is their capacity to supply milk. "This power to give a large supply of milk is one of the characteristics of the cow which almost from the first must have made her most welcome in captivity."[69] To some peoples the ability of animals to carry a burden was of significance. So it is easy to see how some animals were domesticated for purposes other than food.

To this point the discussion of man has been to place him in a setting wherever the stage is set for what some have called the "food-producing revolution." In relation to established, developmental levels the preceding has dealt with the Paleolithic period and most specifically with the Upper Paleolithic and Mesolithic. By this time man had developed sophistication in the making and use of tools — at least of the wooden, bone, and stone varieties. Most anthropologists agree that man had probably developed containers of wood, leather, and basketry, as well as natural containers of shell and plant life. Clothing and shelter were adequate to provide protection from elements such as those of the glacial period:

> If the Paleolithic people had depended wholly on caves for shelter, there would have been a fearful housing shortage. They are known to have made tents and underground houses and, if some of the cave paintings can be so understood, summer wickiups of sticks and brush.[70]

Man had developed a feeling for art and religion and was practicing magic. Socialization was taking root and some concept of property, trade, and specialization was practiced.

In the late Mesolithic period evidence suggests the use of tools to harvest grasses. "There are also some small blades set in straight handles, which were certainly used to cut grass or grain. This use can be determined by a characteristic sheen or polish which develops on stones so employed."[71] This cultivation of grain meets one of the criterion for the Neolithic period.

[68]Schmuker, *op. cit.*, p. 196.
[69]*Ibid.*, p. 197.
[70]Howells, *op. cit.*, p. 102.
[71]Beals and Hoijer, *op. cit.*, p. 264.

V. Gordon Childe often called the Neolithic a "revolution," because it opened the door to an entirely new way of life. Man began to produce his food and was less dependent upon the vagaries of nature. . . . Finally, as the techniques of farming improved in favorable locations, surpluses permitted the support of non-farming specialists and the carrying on of more trade.[72]

Forde wrote that such a term as "revolution"

must be handled cautiously. Modern day people sometimes think of a revolution as something which takes place in weeks or months and not too often years. One must remember that even today there are groups of people living who retain the methods of food gatherers and that "the surviving hunting people are the cultural ancestors of all mankind.[73]

The basis for a new way of life was the establishment of agriculture and the domestication of animals.[74]

According to Brace,

the origin of grain cultivation is accompanied by the increasing importance of grinding tools indicating the need for fine milling of the food stuffs before they can be eaten. Incidentally, habitual use of grinding in food preparation may be a cultural preadaptation to the appearance of the ground stone tools which once were considered the hallmark of the Neolithic.[75]

Cultural adaptations were providing man with the potential of increasing his rate of changes and adaptations.

The use of grain as a food supply had many implications. People became more settled in permanent locations; they also produced surpluses which could be traded for goods, and they had time to develop answers to the many questions that they had previously ignored. Patterns of life changed and the new tools and techniques were developed.

Early farmers are considered to have been horticulturists. Their major tool was a digging stick which is probably an ancestor of the hoe. The actual use of the hoe had to wait until the discovery of metal for making tools. It was also a long time before man began using animals to aid in the tilling of the soil.

Rice is one of the probable grains that early man cultivated with the digging stick. It is also probable that man had learned to

[72]*Ibid.*, p. 265.

[73]Forde, *op. cit.*, p. 371.

[74]Richard Carrington, *A Million Years of Man* (New York: World Publishing Company, 1963), p. 164.

[75]C. Lusing Brace, "Cultural Factors in the Evolution of the Human Dentition," *Culture and the Evolution of Man*, ed. Ashley Montagu (New York: Oxford University Press, 1962), p. 349.

control the rivers so that the waters could be diverted into the fields to aid in the growing of rice. Probably all the grains were originally grown by horticulturists, as is still the case with some rice growers. Early Chinese farmers grew millet without the plow, while the earliest wheat farmers of Europe were horticulturists. With the exception of rice, however, the old world grains do not lend themselves well to horticultural techniques.[76] Thus the early farmer probably relied on the hunt for much of his food supply. He also, however, received grain in exchange for meat and salt. "Most simple horticulture is done by women and only when horticulture comes to provide the main food supply does it become men's work."[77] Eventually horticulture did become the main source of food, and man became a farmer.

When this was happening, other concurrent happenings took place. Man had time to plan and to change his attitudes.

> Even their gods had changed. The spirits and the magic that had been used by hunters weren't of any use to the villagers. They needed gods who watched over the fields and the flocks, and they began to erect buildings where their gods might dwell, and where the man who knew most about the gods might live.[78]

Some of the aspects of modern civilization were beginning; man was living in permanent dwellings; he was beginning to specialize and he took time for aesthetic enjoyment. Specialists developed in the manufacture of tools and jewelry. Tools that were formerly utilitarian became ornamental. Gold and silver were found to be malleable and were shaped into intricate designs and patterns. "While it is true that the Neolithic economy supported a certain number of expert craftsmen, such as potters and weavers, specialization was not an essential characteristic."[79] Specialization, however, was gaining in popularity; and as the villages were able to support specialists, they became more necessary. "Where . . . cultivation is more intensive and is adopted as a male task, hunting and fishing decline in importance or are relegated to specialists."[80]

The concept of specialization meant that someone else had to perform the tasks that were once shared by all. "Division of work meant increased needs, for the hauler of wood could not hunt and the hunter had no time for hauling wood. The potter would make

[76]*Ibid.*, p. 351.

[77]*Ibid.*

[78]Robert J. Braidwood, *Prehistoric Men* (Chicago National Museum Popular Series: Anthropology, No. 37, 1948), p. 87.

[79]Carrington, *op. cit.*, p. 173.

[80]Forde, *op. cit.*, p. 381.

his pots but had no time to keep his household implements in shape, while the flint worker had less time for ceramics."[81]

As one idea serves to generate other ideas, so did early man profit from the ideas of others. It is certain that trade was practiced over long distances so that ideas and practices were borrowed and exchanged. Neolithic Man was undoubtedly very pragmatic, trying and experimenting with ideas and techniques, rejecting those which did not work and accepting those that did. The wheels of progress turned slowly, however, and often culture patterns and beliefs prevented complete acceptance of new ideas. Concerning the expansion of ideas and the development of scientific thought which has its roots in the perception of early man, Carrington wrote that

> all science has its roots in technology, which may be defined as the use of rational principles to achieve material ends . . . . it is often forgotten that the essential technological use of external equipment by our primitive ancestors was the key to the triumphs of Homo-sapiens.[82]

For thousands of years man

> lived without domesticated animals, or the wheel, or agriculture, or pottery, to say nothing of metal tools. It took hundreds upon hundreds of generations for man to learn to put a decent edge on a flint knife. Millenia went by before his aesthetic impulses had even the crudest means of expression in enduring form.[83]

Thus when archaeologists and anthropologists hypothesize about primitive man's culture, they must study the enduring remains, and when no remains exist they must guess. The remains of stone tools, however, give some insight into man's struggle and evolution.

> Man is the only mammal which is continuously dependent on tools for survival. This dependence on the learned use of tools indicates a movement into the previously unexploited dimensions of behavior, and this movement accompanied the advent of bipedalism. With the assumption of erect posture regular use of tools became obligatory; the ability to use tools must have preceded this time.[84]

Eoliths are stone objects whose shape suggests some sort of use as a tool. Experts, however, do not always agree on whether nature shaped the stones or primitive man observed natural shapes and learned to duplicate the shapes. It is very likely, however, that

[81]Lucas, *op. cit.*, p. 238.

[82]Carrington, *op. cit.*, p. 175.

[83]Melville J. Herskovits, *Cultural Anthropology* (New York: Alfred A. Knopf, 1965), p. 36.

[84]George A. Bartholomew and Joseph B. Budsell, "Ecology and the Protohominids," *Culture and the Evolution of Man*, ed. Ashley Montagu (New York: Oxford University Press, 1962), p. 22.

primitive man at first used as tools those things which nature has shaped for him. Such objects as clubs and sharp objects of wood do not remain for archaeologists to find, but stones which would fit the palm of the hand and could be used as weapons have been found with the remains of primitive man. If at first man used natural objects for tools, he eventually learned to fashion his own objects of bone, wood, and stone. The layers in which the fossils of Peking Man were found include also large numbers of stone artifacts which most authorities regard as belonging to a basic flake-tool culture. Many of the implements have been intentionally fashioned while others are natural flakes with signs of secondary trimming.[85] A technique for shaping flint tools, known as the Levalloisian technique, used flakes of flint purposely struck off of a core of flint.

> First the core piece was flaked to a turtle-shell shape and then a flat piece made as if you had chopped off a turtle's head and chopped off some of the shell in doing so. Then a careful blow against this special platform neatly takes off the crown of the turtle's shell giving you a well-formed flake, smooth on one side and pre-flaked on the other. It is practically a pre-fabricated spear point, or knife, or scraper as you wish. In this method the basic form of a tool had been brought under a considerable degree of control, and for that reason, it was an idea important for the future of stone-working.[86]

Making tools of flint by flaking off pieces is a characteristic of much of the Paleolithic period. Neanderthal Man knew the technique of making tools of flint.

> Their characteristic industry is known as the Mousterian, the last of the seven main tool-making industries of the Lower and Middle Paleolithic. . . . The most characteristic Mousterian tools are the so-called "flake-type"; that is to say, they are fashioned from fragments flaked off from larger pieces of stone not from the residual core.[87]

The Upper Paleolithic period is sometimes divided into five main cultural phases. The earliest or oldest of these phases is known as the Chatelperronian period and occurred over 30,000 years ago in Western France. A flint knife with one straight razor sharp edge and with the other edge blunt and curved over to the point is the most characteristic artifact. The Aurignacian phase followed the Chatelperronian period, and during this phase bone was introduced as a substance for making certain tools. Bone was used to make pins, awls, and spearheads. The third phase is known as the Gravettian phase. A characteristic tool used during this period was a very

[85]Carrington, *op. cit.*, p. 91.
[86]Howells, *op. cit.*, p. 78.
[87]Carrington, *op. cit.*, p. 102.

sharp cutting and engraving tool shaped like the blade of a penknife. The artist and tool-maker of this period used the engraving tool to decorate ivory. The fourth phase is noted for the artistic capabilities of its toolmakers. Known as the Solutrean period, the artifacts that represent this period are finely fashioned flint tools in willow-leaf and laurel-leaf shapes. The fifth phase, known as the Magdalenian period, returns to tools of a more functional nature. The tool-makers of the Magdalenian phase were craftsmen with flint but made excellent use of bone, ivory, and horn for tools.

The Upper Paleolithic brings into prominence whole new sets of secondary stone tools, made for working wood and bone into the actual tools wanted. Concave scrapers are found for shaving down the shafts of spears or darts. Awls were made for drilling holes in either bone or wood. And for all kinds of work with these materials there existed a number of different types of small chisels or engraving tools made by striking a flake from the blade the wrong way, so to speak, against the point leaving a shoulder with a narrow, sharp edge.[88]

Forbes wrote that

it was also in the New Stone Age that man began to polish stone. No longer was he limited to the use of wood, horn or flint for his tools. He could now collect hard stones such as granite and diorite and shape them by patient grinding with sand. This meant that he was no longer dependent on the planes or fracture of flint but could develop new stone tools in shapes more appropriate for his purpose. Hence we see definite forms like the pick, the axe, and the sickle being shaped from hard stone.[89]

As man conceived new uses for tools, his powers of concept permitted him to develop tools with special purposes.

It is interesting to note that modern research has found that the cutting edges and shapes of tools, as far as the intrinsic design is concerned, resemble rather closely those of our modern tools. Thus the archaeologist has a better means of distinguishing the use to which these tools were put. It also permits us to conclude, for example, that certain tools were used by carpenters and, therefore, that the origin of carpentry dates back to about this period.[90]

Coulborn observed that "most of our hand tools, even today, are Mesolithic tools with iron or steel substituted for stone, bone or wood."[91]

[88]Howells, *op. cit.*, p. 107.

[89]R. J. Forbes, *Man the Maker, A History of Technology and Engineering* (London: Abelard-Schuman Limited, 1958), p. 26.

[90]*Ibid.*, p. 27.

[91]Ruskton Coulborn, *The Origin of Civilized Societies* (Princeton, New Jersey: Princeton University Press, 1959), p. 32.

Robert Brittain offered a concept which can be used to summarize the changing patterns of tool-making and usage:

For a history of any branch of technology implies a history of humanity in general. Discoveries may be important in themselves, but what makes them significant for human beings is that they bring changes in men's ways of living, in the way they organize their communal affairs, in their ideas of what is right and what is wrong, in their attitudes toward other human beings, and toward the world they live in. . . . In all the later stages of our development, every improvement in . . . tools has had its social results.[92]

"The advent of the metallurgist introduced an entirely new concept into human social organization; in recognition that the full-time highly skilled technologist was a key figure in achieving cultural progress."[93] Lucas suggested that the discovery of metals for implements was probably an accident.

Possibly some startled man hit at a cooling trickle of metal and saw it flatten under the blow and retain that shape. Since the most primitive stage of metal-working today is the hammering of metal into shape, that was undoubtedly the process at the very end of the Age of Polished Stone. The Age of Copper was the beginning of a planned experiment which was so successful that metal tools and weapons, molded on the old stone implements, were soon used the continent over.[94]

The transition from horticulture to agriculture required the ability to use metal profitably.

True agriculture involves the use of the plow and draft animals. . . . Until fairly recent times, of course, the plow was a much cruder implement than we are accustomed to. It lacked any moldboard to turn the soil, and the share was simply a heavy piece of pointed wood, sometimes tipped with metal, attached to a pole fastened to a yoke or harness on the draft animals.[95]

The early plow, however inefficient, meant that much more soil could be worked thus producing more food and increased amounts of surpluses. Studies of primitive societies reveal that the use of metal; the wheel; writing; and larger, more substantial architecture is associated with those societies that have accepted agriculture as a way of life.[96]

[92]Robert Brittain, *Rivers, Man and Myths* (Garden City, New Jersey: Doubleday and Company, Inc., 1958), p. 29.

[93]Carrington, *op. cit.*, p. 173.

[94]Lucas, *op. cit.*, p. 248.

[95]Beals and Hoijer, *op. cit.*, p. 353.

[96]*Ibid.*, p. 354.

Selected Bibliography

Bartholomew, George A., Jr. and Birdsell, Joseph B. "Ecology and the Prothohominids," *Culture and the Evolution of Man.* Edited by Ashley Montagu. New York: Oxford University Press, 1962.

Beals, Ralph L. and Hoijer, Harry. *An Introduction to Anthropology.* New York: The Macmillan Company, 1953.

———. *An Introduction to Anthropology.* 2nd ed. New York: Macmillan Co., 1959.

Brace, C. Luring. "Cultural Factors in the Evolution of the Human Dentition," *Culture and the Evolution of Man.* Edited by Ashley Montagu. New York: Oxford University Press, 1962.

Braidwood, Robert J. *Prehistoric Men.* Chicago: Chicago National Museum Popular Series, Anthropology, Number 37, 1948.

Brittain, Robert. *Rivers, Man and Myths.* Garden City, New Jersey: Doubleday and Co., Inc., 1958.

Brodrick, Alan Houghton. *Man and His Ancestry.* Greenwich, Connecticut: Fawcett Publications, Inc., 1964.

Carrington, Richard. *A Million Years of Man.* New York: World Publishing Company, 1963.

Coon, Carleton S. *The Story of Man.* New York: Alfred A. Knopf, 1958.

Coulborn, Ruskton. *The Origin of Civilized Societies.* Princeton, New Jersey: Princeton University Press, 1959.

Eiseley, Loren C. "Fossil Man and the Human Evolution," *Culture and the Evolution of Man.* Edited by Ashley Montagu. New York: Oxford University Press, 1962.

Forbes, R. J. *Man the Maker, A History of Technology and Engineering.* London: Abelard-Shuman Limited, 1958.

Forde, C. Daryll. *Habitat, Economy, and Society.* 5th ed. New York: E. P. Dutton and Company, Inc., 1961.

Herskovits, Melville J. *Cultural Anthropology.* New York: Alfred A. Knopf, 1965.

Hockett, Charles F., and Ascher, Robert. "The Human Revolution," *Current Anthropology*, V (1964), 135-147.

Hoebel, E. Adamson. *Man in the Primitive World.* 2nd ed. New York: McGraw-Hill Book Company, Inc., 1958.

Holmes, Lowell D. *An Introduction to Anthropology.* New York: The Ronald Press Company, 1965.

Howells, W. W. *Back of History.* Garden City, New Jersey: Doubleday, Inc., 1954.

Keesing, Felix M. *Cultural Anthropology.* New York: Rinehart and Winston, 1963.

Korn, Noel, and Smith, Harry Reece (ed.). *Human Evolution.* New York: Henry Holt and Company, 1959.

Kroeber, Alfred L. *Anthropology.* 2nd ed. New York: Harcourt, Brace and Company, 1948.

Linton, Ralph. *The Tree of Culture.* New York: Alfred A. Knopf, 1955.

Lucas, Henry Stephen. *A Short History of Civilization.* 2nd ed. New York: McGraw-Hill Book Company, 1953.

Montagu, M. F. Ashley (ed.). *Culture and the Evolution of Man.* New York: Oxford University Press, 1962.

Oakley, Kenneth P. *Man the Tool Maker.* Chicago: Phoenix Books, University of Chicago Press, 1957.

Pelto, Pertti J. *The Study of Anthropology.* Columbus, Ohio: Charles E. Merrill Books, Inc., 1965.

Schmuker, Samuel Christian. *Man's Life on Earth.* New York: The Macmillan Company, 1930.

Titiev, Mischa. *Cultural Anthropology.* New York: Henry Holt and Company, 1959.

CHAPTER THREE

Handicraft Technology

Frederick Broadhurst
East Carolina College
Paul E. Harrison
University of Maryland

Introduction

For the purposes of this chapter the term "handicraft" has two meanings. In the first sense it refers to the making of articles by hand for the satisfaction of the immediate needs of the individual or the household. At this stage there was no separate body of craftsmen, and all that could be called industry was carried on within the household group.[1] The primitive agriculturalist was his own manufacturer. He baked his own bread, brewed his own beer, wove his own cloth, and shaped the rough garments he wore. This stage is sometimes designated as the stage of household industry or the family system.[2]

In the second sense, handicraft refers to a system of production that became dominant during the late middle ages. It was this era which saw the rise of the specialized craftsman, the development of the towns as centers of trade, the rise and decline of the guilds, and the spread of the domestic or wholesale handicraft system. The specialized production of articles for sale by individuals

[1]William J. Ashley, *The Economic Organization of England* (New York: Longmans, Green and Co., 1914), p. 34.

[2]Arthur Birnie, *An Economic History of The British Isles* (New York: F. S. Crofts and Co., 1936), p. 98.

or by small groups who practiced their handiwork in the home or shop characterized the handicraft system of manufacturing.[3]

Handicraft Technology

For the purpose of this paper, then, the term "handicraft technology" should be thought of first in the sense of the handicraft system of production that characterized industry throughout the middle ages and continued well into the eighteenth century. In the second sense, the term refers to the technology of the handicraft stage (the sum total of man's attempts in this era to control his physical environment — both natural and that which he created). Thus handicraft technology refers to the technology (in its broadest interpretation) that prevailed when manufacturing systems were relatively simple, being largely characterized by literal hand production and uncomplicated methods of marketing and exchange.

Early Manufacturing Systems

1. Family or Household Manufacturing. Family manufacturing may be more clearly distinguished from other stages of industry by referring to Heaton's concise statement: "In general, production was by the household, in the household for the household."[4] Bucher, as presented by Marshall, stated:

> The character and extent of the production of every household are prescribed by the wants of its members as consumers. Each product passes through the whole process of its manufacture, from the procuring of the raw material to its final elaboration in the same domestic establishment, and reaches the consumer without any intermediary.[5]

Gras used the term "usufacture, or manufacture for use — not for sale,"[6] in describing this early stage in the development of manufacturing systems; although this kind of manufacture is the earliest and most primitive and has in part bowed to other methods. Historically it is the most important type known to man, not so much because it still survives, as because it has fed, clothed, housed, armed,

[3]Edison L. Bowers and R. Henry Rowntree, *Economics for Engineers* (New York: McGraw-Hill Book Company, Inc., 1938), p. 64.

[4]Herbert Heaton, *Economic History of Europe* (New York: Harper and Brothers, 1936), p. 142.

[5]Leon C. Marshall, *Readings in Industrial Society* (Chicago: The University of Chicago Press, 1918), p. 33.

[6]Norman S. B. Gras, *Industrial Evolution* (Cambridge, Mass.: Harvard University Press, 1930), p. 1.

and adorned so many generations — far more than any other type of industrial organization.[7]

According to Ely and Hess, household manufacturing was almost universal both in the direct appropriation stage and throughout the pastoral and agricultural stages. "Its essential characteristics were isolation and economic self-sufficiency, goods being produced mostly for local consumption and not for sale."[8] There was a marked division of labor within the household, estate or plantation, but this division was limited beyond them by the absense of exchange.[9]

A more or less clear-cut division of labor was practiced in household manufacturing regardless of whether the household unit was small (such as the individual family), or relatively large (as the clan, estate, or manor). Boissonnade indicated that every member of the family community, according to sex, age, and aptitude, tried to produce such manufactured goods as were necessary for the elementary necessities of life. The peasant was engaged in building his home, making his furniture, and repairing his ploughshares. His wife and daughters made bread, spun wool, and wove material for garments.[10]

The fall of the Roman Empire resulted in a general ruralization of life in which communities became self-supporting.[11] Heaton stated:

> An occupation census of Europe in the eleventh century would probably have shown that 90 per cent of the people were country-dwellers, drawing their livelihood from farming, fishing, or the forest.[12]

It was from the fall of the Roman Empire until about 1100 A.D. that usufacture, or manufacture for use, was most prevalent.[13] The manor, "that community in which unfree villagers (villeins) cultivated the lord's domain as the price of their selfdom and of their use of a holding,"[14] became the seat of rudimentary manufacturing. Food and drink were prepared in the lord's bake-house, mill, brewery and wine press. Clothing, furniture, candles, and similar articles

[7] *Ibid.*

[8] Richard T. Ely and Ralph H. Hess, *Outlines of Economics* (New York: The Macmillan Company, 1937), p. 28.

[9] *Ibid,* pp. 27-28.

[10] P. Boissonnade. *Life and Work in Medieval Europe* (New York: Alfred A. Knopf, 1937), p. 102.

[11] Frederic A. Ogg and Walter R. Sharp, *Economic Development of Modern Europe* (New York: The Macmillan Company, 1926), p. 43.

[12] Heaton, *op. cit.,* p. 91.

[13] Gras, *op. cit.,* p. 46.

[14] Heaton, *op. cit.*

were manufactured from materials produced locally. The village smith not only made implements but kept them in repair as well.[15]

Gras divided the usufacture stage of manufacturing into three distinct phases. The first he characterized as the purely domestic phase in which the family owns the raw material, does all the work, and ultimately consumes the product. This type of manufacture has been predominant in the collectional, cultural nomadic, and settled village economy.[16] The members of the household must gather its raw materials from the soil, produce all necessary tools and implements, and convert the raw materials to make them usable.[17]

The second phase of usufacture is described as a movement which developed no later than the settled village economy with outside labor being brought in to help the family in its manufacturing activities. An individual develops special skill in making shoes, building boats, carpentry, blacksmithing, or tailoring. His neighbors enlist his help and in this way, profit from his particular aptitude.[18] Because of the unproductiveness of early methods of work, the cooperation of many individuals was necessary for the accomplishment of certain economic ends.[19]

The third phase of usufacture is that in which raw materials are taken to some outsider who finishes the product. For example, during the Middle Ages many villagers took grain to the lord's mill to be ground into flour or meal.[20]

> Throughout the stage of usufacture, no matter what the phase, we observe that the goods are made to be sold. There is no oversupply, for goods are made only in answer to a developed demand.[21]

The technology of the day was relatively simple. Handicraft in the sense of hand production, was practiced exclusively. There were no organized systems of production, trade, and exchange as we think of them in modern industrial society. It has been only within the last century that such industries as "baking, brewing, laundry work, or the making of clothes, rugs, candles, soap, butter, cheese, bacon, jam, and pickles ceased to be domestic industries, especially in the rural homes."[22] Such production is still the usufacture type, but it is being practiced in a different industrial stage.

[15]Ogg and Sharp, *op. cit.*, pp. 43-44.
[16]Gras, *op. cit.*, p. 1.
[17]Marshall, *op. cit.*
[18]Gras, *op. cit.*, p. 3.
[19]Marshall, *op. cit.*, p. 34.
[20]Gras, *op. cit.*, p. 6.
[21]*Ibid*, p. 7.
[22]Heaton, *op. cit.*, p. 113.

2. Retail Handicraft. Retail handicraft was the prevailing manufacturing system from 1100 to 1500 and came into existence

> when the household, manufacturing primarily for its own needs, produced a surplus for sale, and when the artisan, hitherto working on his customer's goods, began to provide the raw materials himself and sell the finished product. It is still, of course, handwork that is being carried on, but it is work for sale to another person. The sale, however, is direct to the user.[23]

Although Ashley did not use the term "retail handicraft," the guild or handicraft stage appears to parallel the retail handicraft stage described by Gras. Thus according to Ashley, production continued (or existed) on a small scale and occurred in either the home of the customer or that of the craftsman. There was a "market" in the modern sense of the word, but it was a small one in which the producer dealt directly with the customer without benefit of an intermediary.[24] The fact that all production was not consumed by the producing unit removed it from the usufacture classification.

Retail handicraft was originated in rural areas, but as civilization became more urbanized there was an even greater need or demand for wares on the retail market.[25] As towns grew, merchant bodies were formed and markets were established; both the peasant and the lord of the manor were provided with a market then for surplus produce. Men were brought together as buyer and seller as never before. The way was thus prepared for the growth of a new class, the craftsman, whose existence was largely dependent on his ability to sell his products.[26]

Ogg and Sharp concluded that industrial growth (in terms of volume, independence, and organization) was closely associated with the development of commerce and the revival of towns and town-life. These movements began in the eleventh century and proceeded to develop at an accelerating rate during the succeeding two or three centuries. Although the Crusades may have provided the impetus industry, trade, and town-life developed as a result of deep-seated economic conditions not particularly related to the Crusades. These included

> growth of population, the increase of wealth, the larger demand for manufactures incident to an improving standard of living, and the social

[23]Gras, *op. cit.*, p. 13.
[24]Ashley, *op. cit.*, p. 36.
[25]Gras, *op. cit.*, pp. 13-14.
[26]*Ibid.*

flexibility created by the emancipation of the serfs and the gradual break-up, in many regions, of the manorial system.[27]

Retail handicraft has two phases, according to Gras. The first of these is the order phase in which the craftsman does not maintain a surplus manufactured stock, but produces upon being commissioned. The second phase of retail handicraft is the chance-sale phase in which the craftsman maintains a surplus of manufactured stock.[28]

The craftsman's wares were displayed either in front of his workshop, on a sidewalk counter, or in the window; he might have sold his products at the markets or fairs or even by peddling them through the countryside. In any case, direct contact between craftsman and consumer continued, but the craftsman was now concerned with selling "the product of his equipment and skill, not the use of it."[29]

Gras emphasized that the essential point in the retail handicraft system was that a sale was made directly to the buyer without the intervention of a third party, such as a capitalist merchant or industrial entrepreneur. The essence of this system was not involved with the guild system; it was not concerned with a finished product, as such; it was not concerned with sale to an ultimate consumer; nor was it concerned with the presence or absence of power machinery.[30]

Retail handicraft has continued as an important aspect of economic organization. This was especially true for industries supplying a purely local demand for food, clothing, buildings and furniture. In such instances, the production unit was small with the craftsman using the labor of family members to a large extent.[31] Here again we note the continuance of an earlier type of manufacturing, a more advanced stage.

The terminology of these economic stages is somewhat confusing. Although historians apply different labels to the various stages of industrial evolution, the essential elements remain the same.

The terminology as developed by Gras has been used throughout this discussion of early manufacturing systems.

The term wholesale handicraft is believed to be an improvement over others in use, each of which has drawbacks. Domestic system leads

[27]Ogg and Sharp, *op. cit.*, p. 44.
[28]Gras, *op. cit.*, p. 16.
[29]Heaton, *op. cit.*, p. 169.
[30]Gras, *op. cit.*, p. 20.
[31]Heaton, *op. cit.*

to confusion with household industry (our usufacture), and refers to only one phase (our independent wholesale handicraft). Putting-out or commission system applies to only one phase of the stage (our dependent wholesale handicraft). E. Lipson . . . uses the term domestic system but really describes the commission system. This is but one example of many confusions which seem to justify a complete change in terminology, unwelcome as that may be to those who have learned the old phrases.[32]

3. WHOLESALE HANDICRAFT. Usufacture was described as that industrial stage in which all that was manufactured was consumed by the producer. There was no surplus for sale. The retail handicraft stage saw the rise of villages and towns and a general expansion of economic and social organization. Here, although production methods remained unchanged, the craftsman became more specialized and began to produce more than he could consume. This over-production was sold directly to the consumer by the craftsman. The uniqueness of the retail handicraft system was that the sale was made directly to the user without the intervention of a middleman. Here we generally find the handicraftsman belonging to a guild.

Wholesale handicraft, the third stage in industrial evolution, is a term used by Gras to identify a system in which "goods are made by one set of persons, marketed by another, and consumed by a third. . . . Manufacture is still characteristically by hand, but sale is no longer direct to the consumer."[33] The indirectness of the system is its chief, distinguishing characteristic.[34] Gras noted two specific stages.

In the *independent phase*, the craftsman still produced by hand labor, but virtually gave up selling to the consumer. Instead, the sale was to a merchant who disposed of the goods in further processes of exchange. The advent of the middleman and the consequent indirectness of this economic system was a significant development in industrial evolution.[35] This phase of wholesale handicraft is designated as *independent* because the craftsman "still supplied his own raw materials and tools, possessed his own little estate, worked at his own pleasure, and sold his finished product (indirectly) as he would."[36]

[32]Gras, *op. cit.*, p. 35.
[33]*Ibid.*, p. 25.
[34]*Ibid.*
[35]*Ibid*, pp. 28-30.
[36]*Ibid*, p. 31.

In the *dependent phase*, the craftsman through some misfortune becomes indebted to a merchant beyond his ability to pay and consequently loses the privilege of living and making a living independently as he did in the previous phase.[37] In the *dependent phase*, the commercial middleman practically dictates the kind and grade of product to be made and may control the manufacturing process.[38] The worker thus loses his independence. He is no longer economically independent as he has to work twelve hours a day, follow orders as to quality and quantity of output, and accept whatever wage was offered.

An example of the independent phase of the wholesale handicraft system is provided by Gras in his account of wine production. When wine that had been previously made for home consumption became so well made that it was handled in interurban trade and was sent long distances, it entered the wholesale handicraft stage. Grapes were gathered and stemmed by the peasants who then pressed out the juice and put it into vats or casks for fermentation. The product was then sold by the peasant to an exporting vintner who ultimately sold it to an importing vintner or to a taverner. It finally reached the customer through the taverner.[39] It should be noted that the craftsman (winemaker) was free to make the product of his choice at his own pleasure and with his own tools and materials.

Another example of the independent phase of wholesale handicraft is cited by Cheyney. In the latter sixteenth and the seventeenth centuries manufacturing was carried on in the craftsman's house by lesser masters with the assistance of a journeyman and one or two apprentices. The master might divide his time between farming and manufacturing. In most cases the tools of manufacture belonged to the master, they were rented out by the employing merchant capitalists. The raw material was often purchased by the small manufacturers and the goods were transported to market and sold to a local dealer or merchant.[40] The system was devoid of the more highly capitalistic elements of the dependent phase.

The dependent phase was denoted by Gras in the following examples:

[37]*Ibid*, p. 37.

[38]Melvin M. Knight, "Handicraft," *Encyclopedia of the Social Sciences*, VII, (New York: The Macmillan Company, 1937), p. 256.

[39]Gras, *op. cit.*, pp. 28-29.

[40]Edward P. Cheyney, *An Introduction to the Industrial and Social History of England* (New York: The Macmillan Company, 1917), p. 188.

In Paris the richest weavers gave up working with their own hands in the thirteenth century. They even abandoned the direct supervision of manufacture, so as to more completely devote themselves to marketing, the adjustment of demand and supply. They gave out the yarn to the poor master weavers working in their homes, paying them so much per cloth for manufacture. In the copper trade of Dinant and the woolen industry of Flanders, we find early illustrations in the thirteenth century of the development of this dependent system, in which rich masters put out materials on which the poor had to work. In the town of St. Omer, weavers, fullers, shearers, and dyers, were almost completely at the mercy of the drapers who employed them at piece wages. In Florence, dyers, shearers, and finishers about 1300 saw themselves robbed of their economic independence and of their direct relations with consumers.[41]

The period of particular prevalence of the wholesale handicraft system was between 1500 and 1750, the independent phase coming first but later giving way to the dependent. The independent phase kept the craftsman more economically independent and more directly responsible for his work. Among its chief disadvantages was the lack of the organization and control of production necessary to a rapidly expanding market.

The dependent phase saw the craftsman become gradually more dependent upon external economic forces and gradually less responsible to the consumer for producing goods of superior quality. Among its advantages was that it provided employment for those who needed it, including the crippled and those who cared for sick parents or children. It gave demand a chance to influence supply,[42] and it allowed for and facilitated a functional division of labor necessary to the more complex forms of industrial organization to come.

4. THE GUILD SYSTEM. The organization of workers into guilds was, according to Ogg and Sharp, the most noteworthy feature in medieval industry.[43] Although many writers in the field of economic development treat the guild system by equating it with the handicraft system, it will be viewed here not as a system of production but as a form of association for the control of production, exchange, and the like. Supporting this idea, Gras made the following remarks:

> So far we have been considering the organization of industry, whilst now we turn to association in industry. . . . We may express organization as the buying of raw materials, the combination of all elements necessary for manufacture, and the sale of the finished product. Such

[41]Gras, *op. cit.*, p. 39.
[42]*Ibid.*, pp. 46-47.
[43]Ogg and Sharp, *op. cit.*, p. 46.

organization, so far as we have gone, has passed through three stages. Association in industry is something very different. It is the coming together of the producers for mutual advantage. The masters may form associations of their own, as may the workmen. Or the two may be members of the same association.[44]

Knight, also, supported this position by describing guild as "a very loose term which has been applied to various associations of people for trading, industrial, professional, religious, and other social purposes in widely separated times and places."[45]

Heaton reported that little was known about western guilds until after 1000 A.D. There is mention of the weavers' guild of Mainz in 1099, the fish dealers' guild of Worms in 1106, and the weavers' guild of Cologne in 1112. A merchant guild was established at Burford in England by 1107, and the weavers' guilds in London and other towns by 1133. In Paris there were five leather working guilds by 1150. At one time London had as many as one hundred guilds. Florence, Venice, and the Flemish towns also had numerous guilds. By about 1300 the guilds had come into existence in most towns.[46]

The guilds developed in two major forms: (1) the merchant guild, "the purpose of which was to regulate the conduct of trade and to monopolize it on behalf of the local merchants,"[47] and (2) the craft guild, "formed primarily to regulate and preserve the monopoly of their own occupations in their own town."[48]

The merchant guild was the earliest form and was "composed of the wealthier citizens, who banded themselves together in the interests of trade and who also assumed certain financial obligations for the community."[49] It was first organized as a private society the objectives of which were the protection of its members and the maintenance of trade interests. During the twelfth century, it was included in the town constitutions; and during the next three hundred years the guild became an increasingly influential group in town governments. Finally it merged so completely with the governmental systems that its unique identity was lost.[50]

[44]Gras, *op. cit.*, p. 50.

[45]Melvin M. Knight, *Economic History of Europe* (New York: Houghton Mifflin Company, 1926), p. 94.

[46]Heaton, *op. cit.*, pp. 208-209.

[47]Ely and Hess, *op. cit.*, p. 29.

[48]Cheyney, *op. cit.*, p. 65.

[49]W. Stanford Reid, *Economic History of Great Britian* (New York: The Ronald Press Company, 1954), p. 95.

[50]Marshall, *op. cit.*, pp. 74-75.

The guild organization included all persons habitually engaged in the business of selling — either products manufactured by themselves or those they had purchased. It seems to have exerted as much authority within its field of trade regulation as that of the town in its field of judicial, financial and administrative jurisdiction. Cheyney stated that preserving a monopoly of trade to its own members was the principal reason for its existence. Non-members, whether from other countries or traders from other towns, were not permitted to buy or sell in the town except under conditions imposed by the guild. They could buy and sell only at such time and place and only such articles as were provided for in the guild regulations. In all cases, they were required to pay the town tolls from which members of the guild were exempt. In addition to holding meetings (at which time officers were elected, new ordinances were passed, and other business was transacted), it fulfilled many fraternal duties for its members. Although the full development of the merchant guild varied in different towns, it reached its widest expansion during the thirteenth century.[51]

As previously noted, membership in the merchant guild included any person actively engaged in the selling of wares, whether produced by himself or purchased for sale. It will be recalled that in retail and wholesale handicraft individual craftsmen were engaged in selling and were therefore merchants who were eligible for membership in the merchant guilds. As Cheyney stated, "there was a considerable period when it must have been a common thing for a man to be a member both of the merchant guild of the town and of the separate organization of his own trade."[52]

The craft guilds seem to have been introduced "in response to the needs of handicraft much as the merchant guild had grown up to regulate trade."[53] Emerging in the twelfth century, they replaced the merchant guilds, and according to Ogg and Sharp:

> In the following hundred years they became the dominant organizations among the non-agricultural populations, rising in many cases to the possession of controlling political power in the municipalities. Their importance lasted into modern times, and only after the French Revolution was their hold upon industry in continental countries fully relaxed.[54]

[51]*Ibid*, pp. 61-64.

[52]Cheyney, *op. cit.*, p. 64.

[53]*Ibid.*

[54]Ogg and Sharp, *op. cit.*, p. 46.

5. The Central Workshop. As a result of the rapidly expanding economy of the late Middle Ages and the attempts of merchants to gain better control of production and product, centralized manufacture was instituted. As Weber indicated, "for the first time disciplined work appeared, making possible control over the uniformity of the product and the quantity of output."[55]

According to Gras,

> centralized manufacture is done in large establishments in which many workmen labor under the direction of a single individual or firm, whose products are sold chiefly by wholesale. The first phase of development may be called the central workshop, the second the factory. The failure to distinguish between these two phases leads to a misunderstanding of some of the essentials of modern industry.[56]

Clough and Cole discussed or defined centralized production in terms of the bringing together by a capitalist or a capitalistic group a large number of workers and a large amount of capital in a given spot. The very nature of the industry sometimes demanded centralized production. In the mines of Germany, for example, and the shipyards of Holland, efficient work required many hands as well as considerable capital. Brewing and sugar refining were also industries in which organization of work on a fairly large scale was easy; they were, in fact, industries in which a single craftsman, with a few helpers, was at a disadvantage.[57]

A typical example of central shop manufacturing which existed during the sixteenth and seventeenth centuries was cited by Friedlaender and Oser:

> John Winchcomb, the biggest English cloth manufacturer of the sixteenth century, employed in his factories 200 weavers, each with an assistant; 200 women carders; 200 girl spinners; 150 child sorters; and 50 shearers, 40 dyers in the dyeing house and 20 walkers in the walking mill.[58]

Other examples are reported from the cloth industry in France in the eighteenth century. In Austria during the same period, the Imperial Wool Factory employed more than 25,000 persons, most of whom worked in the home; but at least 1,000 worked together in the same establishment. Manufacturing on a large scale was also

[55] Max Weber, *General Economic History* (Glencoe, Ill.: The Free Press, 1927), p. 168.

[56] Gras, *op. cit.*, p. 76.

[57] Shepard B. Clough and Charles W. Cole, *Economic History of Europe* (Boston: D. C. Heath and Company, 1952), p. 59.

[58] Heinrich Friedlaender and Jacob Oser, *Economic History of Modern Europe* (New York: Prentice-Hall, Inc., ©, 1953), p. 59.

found in the malt distilleries, soap factories, and primitive blast furnaces which produced raw iron.[59] Central workshops also existed in the United States during this same period.[60]

Additional examples of large scale production during this period were in the production of soap, candles, salt beer, paper, gunpowder, and glass, all of which needed fairly large sums of capital for vats, pans, raw material, fuel, buildings, and working expenses. Production was carried on by large groups of wage earners.[61]

According to Gras, two primary advantages existed in the establishment of such an organization. The first advantage was "for purposes of discipline, so that the workers could be effectively controlled under the supervision of foremen."[62] The second advantage "lay in the division of labor. There were workmen . . . and foremen. . . . Some men did one kind of work, while others were put to something else."[63] A reference is made to division of labor by Clough and Cole in their discussion of the Dutch shipyards in which the work was divided among different craftsmen so that each performed only a few specialized tasks.[64]

Advantages of a central workshop were manifold. It was possible to prevent loafing and the wasting of time by employees, embezzlement and cheating could be more easily detected, standards could be more closely guarded, an organized division of labor could be developed, and all phases of production could be centralized under one room — there was no traveling from household to household to complete the next phase of production.[65]

From the standpoint of production systems as such, Gras referred to at least two types of central workshops. "In one type only handwork was performed. In the other, hand machines were used, among them the potter's wheel, the stocking frame, the spinning jenny, and the sewing machine (Howe's and Singer's).[66] These machines, although quite helpful to employee and production, were all manually operated and controlled. They should not be confused with the later power machines suitable for the type of production which made the factory system possible.[67]

[59]*Ibid.*
[60]Gras, *op. cit.*, p. 81.
[61]Heaton, *op. cit.*, p. 345.
[62]Gras, *op. cit.*, p. 77.
[63]*Ibid.*
[64]Clough and Cole, *op. cit.*, p. 183.
[65]Heaton, *op. cit.*, p. 342.
[66]Gras, *op. cit.*, p. 83.
[67]*Ibid.*

Little need be said of the factory system at this point as it will be discussed in other sections of this yearbook. It came into existence in the eighteenth century as the climax to thousands of years of industrial evolution. In its simplest form, it was the central workshop with power machinery added — power supplies by the treadmill or the waterwheel, or power generated by coal, gas, or electricity. Man's servant, technology, hardly recognizable at this time, having passed through its embryonic stages during the centuries before, had now reached the stage of infancy, and was rapidly becoming the giant destined to implement the progress of mankind in the centuries to come.

Concept of Work

The craftsman, technologist, and inventor have usually occupied an important place in the evolution of civilization, even though some interpretations of history may not make it appear thus.

The discussion which follows centers around craftsmen and technologists, and the development of civilization with particular reference to the position accorded such workers during certain eras.

More than nine tenths of the history of mankind passed by during the Old Stone or Paleolithic Age. During this age which lasted anywhere from 500,000 to 1,500,000 years man developed but little in comparison with the vast technology of today. Archeologists' findings reveal that during this vaguely recorded span of time, man's technology was simple and most of his tools were made of stone. Such tools were formed by breaking, chipping, and flaking hard material like flint. There was little specialization — every man was a nomadic collector, struggling to provide his own shelter, food, and defense. The Middle Paleolithic Age saw man's first use of caves for dwelling. As tool-making by chipping techniques was further developed, bone anvils were used. During the Upper Paleolithic Age fire was utilized, horn and ivory became tool-making materials, and specialized tools such as needles with eyes made their appearance. The Middle Stone or Mesolithic Age designates the transition period somewhere between 9,000 - 4,000 B. C. that occurred near the end of the Paleolithic Age. It marks the beginning of the era of human settlement and cultivation. The crude plow was developed and the domestication of animals was begun. The Neolithic Age saw man become an established food producer rather than a nomadic collector. Stone polishing was developed, and the lamp, the wheel, and writing were invented. Other advances included the smelting of copper and bronze. Iron was produced around 1500 B. C. and was used throughout Europe and Asia by the year 400 B. C. According to Derry,

> time and skill was no longer monopolized by the needs of the stomach, for the agriculturalist, unlike the hunter, has seasons of comparative leisure and makes a permanent home. Society could now find scopes for handicraft and trade.[68]

Man's ability to alter his environment had brought him a long way toward civilization even though he was not a specialized craftsman in the sense of later periods. The concept of work was attached to self-survival and the provision of whatever comforts he could acquire.

Later developments enhanced the arrival of the civilizations of the great Empires of Western Asia, Egypt, India and the Far East along with the Greek and Roman civilizations. In writing of the attitude of the Greeks toward manual labor Bowen commented: "The Greeks had a horror of manual labor and despised laborers. . . . The applied scientist, if one can use such an expression in connection with those times, was a slave or a craftsman."[69]

Finch supported this point as follows:

> A large proportion of the population were slaves. Furthermore, all practical affairs, all activities of craftmanship and hand labor, were left to menials. The leaders of Greek thought regarded manual work as destructive alike to the bodies and minds of the workers — a viewpoint which still occasionally crops up and which long caused engineering, because of its necessarily close association with the practical arts, to be regarded as a "navvy" profession.
>
> * * * * * * * * *
>
> Even Archimedes (287-212 B. C.), popularly acclaimed for his remarkable mechanical inventions, appears to have been ashamed of his interest in such works. He apologized for them, claiming they were carried out merely for his diversion and amusement.[70]

Singer attributed much of this lack of accomplishment in technology to the philosophies of Aristotle and Plato which degraded those who worked with their hands.[71]

[68]Thomas Derry and Trevori Williams, *Short History of Technology* (London: Oxford University Press, 1961), p. 6.

[69]Harold G. Bowen and Charles F. Kettering, *A Short History of Technology* (West Orange, N. J.: The Thomas Edison Foundation, Inc., 1954), p. 18.

[70]James K. Finch, *Engineering and Western Civilization* (New York: McGraw-Hill Book Company, Inc., 1951), pp. 14-15.

[71]Charles J. Singer, *Technology and History* (London: Oxford University Press, 1952), p. 5.

In Greece, technology generally ranked below pure science. The freeman gave his talents to the State, to art or to pure science. "Practical production was in general the business of the foreigner and of slaves."[72]

At least one author disputed the notion that the Greeks considered work beneath the dignity of a free man. Mitchell pointed out that any prejudice against manual labor certainly did not exist throughout the era of Greek civilization, but was of comparatively late origin.[73]

The Roman world showed more interest in technical achievement than did the Greek, yet they apparently attempted no transformation of technical accomplishment or specialization in the technical crafts. Among the Romans "there was no real application of science to technical achievement."[74]

Finch noted that while we regard the Romans as the greatest of ancient engineers especially for their accomplishments in road building and architecture, the Roman mind did not value the qualities necessary for continued technological advance.[75]

Bowen described Rome as technologically sterile. The Romans were copiers rather than creators. Roman fame rests largely on conquests, law and administration. Their technical contributions to the Middle Ages were few.[76]

Industry in the Middle Ages was scant and simple. Handicraft was the principal type of manufacturing until the fifteenth century, and the manor was the seat of such production as was carried on. Prior to the twelfth century labor was largely servile, although it rapidly acquired a status of freedom thereafter.[77] Technological achievement was limited to areas which had received the culture's "seal of approval."[78] According to Forbes, technology and the crafts were very much in the service of the church,[79] and as Nibet stated,

> the guilds, the morally sovereign church and all its component orders, the communities, the well marked social classes, all alike were organized with ends in view which made the role of technology strictly a subordi-

[72]Friedrich Klemm, *A History of Western Technology* (Cambridge, Mass.: The M. I. T. Press, 1954), p. 19.

[73]H. Mitchell, *The Economics of Ancient Greece* (Cambridge: W. Heffer and Sons Limited, 1963), pp. 9-19.

[74]Klemm, *op. cit.*, pp. 42-43.

[75]Finch, *op. cit.*, p. 17.

[76]Bowen and Kettering, *op. cit.*, p. 24.

[77]Ogg and Sharp, *op. cit.*, pp. 43-44.

[78]Robert A. Nisbet, *Man and Technics* (Tucson: University of Arizona Press, 1956), p. 11.

[79]R. J. Forbes, *Man the Maker: A History of Technology and Engineering* (New York: Abelard-Schuman Limited, 1958), p. 109.

nate one. . . . The technologist, like the scholar and the merchant lived his days within tight associations founded upon rigid duty to the larger whole. . . . Technology was the servant of the community and it knew its menial place well.[80]

The craftsman or technologist of the Middle Ages was considered subordinate to the artist, statesman, theologian and nobleman. His creative achievements were few and were valued largely insofar as they served the values of the non-technically oriented society of the day.

From the earliest beginnings of industry on into the early stages of the handicraft era, craftsmanship and technology—despite their importance in the development of civilization—were never accorded dominant roles in the social organization of their time. Until the twelfth century, labor was largely servile with slavery and serfdom the prevalent modes. Labor rapidly acquired free status during the twelfth century, specialization increased, and social organization became more complex. The craftsman who performed his job particularly well was respected and he perhaps even acquired a patron who kept him employed. "Thus the craftsman increased gradually in individuality, security, scope and importance until the invention of machinery revolutionized industrial production."[81] The craftsman became the keystone of technological progress in the developing world of commerce. Guilds were organized to offer him protection and security.

Craftsmanship of the Handicraft Stage

The term craft is defined as art or skill, and the craftsman is defined as one who practices some trade or manual occupation. Thus craftmanship becomes the degree of skill that is exemplified in the work or in the article produced by the craftsman. In this instance the concern is with the craftsmanship of the periods of history when virtually all that was produced was accomplished without the aid of machinery.

The craftsmen of ancient Egypt and Mesopotamia were apparently very skillful, for they produced excellent work solely by hand. According to Forbes, "fine woodwork and ivory work show that the ancient craftsman would have little to learn from modern specialists in this field."[82]

Bowen and Kettering described the craftsmanship of the Greeks as superb. They excelled in the design and decoration of

[80]Nisbet, *op. cit.*, pp. 11-12.
[81]Knight, *op. cit.*, p. 255.
[82]Forbes, *op. cit.*, p. 44.

pottery, and they constructed aqueducts and tunnels of a high order. They possessed a great sense of beauty, harmony, and proportion — "everything the Greeks touched was endowed with fresh beauty and was really a Greek creation."[83] Forbes wrote:

> Turning to the arts and crafts of the Greeks, we cannot help noting ... how beautiful the products of the Greek craftsman could be ... the products turned out there were not imitations but typical Greek creations.[84]

The following comments which were offered by Mitchell contradicted other sources:

> The Greek potter was a supreme artist; the present-day one can beat him as a technician. The Greek metallurgist was severely hampered in his processes by his inability to produce very high temperatures in his furnace; the modern metallurgist is far superior to him — we may even say he is a greater artist. ... but to say that the ancient workman was a superior craftsman is nonsense; he was not, simply because the means at his command were limited and his capabilities circumscribed. He worked with what he had, but he had not got very much; we have a great deal and so we can beat the Greek. Whether or not we may derive any satisfaction from that may be left to each of us to settle for himself.[85]

Roman craftsmanship is exemplified by the great roads, aqueducts, bridges, water supplies, and structures of stone and masonry. It was reported by one author that the Romans built 180,000 miles of paved roads, of which over 50,000 miles were main arteries.[86] The quality of Roman workmanship is attested to by the fact that many of their structures have withstood the onslaught of time.

It was noted earlier that hand production characterized industry throughout the Middle Ages until the invention of machinery revolutionized industrial production. During this period which lasted around 1200 years, the seat of production was first in the manor and later in the towns as social organization became more complex and specialization increased. Accounts of craftsmanship during this long period follow.

According to Clapham,

> some of the smiths of the fifth, sixth and seventh centuries were wonderful craftsmen. ... Great men had their gold-embroidered clothes; their buckles and brooches were gilt; their drinking-horns were mounted in silver-gilt or in gold. ... The workmanship we admire; some of it could not easily be bettered; but the workers escape us. Were any of them

[83]Bowen and Kettering, *op. cit.*, p. 18.
[84]Forbes, *op. cit.*, pp. 64-65.
[85]Mitchell, *op. cit.*, p. 170.
[86]Bowen and Kettering, *op. cit.*, p. 20.

surviving Romano-Britons as has sometimes been supposed? Did the bronzesmith or goldsmith — and this seems most likely — move about from hall to hall, working for his keep and some reward? An expert specialist he must have been. No one else could have done such work.[87]

Salaman, in the History of Technology, Vol. III, wrote that during the Middle Ages and later most villagers supported a blacksmith, a carpenter-wheelwright, and a mason.

The village tradesmen developed a tradition of skill and an instinctive talent for good design. A very high level of workmanship and design was maintained. Wherever one goes, it is scarcely possible to find a poorly made cart or plough, a badly forged harrow, or shoddy work in the saddlery or harness.[88]

Gras supported this view as he wrote:

During the centuries of prevalence and of growth, in the ancient, medieval, and modern times, wherever town economy prevailed, there was no cessation in the effort to produce a genuine commodity. The artisan manufactured wares as if he was himself to use them. . . . Apart from the carelessness of a few individuals, and the vivaciousness of others, good workmanship prevailed. It was the accepted ideal. The guilds wrote this ideal into their ordinances and had no great difficulty in enforcing it until the market expanded and another system came into being.[89]

The rise of the craft guild system about 1100 A.D. did much to promote the ideal of good craftsmanship. In writing of the functions of the craft guild, Barnes noted that they regulated wages; fixed prices and conditions of sale; determined the hours and the conditions of labor; and inspected workmanship and the quality of materials. The Medieval artisan took pride in his craft, and an added incentive to produce good work lay in the fact that the worker sold directly to the consumer.[90]

Barnes further noted that standards of excellence were not always maintained, even by the guilds. Pots melted when placed on the fire, and cloth was stretched. "Falsework" of all kinds prevailed. Such "falsework" was punished by fine, and repeated offenses brought explusion from the guild.[91]

[87]Sir John Clapham, *A Concise Economic History of Britain* (Cambridge, England: The Cambridge University Press, 1951), pp. 65-66.

[88]Charles J. Singer (ed.), *History of Technology,* Vol. III (Oxford: Clarendon Press, 1956), pp. 111-112.

[89]Gras, *op. cit.,* p. 21.

[90]Harry E. Barnes, *An Economic History of the Western World* (New York: Harcourt, Brace and Company, 1937), p. 183.

[91]*Ibid,* p. 184.

Thus Salzman, as presented by Marshall, wrote:

> Sentimentalists imagine the medieval workman loved a piece of good work for its own sake and never scamped a job. Nothing could be further from the truth. The medieval craftsman was not called a man of craft for nothing. . . . Cloth was stretched and strained to the utmost and cunningly folded to hide defects; a length of bad cloth would be joined onto a length of superior quality, or a whole cheap cloth substituted for the good cloth which the customer had purchased; inferior leather was faked up to look like the best and sold at night to the unwary; pots and kettles were made of bad metal which melted when put on the fire; and everything that could be weighed or measured was sold by false measure.
>
> * * * * * * * * *
>
> To give them (buyers) their due, the guilds recognized the importance to their own interests of maintaining a high standard of workmanship, and co-operated loyally with the municipal authorities to that end.[92]

The guilds contributed much towards the training of craftsmen. A boy could learn the skill of a trade by studying under the master as an apprentice. Upon completion of the apprenticeship be became a journeyman and could become a master by proving his skill with his masterpiece.[93]

The guild system had its greatest influence in the sixteenth and seventeenth centuries. It did much to stimulate good craftsmanship during a period in which the worker was personally becoming less responsible for the quality of his work. With the decline of the guild system and the subsequent development of more complex industrial production systems, the quality of work gradually became less perfect. There was no longer the close connection between manufacturing, exchange, and consumption that had characterized work in some previous centuries.

The rise of the central workshop system further disassociated the craftsman from his work. He was now selling virtually nothing but his labor even though production was still very largely by hand.

Finally, the industrial revolution radically changed the quality of craftsmanship by causing mass demand based on low cost to become the controlling factor in production. The manufacturer's goal of pleasing the impersonal market replaced the craftsman's zeal to please the individual consumer. The designer became an operator employed to give salable form to machine-made products.[94]

[92]Marshall, *op, cit.*, pp. 88-89.

[93]Friedlaender and Oser, *op. cit.*, pp. 55-56.

[94]Charles R. Richards, "Industrial Arts," *Encyclopedia of the Social Sciences,* VIII (New York: The Macmillan Company, Inc., 1937), p. 688.

Economic Systems

Up to this point handicraft technology has been discussed in terms of its production or manufacturing systems. The concept of work during the handicraft stage of industrial evolution, and the craftsmanship of the period have been treated. Contextual meanings of the terms handicraft and technology were also developed to provide a frame of reference for the whole discussion.

This concluding section offers a brief treatment of economic systems as they have evolved from earliest times.

A dictionary defines an economic system as "the structure of economic life in a country, area or period."[95]

In defining an economic system, Birnie wrote:

> From the earliest time the way in which wealth has been produced and shared out has been determined by some kind of agreement among the producers. The totality of customs and agreements which regulate the production and distribution of wealth in any society we call its economic systems.[96]

Marshall and Lyon noted that an "economic organization or economic system . . . might very sensibly be spoken of as our want-gratifying machine.[97] In discussing the complexity of the subject, they mentioned that its parts would include laws, banks, factories, labor unions, contracts, schools, transportation systems, private property, competition, employer's associations, specialization, inheritance, wages, interest, profit, and many other institutions.[98]

So far, industrial evolution has been discussed primarily from the standpoint of production or manufacturing systems. Reference to Ely's tables shows that other viewpoints are possible and necessary for a more complete understanding.

An examination of Table I shows that Bucher identified three basic systems in the evolution of industrial society:

1. The independent economy of the hunting, pastoral and agricultural stages of production.
2. The town economy of the handicraft era.
3. The national economy of the industrial stage.

[95]"By permission. From Webster's Seventh New Collegiate Dictionary, copyright 1967 by G. & C. Merriam Company, Publishers of the Merriam-Webster Dictionaries."

[96]Birnie, *op. cit.*, pp. 1-2.

[97]Leon C. Marshall and Leverett S. Lyon, *Our Economic Organization* (New York: The Macmillan Company, 1923), p. 19.

[98]*Ibid.*

TABLE I

Economic Stages From Several Standpoints*

From the Standpoint of Production	From Bucher's Standpoint	From Hildebrand's Standpoint	From the Labor Standpoint		From Gidding's Standpoint[1]
1. Hunting and Fishing	Independent Domestic Economy	Truck Economy	Slaughter of Enemies, Woman's Labor, and Beginning of Slavery	Ceremonial	Luck Magic
2. Pastoral					Sacrificial
3. Agricultural			Slavery and Serfdom	Business Economy	Slave Labor
4. Handicraft	Town Economy	Money Economy	Free Labor Governed by Custom		Trade
5. Industrial	National Economy (World Economy)[2]	Credit Economy	Individual Contact with Increasing Regulation by Statute Group Contract and Regulation by Statute		Capitalistic

[1]Probably Professor Giddings would not himself be willing to state at just what points in industrial evolution these divisions come, and manifestly there is a considerable overlapping. All that the present author intends to say is that there is a general correspondence in the stages as indicated in the table.

[2]Added by the present author. / Ely /

*Adapted from Richard T. Ely, *Studies in the Evolution of Industrial Society* (New York: The Macmillan Company, 1903), p. 71.

Bucher's classification was in terms of the "length of time which elapses between the production and consumption of the goods."[99]

Ely (Table II) has added a fourth economic system, world economy, that occurs as modern technology develops more sophisticated systems of transportation, communication and trade.

In the same Table II Hildebrand looked at the evolution of industrial society with respect to the transfer of goods. His classification included:

1. The truck economy which prevailed during the handicraft stage.

[99]Richard T. Ely, *Studies in the Evolution of Industrial Society* (New York: The Macmillan Company, 1903), p. 66.

TABLE II

The Economic Stages*

From the Standpoint of Production	From the Standpoint of Exchange	From the Standpoint of Labor	From the Standpoint of the General Economic Organization
1. Direct appro-priation	Conquest and seizure	Labor Class not differentiated. Beginning of slavery and serfdom	Tribal and independent economy
2. Pastoral	Barter	Slavery and serfdom	Household and neighborhood economy
3. Agricultural	Barter and money	Serfdom and free labor	Village economy
4. Handicraft	Money	Free labor governed by custom	Custom work
5. Industrial	Credit	Individual contract and group contract	National or capitalistic economy

*Adapted from Richard T. Ely and Ralph Hess, *Outlines of Economics* (New York: The Macmillan Company, 1937), p. 26.

2. The money economy which prevailed during the handicraft stage.
3. The credit economy that has become dominant in today's industrial system.

Table II presents economic systems from other points of view. Attention should be paid to Ely's presentation of economic stages from the standpoint of the general economic organization. This includes:

1. The tribal and independent economy which existed during the direct appropriation or hunting stage of production.
2. The household and neighborhood economy of the pastoral production stage.
3. The village economy of the agricultural production era and reaching into the handicraft stage.
4. The custom work (economy) of the handicraft stage.
5. The national or capitalistic economy of the industrial production stage.

In discussing economic stages, Seligman wrote of the rudimentary economic systems of primitive man and of man's transition from the lower stages of civilization, as a prelude to a discussion of economic systems since the adoption of agriculture.[100]

Regarding economic progress since the advent of the agricultural stage of production, Seligman wrote:

> If we regard economic conditions from the standpoint of the relations of production to consumption — for these are the fundamental economic facts — we may divide the world's history into three great stages, known respectively as the self-sufficing economy, the trade or commercial economy and the capitalist of industrial economy. From another point of view these may also be called the isolated economy and the national economy.[101]

Thus Seligman's list included:

1. The primitive and transitional economies which may be compared with Ely's tribal and independent system.
2. The self-sufficing or isolated economy which may be compared with Ely's household or neighborhood economy.
3. Trade or commercial economy which may be compared with the village and custom work economies of Ely.
4. The capitalistic or industrial economy which largely coincides with Ely's national or capitalistic economy.

The evolution of economic systems was given from a somewhat different point of view by Keiser. His approach is to discuss what he identified as "the four historical economic periods (medieval, mercantile, *laisse-faire*, and mixed capitalistic periods)."[102]

As Keiser described the economic systems of these periods,[103] it is clear that they can be compared with the classifications of other economic historians as follows:

1. The medieval economy (the self-supporting, household or neighborhood economy).
2. Mercantilism (the trade or commercial, village, and custom work economies).
3. *Laissez faire* or free enterprise economy (the early modern capitalistic or national economy).
4. Mixed capitalism (the present day national, capitalistic, or industrial economy).

Economic systems can be studied from yet another point of view. A study could be organized under the basic division of collec-

[100]Edwin R. A. Seligman, *Principles of Economics* (New York: Longmans, Green and Company, 1923), pp. 67-74.

[101]*Ibid*, pp. 74-75.

[102]Norman F. Keiser, *Introductory Economics* (New York: John Wiley and Sons, Inc., 1961), p. 19.

[103]*Ibid*, Chap. II.

tivism and capitalism and would include such topics as capitalism, democratic socialism, totalitarian socialism, communism, and fascism. A classification such as this would not be useful for the purposes of this paper since capitalism, and particularly its variations, did not develop during the era of handicraft technology.

The predominant economic system during the handicraft stage of production has been identified by several different names. Bucher has called it the town economy; Hildebrand, the money economy; Ely, the village and custom work economy; and Seligman, the trade or commercial economy. The system has been further described by Keiser as the later medieval period and the period of mercantilism. Analysis of the writings of these historians suggests that they were all describing the same basic economic system, but from different points of view.

Previously in this chapter, a rather thorough discussion of early manufacturing or industrial production systems was presented based upon the stages of industrial evolution according to Gras. This classification included the stages of usufacture, retail handicraft, wholesale handicraft, and centralized manufacture. Using the economic development of England as a base, Gras stated that usufacture or the household manufacturing system prevailed up to about 1100 A. D. and that from 1100 to about 1750 the handicraft system in its various phases emerged and remained predominant until the advent of highly centralized industry.[104] The ensuing discussion, centered around the handicraft era of production, utilizes the same approximate periods of history. The periods involved are the Medieval Era, 600-1500; and Early Modern times, 1500-1776.

If we are to consider the economic systems during which Gras' usufacture (or manufacture for use in the household) was the principal type of industry, then we must begin with the independent or household economic system and proceed through the system identified as village economy, for these systems "seem to have been nearly universal in the stage of direct appropriation and throughout the early pastoral and agricultural stages"[105] — the era of prevalence for usufacture.

Typical examples of these systems in operation are found in the manorial economy of England between the approximate dates of 600-1500 A. D. From the fall of the Roman Empire to about the middle of the nineteenth century, the economic life of Europe was based predominantly on agriculture. The manor or village was the typical economic unit of medieval Europe. The manor served the

[104]Gras, *op. cit.*, Chap. I, II, III, IV, and VII.
[105]Ely and Hess, *op. cit.*, p. 28.

function of organizing land and labor for production. It existed in an age when money was scarce, markets were limited, governments were weak, and war was common. During this period the manor was probably the best way of ordering life and work.[106]

According to Clough and Cole the manor was not only a political and social unit, but most important from the standpoint of economic history, an economic unit as well. The inhabitants worked together in the same fields, turned their livestock in the same pastures, gathered their fuel in the same woods, and paid tithes to the same church.[107]

Clough and Cole stated:

> The manor has been held up by many historians as an instance of local self-sufficiency. It is true that it produced practically all that it needed in the way of food, fuel, clothing, and the other necessities of life. . . . The village smith made and repaired plows and tools. The fields and woods provided food and drink. . . . It produced most of what it used, and it used most of what it produced.[108]

Discussing the independent economy of the manor or village, Birnie noted that it was largely a self-sufficing unit. The inhabitants supplied their own food and drink, sheared their own wool and wove it into cloth, made skins into leather, and produced by hand labor the clothes and shoes that they wore. There was very little need for money. The manor was an example of a natural economy as compared with the money or credit economy of later systems. Trade relations with the outside world were quite limited. The lord of the manor bought luxuries such as wines and silks and paid for them with grain, wool, and skins. Such materials and products as iron, tar, salt, and millstones were sometimes imported.[109]

Medieval England, especially prior to 1100 A. D., provides examples of the relatively simple, independent, self-sufficing, household economies of the village.

The decline of the independent economy of the manor and the rise of towns as important centers of trade began during the twelfth century. With these developments came the rise of a new class, the craftsmen who were now making articles for sale rather than for personal or household consumption. The guilds grew in response to the increasing importance of the handicraft system of production.

The forces that generated the changes, according to Clough and Cole, were

[106]Clough and Cole, *op. cit.*, pp. 4-6.
[107]*Ibid*, p. 6.
[108]*Ibid*, p. 19.
[109]Birnie, *op. cit.*, pp. 57-58.

1. The gradual rise of a money economy, in which goods were bought and sold for money, labor was paid for by money wages, land was paid for by money rents.
2. The increase of trade and industry, which created markets where the villagers could sell their products and buy the things they needed.
3. The rise of national states, which substituted national taxes for some part of the manorial dues and national justice for manorial courts.[110]

In support of this Barnes stated:

Of principal importance in the decline of the manor was the introduction of the agricultural specialization that accompanied the growth of markets and trade. The more disruptive changes that took place during this period were: (1) The rise of the local grain markets; (2) the increase in the number of free tenants; (3) the communication of personal services into money payments; (4) the appearance of a class of men either entirely or partly dependent upon wages received for agricultural labor; and (5) the development of a money economy.[111]

By the middle of the thirteenth century there were about two hundred towns in England that could be distinguished from the manorial villages by their size, form of government, and inhabitants' occupations.[112]

The town or trade economy, along with the handicraft type of production and the guild form of organization, gained in importance. Great advances in transportation, trade, and commerce, the agrarian revolution of the sixteenth century, the rise of national systems of government, changes in economic opinion and thought, and the beginnings of the scientific and industrial revolutions were characteristic of these times.

It remained the chief economic system of western civilization until the advancing technology, along with political and social factors, stimulated the beginnings of other systems.

Selected Bibliography

Allen, Francis R. *Technology and Social Change.* New York: Appleton-Century Croft, 1957.

Ashley, William J. *The Economic Organization of England.* New York: Longmans, Green and Company, 1914.

Barnes, Harry E. *An Economic History of the Western World.* New York: Harcourt, Brace and Company, 1937.

Birnie, Arthur. *An Economic History of the British Isles.* New York: F. S. Crofts and Company, 1936.

[110]Clough and Cole, *op. cit.*, p. 20.
[111]Barnes, *op. cit.*, p. 148.
[112]Cheyney, *op. cit.*, p. 57.

Boissonnade, P. *Life and Work in Medieval Europe.* New York: Alfred A. Knopf, 1937.

Bowen, Harold G., and Kettering, Charles F. *A Short History of Technology.* West Orange, New Jersey: The Thomas Alva Edison Foundation, Inc., 1954.

Bowers, Edison L., and Rowntree, R. Henry. *Economics for Engineers.* New York: McGraw-Hill Book Company, Inc., 1938.

Bronowski, J. *et. al.* eds. *Technology: Man Remakes His World.* Garden City, N. Y.: Doubleday & Company, Inc., 1964.

Cheyney, Edward P. *An Introduction to the Industrial and Social History of England.* New York: The MacMillan Company, 1917.

Clapham, Sir John. *A Concise Economic History of Britain.* Cambridge, England: The Cambridge University Press, 1951.

Clough, Shepard B., and Cole, Charles W. *Economic History of Europe.* Boston: D. C. Heath and Company, 1952.

Derry, Thomas K., and Williams, Trevor I. *A Short History of Technology.* New York: Oxford University Press, 1961.

Dietz, Frederick C. *An Economic History of England.* New York: Henry Holt and Company, 1942.

Dewhurst, Frederic, and Associates. *America's Needs and Resources.* New York: The Twentieth Century Fund, 1955.

Dunsheath, Percy (ed.). *A Century of Technology.* New York: Roy Publishers, 1952.

E. I. Du Pont de Nemours & Company. *The Story of Technology.* Wilmington, Delaware: E. I. Du Pont de Nemours & Company, 1959.

Ely, Richard T. *Studies in the Evolution of Industrial Society.* New York: The Macmillan Company, 1903.

Ely, Richard T., and Hess, Ralph H. *Outlines of Economics.* New York: The MacMillan Company, 1937.

Feirer, John L. *"Industrial Arts and Space Technology,"* Industrial Arts and Vocational Education, February, 1967, Vol. 56. Milwaukee: Bruce Publishing Company, 1967.

Finch, James K. *Engineering and Western Civilization.* New York: McGraw-Hill Book Company, Inc., 1951.

Forbes, R. J. *Man the Maker: A History of Technology and Engineering.* New York: Abelard-Schuman Limited, 1958.

Friedlaender, Heinrich E., and Oser, Jacob. *Economic History of Modern Europe.* New York: Prentice-Hall, Inc., 1953.

Gras, Norman S. B. *A History of Agriculture in Europe and America.* New York: F. S. Crofts and Company, 1925.

———————. *Industrial Evolution.* Cambridge, Massachusetts: Harvard University Press, 1930.

Heaton, Herbert. *Economic History of Europe.* New York: Harper and Brothers, 1936.

Keiser, Norman F. *Introductory Economics.* New York: John Wiley and Sons, Inc., 1961.

Klemm, Friedrich. *A History of Western Technology*. Cambridge, Massachusetts: The M. I. T. Press, 1954.

Knight, Melvin M. *Economic History of Europe*. New York: Houghton Mifflin Company, 1926.

Knight, Melvin M. "Handicraft," *Encyclopedia of the Social Sciences*, Vol. VII. New York: The MacMillan Co., Inc., 1937.

Kranzberg, Melvin. ed. *Technology and Culture*, Vol. I. Detroit: Wayne State University Press, Winter, 1959 - Fall, 1960.

Kranzberg, Melvin, and Pursell, Carroll W. *Technology in Western Civilization*. New York: Oxford University Press, 1967.

Lipson, E. *The Economic History of England*, Vol. II. New York: Barnes and Noble, Inc., 1961.

Marshall, Leon C. *Readings in Industrial Society*. Chicago: The University of Chicago Press, 1918.

Marshall, Leon C. and Lyon, Leverett S. *Our Economic Organization*. New York: The Macmillan Company, 1923.

Mitchell, H. *The Economics of Ancient Greece*. Cambridge: W. Heffer and Sons, Limited, 1963.

Nisbet, Robert A. *Man and Technics*. Tucson: University of Arizona Press, 1956.

Ogg, Frederic A., and Sharp, Walter R. *Economic Development of Modern Europe*. New York: The Macmillan Company, 1926.

Olson, Delmar W. *Industrial Arts and Technology*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1963.

Oser, Jacob. *The Evolution of Economic Thought*. New York: Harcourt, Brace & World, Inc., 1963.

Oxford English Dictionary, Vol. V, H - K. Oxford: The Clarendon Press, 1933.

Reid, W. Standford. *Economic History of Great Britain*. New York: The Ronald Press Company, 1954.

Richards, Charles R. "Industrial Arts," *Encyclopedia of the Social Sciences*, Vol. VIII. New York: The Macmillan Company, Inc., 1937.

Rostow, W. W. *The Stages of Economic Growth*. Cambridge, Massachusetts: The Harvard University Press, 1960.

Seligman, Edwin R. A. *Principles of Economics*. New York: Longmans, Green and Company, 1923.

Singer, Charles J. (ed.). *History of Technology*, Vols. I - IV. Oxford: Clarendon Press, 1954-1957.

Singer, Charles J. *Technology and History*. London: Oxford University Press, 1952.

Smart, Dalton. "An Investigation into the Nature and Meaning of the Term Technology." Unpublished Master's Thesis, Industrial Education Department, University of Maryland, 1965.

Walker, Charles R. *Modern Technology and Civilization*. New York: McGraw-Hill Book Company, Inc., 1962.

Weber, Max. *General Economic History*. Glencoe, Illinois: The Free Press, 1927.

Webster's Seventh New Collegiate Dictionary. Springfield, Massachusetts: G. and C. Merriam Company, 1965.

Yoder, Dale. *Manpower Economics and Labor Problems*. New York: McGraw-Hill Book Company, Inc., 1950.

CHAPTER FOUR

The Industrial Revolution

William F. Tierney
University of Maryland

Introduction

The importance of the Industrial Revolution lies in the fact that it was the preface to other technological developments throughout the world. Historians, economists, and other writers have tended either to glorify or to crucify the social, economic, and political impact or consequences of the industrial development in England, according to their individual viewpoints and prejudices. This revolution took place during the latter half of the eighteenth and early half of the nineteenth centuries. An objective understanding of the Industrial Revolution lies somewhere between the two extremes. Therefore, in this chapter the author will attempt to present varying viewpoints concerning the many facets of the Industrial Revolution. An endeavor will be made to sift the relevant facts and points of view from the irrelevent, to identify documentable generalizations, and to emphasize the revolution's causes, growth and social impact rather than its mechanical inventions and technical developments (which are treated in more detail in other chapters of this yearbook). By trying to identify some of the interdependencies of the economic, social, political, and scientific developments and trends as well as the many contributing causes and effects of the Industrial Revolution, the author will strive to heed the caution of George N. Clark that the idealist fallacy in historiography is not the only example of error of seeking a prime mover in history; another (very similar error) is the tendency to magnify the importance of a single factor.[1]

[1]George N. Clark, "The Industrial Revolution: A Reappraisal," *The Industrial Revolution in Britain Triumph or Disaster?* ed. Philip A. M. Taylor (Boston: D.C. Heath and Co., 1958), p. 87.

Definition

The term "Industrial Revolution" usually refers to a period in English history covering approximately a century — the period from about 1750 to 1850. The expression is sometimes also used to identify similar periods, though not exact counterparts, which have occurred in other countries during their industrialization. In America and Germany, the revolution took place later than in England, starting in the former countries about the turn of the nineteenth century and continuing until the beginning or early part of the twentieth century. In Canada, Russia, and Japan widespread industrial development took place during the first half of the present century prior to World War II. In Egypt, Arabia and other parts of Africa, as well as in China and other places in the Far East, it started after World War II. Since World War II, there has been both a resurgence of technological development in West Germany and Japan and the beginnings of industrialization in India and South America. The importance of these periods in the history of various countries lies in the fact that they almost invariably involve a change from custom to mass production methods of manufacturing, the establishment of factory systems, and the development of the corporate structures of our modern industrial world.

The term "Industrial Revolution" was coined by a French writer and popularized by the renowned historian Arnold Toynbee. In describing the historical events of this period relating to technological, political, and economic change, early writers represented these changes as drastic social upheavals. For example, Charles A. Beard defined the Industrial Revolution as

> that great transformation which has been brought about during the past one hundred and fifty years, by discoveries and inventions which have altered fundamentally all the methods of production and distribution of the means of life, and consequently revolutionised all the economic functions of society.[2]

H. O. Meredith similarly described the events and changes of the period:

> The old order had not really been stationary but change, as has been seen, had been, for a century and a half, abnormally slow. It now acquired suddenly unprecedented momentum. Again, whilst it is true that this momentum has gathered rather than lost force since 1830, the close of the Revolution may be dated from that year.[3]

[2]Charles A. Beard, *The Industrial Revolution* (London: George Allen & Unwin Ltd., 1901), p. 1.

[3]H. O. Meredith, *Economic History of England* (London: Sir Isaac Pitman & Sons, Ltd., 1910), p. 221.

But the term "Industrial Revolution" is actually misleading; the word *revolution* connotes a sudden upheaval when, in reality, the industrial transition evolved over a longer period of time, even centuries, and drew heavily upon the knowledge of previous cultures. In this light, it might have been more properly called the Industrial *Evolution* — a "long process," as Nef pointed out,

> reaching as far back as the middle of the sixteenth century and extending to the end of the nineteenth century rather than a sudden phenomenon associated with the late eighteenth and early nineteenth centuries.[4]

Nef further observed that

> the concept of an 'Industrial Revolution' would seem to be especially inappropriate as an explanation of the triumph of industrial civilization in Great Britain.[5]

For, as he pointed out, the term "revolution" implies a sudden process; yet this industrial change was probably more continuous in Great Britain than in any other country.

In a similar vein, Louis W. Moffit described two types of revolutions. The first, typified by the French Revolution, "consists of a sudden revolt against galling conditions that had at last become intolerable,"[6] and a second, exemplified by England's industrial transition,

> represents the bursting forth of fresh energy, a growth so rapid and so extensive that room cannot be found for it within the old limits. Such a revolution does not so much destroy the old as leave it behind, to rear a new and better structure, or at least one better adapted to a new age. Its purpose, so far as it is conscious of one, is to reach some new and alluring position. An outlet must be found for the energy that tingles in every nerve of the community.[7]

Moffit concluded, therefore, that

> the period prior to 1760 was not one of stagnation. New inventions did not, like accidental electrical contacts, galvanize sluggish industry into a sudden fresh activity. Rather they were evidences of the expanding life which could not develop sufficiently under the old arrangements.[8]

The beginning phase of the Industrial Revolution, represented by the production of articles through the use of simple, hand-operated

[4]John U. Nef, "Not One, but Two Industrial Revolutions," *The Industrial Revolution in Britain Triumph or Disaster?* ed. Philip A. M. Taylor (Boston: D. C. Heath and Company, 1958), p. 15.

[5]*Ibid.*

[6]Louis W. Moffit, *England on the Eve of the Industrial Revolution* (New York: Barnes & Noble, Inc., 1964), p. xiii.

[7]*Ibid.*

[8]*Ibid.*, p. xiv.

machines is often referred to as the First Industrial Revolution and the next phase, characterized by the manufacture of products utilizing more sophisticated and complex power driven machinery, is commonly called the Second Industrial Revolution. In our own day, it is interesting to note how the term, Industrial Revolution, is used. For example, the *World Book International* indicates that

> some observers consider automation so important that they have called it the *Second Industrial Revolution.* The term *Second Industrial Revolution* is used because automation not only increases the productive capacity of factories (as did the first industrial revolution), but it also changes the relationship of man to his machines.[9]

Our present Space Age, with its computer-operated machinery and automated factories, may very logically be identified by future historians as the third phase of the Industrial Revolution in the production of goods and services. This new breakthrough in production methods — and its concomitant effects on the numbers of people employed, the skills required, the types of work eliminated and created, the reductions in the length of the work week, and the migrations to the suburbs and back to the cities — may well result in a tremendous impact on civilization in terms not only of technological but also of social, economic, and political changes which might far outstrip the effects which the first or second phases of the Industrial Revolution had on British, American, and other cultures.

In a final consideration of a definition of the term "Industrial Revolution," we might well consider Ashton's following suggestion:

> The industrial revolution is to be thought of as a movement, not as a period of time. Whether it presents itself in England after 1760, in the United States and Germany after 1870, or in Canada and Russia in our own day, its character and effects are fundamentally the same. Everywhere it is associated with a growth of population, with the application of science to industry, and with a more intensive use of capital. Everywhere there is a conversion of rural into urban communities and a rise of new social classes. But in each case the course of the movement has been affected by circumstances of time and place. Many of the social discomforts that have been attributed to the industrial revolution in Britain were, in fact, the result of forces which (for all we know) would still have operated if manufacture had remained undeveloped and there had been no change of economic form.[10]

[9]"Automation," *The World Book Encyclopedia*, 50th ed., Vol. I, p. 917.

[10]T. S. Ashton, *The Industrial Revolution 1760-1830* (New York: A Galaxy Book, Oxford University Press, 1964), p. 98.

In essence, therefore, we might conceive of the Industrial Revolution as a movement which transforms a society from an agrarian one to an industrial one that makes extensive use of machinery, operates its business and industry on a large scale, and supplies its members' material needs through trade in worldwide markets. Fairchild, Furniss, and Buck pictured the transition as follows:

The Industrial Revolution involved the displacement of the domestic system of manufacture by the factory system, a great extension of division of labor, the invention and perfection of machinery in all lines of manufacturing, mining and transportation, and consequently an enormous increase in the output of industry. It further involved social changes of great consequence, the congregation of workers in large factory towns, the beginnings of organized labor, the rise of a new class of capitalists, and in England a new political alignment. In almost every phase of social, political, and economic life conditions were altered, new relationships brought into being.[11]

The Setting or Background

In England at the middle of the eighteenth century the economic, social, and political conditions were favorable for the forthcoming industrialization. In the economic realm, England's agrarian society was reasonably affluent with 50,000 square miles to support her approximately 8,500,000 people. She had adequate raw materials, and both her industry and export trade were firmly established. The population was increasing rapidly, thereby providing expanding domestic markets; and her thirty trans-atlantic colonies were increasing her exports. Beard gave the following description of England on the eve of the Industrial Revolution:

To realize the magnitude of the change wrought in industry, politics, and social organization, we must turn to England of 1760, and examine the old order. . . . At the middle of the eighteenth century man produced the necessaries of life — food, clothing, and the like — by the labour of his hands, almost unaided by machinery. The flail, the primitive plough, the spinning wheel, the hand loom, and a few other rude appliances assisted the manual worker in his tasks, while the horse and water furnished the power used to turn the wheels of some small factories. The commodities so produced were transported by slow and tedious methods to the markets. Man seemed to be a helpless pigmy,

[11]Fred Rogers Fairchild, Edgar Stevenson Furniss, and Norman Sydney Buck, *Elementary Economics* (New York: The MacMillan Company, 1930), p. 55.

confined and overawed in his activities by the tremendous forces of an apparently uncontrollable natural world.[12]

Professor Heaton described England as a country whose

population had (by 1750) almost trebled and was growing quickly. Commercial agriculture covered much of the country, some grain was being exported, but wool was kept at home by law for use in a cloth industry that was now the largest in Europe. The production of metal goods was highly developed, and coal fired a wide range of industries. British merchants, using British ships, were firmly established in most European ports, in the oriental and African trades, and in every kind of traffic with the Americas. Emigration and conquest had created an empire with thirty trans-atlantic colonies. London was within a short step of displacing Amsterdam as the world's financial and commercial center.[13]

Early writers frequently mentioned enclosures — the process of dividing open fields and common fields by quickset hedges, stone walls, fences, or rows of trees — as the means of supplying a source of labor for industry. However, more recent studies have shown that the numbers of small landowners actually increased.

The importance of enclosures lies in the fact that they enabled the application of sound, improved scientific principles to farming methods, thereby making the soil more productive, permitting a smaller proportion of the labor force to be involved with the production of food and, at the same time, enabling these persons to engage in other productive activities. Ashton indicated that

the essential fact about enclosure is that it brought about an increase in the productivity of the soil. There has been much discussion as to whether it led to a decline in the number of cultivators, and some who hold that it did write as though this were a consequence to be deplored. It is a truism, however, that the standard of life of a nation is raised when fewer people are needed to provide the means of subsistence. Many of those who were divorced from the soil (as the stereotyped phrase goes) were free to devote themselves to other activities: it was precisely because enclosure released (or drove) men from the land that it is to be counted among the processes that led to the industrial revolution, with the higher standards of consumption that this brought with it.[15]

[12]Beard, *op. cit.*, pp. 3-4.

[13]Herbert Heaton, *Economic History of Europe* (2d ed. rev.; New York: Harper & Brothers, 1948), p. 307.

[14]Jonathan D. Chambers, "Enclosures and the Rural Population: A Revision," *The Industrial Revolution in Britain Triumph or Disaster?* ed. Philip A. M. Taylor (Boston: D. C. Heath and Co., 1958), pp. 75-82.

[15]Ashton, *op. cit.*, p. 20.

Taylor suggested another factor — that a falling death rate, coupled with an increased birth rate, was a possible cause of an increased supply of labor which, in turn, provided general economic stimulation.[16]

The reasons that the Industrial Revolution originated in England rather than in any one of the other European countries are discussed by Fairchild, Furniss, and Buck, and may be outlined as follows:

personal freedom	— serfdom had disappeared in England by the end of the sixteenth century
industrial freedom	— guild monopolies of the trades had pretty well broken down
political freedom	— English producer in contrast to Continental producer was relatively free of governmental regulation and restriction — this favored experimentation with new modes and methods of production
free trade	— abolition of customs barriers between towns
religious freedom	— England served as a haven of refuge for skilled workers suffering from religious persecution on the Continent
geographical location	— isolation rendered England free from fear of foreign aggression and contributed toward making her a favorable field for industrial changes
large accumulation of capital	— secured mainly from foreign trade, permitted large investments in expensive machinery
large expanding foreign markets	— if more goods could be produced, they could be sold
available labor	— large scale production possible due to availability of large numbers of skilled men trained in the trades
availability of raw materials	— large deposits of iron and coal located conveniently to each other[17]

Interdependency of Industries

Although technological progress was probably most spectacular in the textile industry, and although most accounts of the Industrial Revolution are concerned with changes and advances in this industry, these breakthroughs would never have been possible without

[16]Philip A. M. Taylor (ed.), *The Industrial Revolution in Britain Triumph or Disaster?* (Boston: D. C. Heath and Company, 1958), p. 74.
[17]Fairchild, Furniss, and Buck, *op. cit.*, pp. 56-57.

similar strides in other industries such as agriculture, mining, metal-working, ship building, power production, finance, and transportation. Inventions in any one of these industries could have and undoubtedly did have an effect on progress in the others. For example, the development and improvements in the steam engine were applied in mining, textiles, pottery manufacture, foundries, and transportation. Industrial as well as economic reciprocity is pointed out by Ashton in the following passage:

> So far the process of invention has been traced first in one industry and then in another. The arrangement has the merit of making clear what was involved in each successive step, but it fails to bring out the way in which discoveries in different fields of activity were linked together. Sometimes it was a simple case of imitation. . . . Sometimes an advance in one sphere was a condition of progress in another. . . . Often two or more industries went hand in hand, each contributing to the forward movement of the other . . . an improvement in one process frequently put pressure on those concerned with an earlier, parallel, or later process in the same industry.[18]

Ashton went on to point out that

> the industrial revolution was an affair of economics as well as of technology: it consisted of changes in the volume and distribution of resources, no less than in the methods by which these resources were directed to specific ends. The two movements were, indeed, closely connected. Without the inventions industry might have continued its slow-footed progress — firms becoming larger, trade more widespread, divisions of labour more minute, and transport and finance more specialized and efficient — but there would have been no industrial revolution. On the other hand, without the new resources the inventions could hardly have been made, and could never have been applied on any but a limited scale. It was the growth of savings, and of a readiness to put these at the disposal of industry, that made it possible for Britain to reap the harvest of her ingenuity.[19]

The dependence of industry on the successful efforts in agriculture and similarly the dependence of agriculture on expanding and flourishing industrial centers were indicated by Mantoux in the following passage:

> But these improvements, independent though their progress may seem to be, were only part of a more general evolution, and their success was largely due to the support they received from each other.[20]

[18]Ashton, *op. cit.*, p. 62.

[19]*Ibid.*, p. 66.

[20]Paul Mantoux, *The Industrial Revolution in the Eighteenth Century, an outline of the beginnings of the modern factory system in England* (New York: Harper & Row Publishers, 1961), p. 184.

Although the agricultural evolution which preceded and continued through the Industrial Revolution was due more to improved methods of crop rotation, animal breeding, land drainage, enclosure, and consolidation of small farms than to technological innovations such as the invention of the steam plough and the thresher, it was sufficiently extensive and effective to pave the way for progress in other industries. These facts were put forth by Beard, Ashton, and Meredith. Agricultural implements, they wrote, "were by no means of an improved type, although about this time several labour-saving tools and machines were invented."[21]

Ashton stated that

> the extensive use of machinery on the land came only with the twentieth century. In the 1780's new types of ploughs were introduced, and a Scottish millwright devised a more efficient threshing machine. The increased output of iron led to a substitution of metal for wood in the frame of the plough, as well as in parts of the harrow and the roller; and in 1803 a ploughshare of steel was put on the market. None of these innovations, however, was of consequence: it is in other directions that we must look for the major changes in agricultural technique.
>
> In 1760, Joseph Elkington began to develop new methods of drainage in Warwickshire. About the same time Robert Bakewell (1725-94) of Dishley in Leicestershire, using empirical methods of inbreeding, was producing cattle which gave a bigger yield of beef, as well as horses of greater power, and sheep of larger size and weight. From the late "seventies" Coke of Holkham (1752-1842) was expending vast sums on the improvement of his estate, making use of marls and clover, introducing new grasses and artificial feeds, giving inducements to tenants to keep their land in good heart, and advertising widely the merits of Norfolk husbandry.[22]

Meredith described the improvements in agricultural techniques as an "elaboration and generalization of principles" which

> may be grouped conveniently under two heads, the conception that the productive power of a given acreage could be increased by skilful rotation of crops and careful manuring, and the deliberate selection of breeding stock and seed with a view to preserving the most profitable, and weeding out the wasteful varieties.[23]

Arnold Toynbee indicated the importance he attached to agriculture when he stated that

[21]Beard, *op. cit.*, p. 9.
[22]Ashton, *op. cit.*, pp. 44-45.
[23]Meredith, *op. cit.*, p. 233.

an agrarian revolution plays as large a part in the great industrial change of the end of the eighteenth century as does the revolution in manufacturing industries.[24]

Toynbee also identified the importance of interrelationships between trade, communications and transportation and industrial progress and the latter's dependence on the expansion and development of the canal and road systems.

A further growth of the factory system took place independent of machinery, and owed its origin to the expansion of trade, an expansion which was itself due to the great advance made at this time in the means of communication . . . Some years afterwards, the roads were greatly improved under Telford and Macadam; between 1818 and 1829 more than a thousand additional miles of turnpike road were constructed; and the next year, 1830, saw the opening of the first railroad. These improved means of communication caused an extraordinary increase in commerce.[25]

Toward the latter part of the Industrial Revolution the importance of the railroads and the mercantile marine shipping was pointed out by Beales:

Improved communications stimulated the industrial and commercial expansion of the new manufacturing areas and confirmed the localization already effected. The new network of communications widely extended personal mobility and facilitated further urbanization. The railways broke the monopoly of the canal companies, as the canals had of the river navigation companies — cheaper transport meant cheaper prices, with an attendant train of advantages to all classes. . . . They encouraged new habits of investment among new classes of investors. . . . They forced the State to face questions of monopoly, and of the regulation of monopoly, in the very heyday of individualism. Indirectly, they did more than any other simple agency to break the prestige of the landed aristocracy, and they assured the continuance of the expansion of industries into the future. The influence of railways is best summed up, perhaps, in the statement that Great Britain became an economic unity.

* * * * * * * * *

The growing volume of trade necessitated a great expansion of the mercantile marine in the eighteenth century. . . . In ocean shipping the wooden sailing-vessel more than held its own until the sixties of the nineteenth century. . . . But progress was not very rapid till the invention of the compound engine (1854), the establishment of coaling-stations, and the building of large vessels with iron hulls. The liner services then

[24]Arnold Toynbee, "The Classical Definition of the Industrial Revolution," *The Industrial Revolution in Britain Triumph or Disaster?* ed. Philip A. M. Taylor (Boston: D. C. Heath and Co., 1958), p. 3.

[25]*Ibid.*, pp. 4-5.

developed rapidly, and ocean-going tramps were able to pioneer new services and to gather occasional cargoes as well as the great seasonal cargoes of foodstuffs and raw materials.[26]

The impetus to industrial expansion provided by foreign trade and markets and its importance to the Industrial Revolution were pointed out by Moffit:

> On the eve of the Industrial Revolution, industry in England was feeling the impetus of commercial expansion. Foreign trade was in the process of being quadrupled within a century, and home trade was no doubt increasing at a similar rate.[27]

Other Contributing Conditions, Causes, and Events

In addition to the previously noted favorable conditions of the setting or background for the development of the Industrial Revolution and the stimulation of progress due to the interdependency of industries, other equally if not more important conditions include such elements as a propitious intellectual atmosphere, advantageous governmental regulations or political influence, and the all-important part played by inventors and the applications of their ideas. In the realm of the advancement of knowledge, encouragement came from many sources, especially in relation to the practical applications of scientific advances and technological progress in the form of new processes, machines, and products. Professor Heaton made the following observations:

> Popular interest in industrial improvement resembled the wave of curiosity and zest for experiment that we saw sweeping agriculture. Societies were set up to foster technical progress. . . . Meanwhile, as individuals or as members of learned societies, the scientists of all nations were in touch with each other, developing a "remarkable esprit de corps" strengthened by "frequent personal relations" (Pace). . . . The scientists were also getting into closer touch with industry and agriculture, for their knowledge of physics and chemistry was now reaching a point where it could answer some technical questions. . . . The decades after 1750 were thus marked by a quickening spirit of inquiry and search for new things.[28]

In the area of governmental regulation the picture is somewhat confused. In relation to some aspects of industry there was little or no regulation, while in others there were many laws — with but

[26]H. L. Beales, *The Industrial Revolution 1750-1850, An Introductory Essay* (New York: Reprints of Economic Classics: Augustus M. Kelley, Publishers, 2nd ed., 1958, first published by Frank Cass & Co., Ltd., 1928), pp. 61-63.

[27]Moffit, *op. cit.*, pp. 191-192.

[28]Heaton, *op. cit.*, pp. 482-483.

weak or nonexistant enforcement. In relation to quality control, standards of workmanship, and standards of measurement, state regulation had pretty well faded out of the picture; relative to the regulation of the labor force and working conditions, attempts were made to eliminate appalling conditions and to improve almost unbearable situations. In the latter sphere, however, progress was negligible and moved at a snail's pace. In fact some of the legislative acts (such as the Combination laws of 1799 and 1800, the rejection of the Chartists' petitions in 1839, and a second failure of the Chartists Movement in 1848) were definite obstacles or setbacks for the advancement of labor's cause. The Factory Acts of 1802, 1819, and 1831, and the repeal of the Combination laws in 1824 indicated some progress and improvement during the first half of the nineteenth century. Even though these attempts at improvements through legislation were in the right direction, they were at most feeble efforts which merely scratched the surface; for as some authors have pointed out it was one thing to pass laws and quite a different thing to enforce them. The demise of regulations concerning the quality and measurement of goods, for example, was described in detail by Moffit.[29]

Ashton pointed out the lack of enforcement of both detrimental and desirable legislation:

> The whole apparatus of penal legislation was, indeed, of less effect than might have been imagined. Many unions were formed in the first quarter of the nineteenth century, and some of these operated in the open, without any action being taken to put them down.
>
> * * * * * * * * *
>
> Experience under the Factory Acts of 1802, 1819 and 1831 proved that until a body of inspectors had been trained it was little use to lay down minimum conditions of hours and work. The experience of boards of health showed that until there was a larger supply of medical men and other professional experts not very much could be done to improve conditions in the towns.[30]

Professor Heaton made similar observations regarding the lack of enforcement and related problems:

> To pass an act was one thing, to enforce it was another. The inspectors faced a herculean task, confronted with the apathy of some parents and the hostility of some employers. Children seldom had birth certificates, and forged certificates were often presented. Factory clocks were not always reliable, schools were not everywhere available, teachers

[29]Moffit, *op. cit.*, pp. 213-215.
[30]Ashton, *op. cit.*, pp. 93, 97.

were often illiterate, and fines were sometimes so light that employers escaped any real punishment.[31]

The lessening, weakening, and even abolition of many legislative acts during the period of the Industrial Revolution (1750-1850) were the outgrowth of governmental policies advocated by many economists and statesmen and stood in direct contrast to the economic policies of the government during the preceding two and a half centuries. In describing this laissez-faire policy Professor Flinn wrote:

> There appeared, in the later eighteenth century, an approach to economic affairs which has been called *laissez-faire* (an expression first used earlier in the century by a French economist). By *laissez-faire,* these economic writers of the late eighteenth and early nineteenth century meant the absence of direct attempts of the government to control and regulate the nature and direction of economic development. Those who advocated *laissez-faire* recognized, however, that there were still many spheres in which it would be necessary for the government to take action, and they made it clear that an important field of government action lay in protecting the weaker members of society and in providing certain services such as poor relief, public health services and education which private enterprise of its own was unlikely to offer. The immediate aims of the *laissez-faire* economists were the abolition or reduction of import and export duties, of monopolies, of the Navigation Acts, and of the whole system of colonial regulation.[32]

An understanding of a possible reason for the government's apparent lack of concern for the conditions of employment may be drawn from Clark's explanation that the policy of laissez faire "was adopted not only because it enabled merchants and manufacturers to make fortunes without regard to the needs of the wage-earners; but because it opened the gates for the new wealth without which there could have been no social welfare."[33]

An insight into the nature of the working conditions of the times may be gained from Professor Heaton's following account of the provisions of the Factory Acts:

> The first factory act (1802) was passed to protect British pauper children who had been handed over by local poor-relief authorities as apprentices to some cotton factory owners. . . . the "Health and Morals of Apprentices Act" passed with little opposition. It dealt with:

[31]Heaton, *op. cit.*, p. 727.

[32]M. W. Flinn, *An Economic and Social History of Britain 1066-1939* (London: MacMillan & Co. Ltd., 1965), p. 194.

[33]George N. Clark, *op. cit.*, p. 87.
Industrial Revolution in Britain Triumph or Disaster? ed. Philip A. M. Taylor (Boston: D. C. Heath and Co., 1958), p. 87.

(1) *Sanitation.* Mill walls and ceilings must be whitewashed twice a year; ventilation and lighting must be adequate. (2) *Hours.* The working day was not to exceed twelve hours, and nightwork must be abolished. (3) *Education.* Instruction in the three R's must be provided. (4) *Inspection.* Two visitors — one a local justice and the other a clergyman — were to inspect the mills, and offending employers were to be fined.

* * * * * * * * *

That act (1819) forbade children under nine to work in cotton factories; thus an age limit was introduced.

* * * * * * * * *

The Factory Act of 1833 . . . did not provide for a simple ten-hour day, but it did take many important steps. (1) It applied to cotton, wool, and linen mills. (2) No child under nine could be employed. (3) Children between nine and thirteen years were not to work more than nine hours a day or forty-eight hours a week, and must spend three hours a day in school. Compulsory education thus began in a factory act. (4) Young persons (thirteen to eighteen years) must not work more than twelve hours a day or sixty-nine a week, and no one under eighteen years could work on the night shift. (5) Effective inspection was provided. Four full-time inspectors were appointed to enforce the act and bring offenders to court.[34]

Although man's exploitation of his fellow man by no means started during the Industrial Revolution and the advancements in technology were not the cause of poor working and living conditions for the laboring man, most writers are in agreement that most situations (with but a few exceptions) were rather despicable. Mantoux described the state of serfdom which still existed through the latter years of the eighteenth century as follows:

Between the small craftsman, at once master and artisan, and the wage-earning workman of "manufacture," can be found all the intermediate stages between independence and economic subjection, between extreme dispersion and highly developed centralization of capital and control. Moreover, side by side with cottage industry, there still survived the remains of an even older order of things, to which it is harder to attach imaginary virtues. Villenage, when it was abolished in France by the Constituent Assembly, had only just disappeared in British industry. Till 1775, the workers in the coal mines and the salt pits of Scotland were serfs in the full legal sense of the word. Bound for life to the coal mines or salt pits, they could be sold along with them. They even wore a visible sign of their slavery in the shape of a collar, on which was engraved the owner's name.[35]

[34]Heaton, *op. cit.*, pp. 724-727.
[35]Mantoux, *op. cit.*, pp. 73-74.

Although the writings of the Hammonds were criticized for their intense sympathy for victims of hardship or oppression, other writers' accounts of the employment conditions of the times are in fairly close agreement. The Hammonds described the child labor situation and the evils of the apprenticeship system in detail. They pointed out the deplorable working conditions for children as well as the inhumane treatment they experienced under their employers — both as "workhouse" children under the apprentice system and as "free-labor" children in the later, factory system.[36]

Neither the Industrial Revolution nor the factory system should be blamed for the deplorable working conditions which prevailed during this period in history, for human degradation in the form of slavery and serfdom had been condoned and tolerated long before this era of technological advancement. Long working hours, brutal servile work under the threat of the lash, and inhuman working conditions with little or no reward were commonplace from the days of the Greeks and the Roman galley slaves to the days of medieval serfs. The Industrial Revolution did, however, bring these conditions to the forefront and, in a sense, started movements to alleviate, or at least to improve, some of the prevailing conditions. As Ashton pointed out, the failure of the Industrial Revolution to fully reward the common man was due to a lag in administrative processes:

> for much of the overcrowding and squalor was the result of the fact that progress in science was then, as to-day, more rapid than that in administration. "The remote influence of arrangements has been somewhat neglected," wrote Dr. Kay in 1832, adding to this meiosis that the neglect arose "not from the want of humanity, but from the pressure of occupation and the deficiency of time.
>
> * * * * * * * * *
>
> If the industrial revolution was not able to bring its rewards in full measure to the ordinary man and woman it is to the defects of administrative, and not of economic processes, that the failure must be ascribed.[37]

Invention and Technology

In their descriptions of the Industrial Revolution, many writers placed much of their emphasis on technical developments in the

[36]John L. and Barbara Hammond, "The Industrial Revolution: The Rulers and the Masses, *The Industrial Revolution in Britain Triumph or Disaster?* ed. Philip A. M. Taylor (Boston: D. C. Heath and Co., 1958), pp. 35-36.

[37]Ashton, *op. cit.*, pp. 96-97.

textile industry. However, as indicated earlier in this chapter, technological breakthroughs in practically all industrial fields were interdependent and will, therefore, be treated in terms of progress in relation to raw materials, power and prime movers, product manufacture, and the distribution of goods through various means of transportation. Invention, irrespective of whether it was considered as cause or effect, played a primary role during the Industrial Revolution. In fact, if it were not for the success of the inventors of this period, there would have been little progress to write about.

Relative to *raw materials*, improved methods of extraction, smelting, and refining were of extreme importance not only for the greater quantities and better quality of the ores and metals needed for production but also as a source of fuel for prime movers to operate pumps used in mining, stationary engines used in manufacturing, and steam engines utilized to propel boats, ships and trains. Invention involving the application of scientific principles played a tremendously important part in the evolution of technology and the adage "necessity is the mother of invention" even though timeworn is still quite appropriate. The iron mining industry, experiencing an economic depression in the early part of the eighteenth century, needed a cheaper and more efficient fuel than charcoal which was used in smelting iron ore. Professors Fairchild, Furniss, and Buck stated that "a cheaper and more efficient fuel had to be discovered before any great expansion in the production of iron could be expected."[38]

Roger Burlingame pointed out the importance of early developments in the mining of iron and coal and its subsequent bearing on the later development of the steam engine.

> The fact that the early atmospheric engine of Thomas Newcomen did this job ["pumping in connection with the mining of coal"] was immensely important to the production of iron and to the abundance of fuel — both essential to the later development of the double-acting rotary engine of James Watt which furnished the nineteenth-century factory with power.[39]

H. L. Beales also recognized developments in the iron industry as the prelude to great industrial progress. He pointed out that once coke was used successfully in iron-making plants,

> the iron industry was at last able to escape from its slough of despond and to supply the world with the capital goods, the material of construction and the varied articles of popular use which were so ur-

[38]Fairchild, Furniss, and Buck, *op. cit.*, p. 57.

[39]Roger Burlingame, *Backgrounds of Power* (New York: Charles Scribner's Sons, 1949), p. 50.

gently needed. The industrial significance of what had been accomplished was illustrated when the Carron works was founded in 1759. From the outset Carron was conceived on a big scale: it adopted the latest practice: it initiated an industrial revolution in Scotland: it gave Watt his entrance into industry. It foreshadowed the great industry of our own day.[40]

Technological progress in the coal mining and iron industries was aptly described by Professor Ashton;[41] the French writer Paul Mantoux traced both the progress made in the coal and iron industries (noting at the same time the problems of inventors in both the mining and metal industries) and the early manufacture of steel.[42]

Increased efficiency in coal utilization and improved processes in the smelting of iron ore are clearly indicated by the following excerpt from Fairchild, Furniss, and Buck:

In the last half of the eighteenth century the production of iron increased seven-fold, that of coal more than doubled. In the first half of the nineteenth century iron production increased twenty-four-fold, that of coal somewhat over six-fold. These figures are interesting not only in showing the absolute increases in both iron and coal, but also in pointing out the increased efficiency in the use of coal. When we realize that coal was being used for power to an ever increasing degree, a twenty-four-fold increase in iron production coupled with a six-fold increase in coal production points clearly to improved processes.[43]

The need for large quantities of raw materials in the textile industry also stimulated invention. In his description of Eli Whitney's invention the cotton gin, Beard pointed out this need:

The problem of supplying the enormous demand for raw materials now confronted the cotton growers of America. The capacity of the jenny had multiplied many fold, but it still took an old coloured woman a whole day to thoroughly clean one pound of raw green seed cotton, while the best of hand-workers on ordinary cotton could only prepare five or six pounds a day. Eli Whitney . . . recognised the difficulties with which the planters had to deal, and, at the solicitation of some friends, set to work to construct a mechanical cotton cleaner. . . . As soon as it [Whitney's "saw gin"] was put into practical working order, one man by its aid could clean upwards of a thousand pounds of cotton a day, and the producers, by the use of this machine, could supply the demands of the spinners. From the field to the shop counters, cotton

[40]Beales, *op. cit.*, p. 54.
[41]Ashton, *op. cit.*, pp. 46-48.
[42]Mantoux, *op. cit.*, pp. 271-297.
[43]Fairchild, Furniss, and Buck, *op. cit.*, p. 58.

now passes through a series of mechanical processes in which the labour of man is reduced to the minimum.[44]

The harnessing and development of *power and prime movers* are tied in closely with the procuring of raw materials, the driving of machinery in manufacturing products, and the transporting of both the raw materials to the manufacturer and the finished products to the consumers. First water power, then the steam engine provided the motive force for the factory system. Mantoux identified the importance and limitations of water power during the early part of the Industrial Revolution as follows:

The old water-wheel, which for many centuries had worked flour mills, and since the end of the Middle Ages had been used to work the mallets of fulling mills, the bellows and hammers of ironworks or pumps for supplying and draining water, in the eighteenth century took on a character of universal utility. It was found wherever a branch of industry was being either created or transformed. It made it possible to work, in one building, numerous and powerful machines. It enabled work to be organized in large workshops, where the men were brought under strict discipline which was the necessary and immediate outcome of machine industry.

* * * * * * * * *

The use of water power limited industries to certain localities, as a water mill could not be built except near a plentiful stream of swiftly running water. . . . This was one difficulty, and the other was that even in those places where water power did exist it was often insufficient. The clumsy systems of wheels and troughs which were used to collect and transmit it wasted a good deal, and the modern resource of obtaining additional energy from a distance by means of electricity was, of course, not available. The only practicable method which then existed of increasing the supply of power on the spot, was to create artificial waterfalls. But then the water had to be raised to the level of a reservoir by means of a pump, and this is how the steam engine first came to be used.[45]

Another situation which led to the invention of the steam engine as a source of power was the increased demand for coal. This invention led to the sinking of deeper shafts which, in turn, brought about the problem of flooding. Fairchild, Furniss, and Buck indicated that

this difficulty was partially solved by the invention of the steam engine early in the eighteenth century and the improved steam engine of

[44]Beard, *op. cit.*, pp. 28-29.
[45]Mantoux, *op. cit.*, p. 312.

Watt later on, which made it possible to pump out the water as well as to haul up the coal by power.[46]

Mantoux described early practical applications of steam by Thomas Savery's steam engine and Newcomen's atmospheric engine. Savery's "machine, although very simple, made use of two different forces: atmospheric pressure to raise the water and the expansion of steam to lower it again."[47] Savery intended for his engine

to serve many purposes; it was to drain marshes, to pump water out of mines, to supply water to towns and houses, to put out fires and to turn the wheels of mills. . . . It worked slowly and its power was limited. Moreover, its use was not without danger, as no one knew how to prevent explosions in the absence of any pressure gauge, or regulator to lessen the pressure. As soon as Newcomen's engine became known the earlier one was at once abandoned.

The essential difference between the two inventions (and from the point of view of theory the difference is all in Savery's favour) was that Newcomen did not make use of the expansion of steam. In fact, he only made use of steam to create through condensation a vacuum in the tank. The most appropriate name for his engine would be an atmospheric engine.[48]

Newcomen's

engine as first produced was very clumsy. The piston did not fit exactly into the cylinder; condensation, which was obtained by watering the outside of the cylinder with cold water, was very incomplete; while the tap had to be opened and closed by hand seven or eight times a minute. Successive improvements partly remedied these defects. . . . By about 1720 the engine had been sufficiently improved to give satisfaction, and it remained practically unaltered for over half a century.[49]

Professor Ashton described in detail the improvements made to Newcomen's engine by James Watt in 1769:

He [Watt] saw that the chief defect of the atmospheric engine arose from the alternate injection and condensation of steam: in order to prevent the steam from condensing before the piston had completed its upward stroke, it was necessary to keep the cylinder warm; but, equally, in order to condense the steam for the return stroke, it was necessary for it to be cold. The sudden changes in the temperature of the cylinder wall meant that a great amount of potential energy ran to waste. Watt . . . hit on the solution of introducing a separate con-

[46]Fairchild, Furniss, and Buck, *op. cit.*, p. 57.
[47]Mantoux, *op. cit.*, p. 313.
[48]*Ibid.*, pp. 314-315.
[49]*Ibid.*, pp. 316-317.

denser which could be kept permanently cool while the cylinder could be kept permanently hot. Within a few weeks a model was made, but many years were to pass before the technical difficulties of translating this into a full-scale engine were overcome. . . . In 1774 . . . James Watt left Scotland for Birmingham. Here he had the support of a man, [Matthew Boulton] already well established in business. . . . At Boulton's Soho works there were the craftsmen Watt needed to make the valves and other delicate parts of the engine.

* * * * * * * * *

If Watt had done no more than this he would have established a claim to a place in the front rank of British inventors. But he could not rest satisfied with having made improvements, however great, in what was little more than a steam pump. His mind had long been busy with the idea of converting the to-and-fro action into a rotary movement, capable of turning machinery, and this was made possible by a number of devices, including the sun-and-planet, a patent for which was taken out in 1781. In the following year came the double-acting, rotative engine, in which the expansive force of steam was applied to both sides of the piston; in 1784 the parallel motion; and in 1788 the beautiful device of the governor, which gave the greater regularity and smoothness of working essential in a prime mover for the more delicate and intricate of industrial processes.[50]

In the realm of *product manufacture*, the textile industry provides a typical example. Technological progress, in the form of inventions of machines for improving the methods of processing fibers and weaving thread, formed the backbone of the textile industry. These inventions speeded up the manufacturing methods, replaced much hand labor, and enabled the establishment of the factory system with its large quantity production.

Since the literature is replete with information on the textile industry, only mention of some of the inventors and their contributions will be made here. In the silk industry, in 1717, John Lombe built a silk throwing machine from plans which he obtained in Italy. The inventor is unknown. In the woolen industry, in 1733, John Kay invented the flying shuttle. Fitted with tiny wheels, it could be thrown by one person in weaving wide cloth.

In the cotton industry, numerous inventions included the spinning machine by John Wyatt in 1733 and a second spinning machine by Lewis Paul in 1738. Paul obtained the first patent on this invention. He also developed, around 1740, a cylindrical carding machine. The spinning jenny which revolutionized the industry was invented by James Hargreaves between 1764 and 1767 and patented

[50]Ashton, *op. cit.*, pp. 48-50.

in 1770. At about the same time Richard Arkwright, the founder of the factory system, developed the water frame. In 1785 the power loom was invented by Edmund Cartwright.

In the pottery industry, in the latter half of the eighteenth century Josiah Wedgwood experimented ceaselessly with clays, glazes, colors, ovens, and temperature control. He invented or improved tools, lathes, and other pieces of equipment. In striving for quality he employed artists and searched for relics and records of the ancient world for classical designs for his "first line" merchandise.

For the *distribution of goods* as well as for the procurement of raw materials, many developments took place in the various forms of transportation — from canals, rivers, and the high seas to roads and railroads. Professor Ashton described the benefits of the canal era:

> The canal era was a short one — it coincided with the period 1760-1830 — but it saw momentous changes in economic life. The cost of bulky or heavy commodities such as coal, iron, timber, stone, salt, and clay was greatly reduced; agricultural regions which had been remote from the market were brought within the widening circle of exchange; the fear of local famine, of both fuel and food, was removed; and the closer contact with others which the new means of communication afforded had a civilizing influence on the populations of the Potteries and other inland areas.[51]

Ashton also described the development of the roads and turnpike system:

> In the first half of the century . . . the policy was one of making the traffic conform to the roads. After 1750, however, attempts were made to adapt the roads to the traffic. The number of turnpikes increased vastly, especially in the early "fifties," and again in the early "nineties," when rates of interest were low; and in the growing industrial regions of the North, in particular, several self-taught engineers did much to increase the carrying capacity of the highways.
>
> * * * * * * * * *
>
> If the changes in the roads were of less moment to industry than those in the waterways, their effects on internal trade were significant: the commercial traveller came to take the place of the "rider-out"; the Royal Mail became a more efficient channel of correspondence; and the processes of placing orders and remitting money were made more simple and speedy.[52]

Professor Beales indicated the progress in the railroads and the contributions they made to the British economy:

[51]*Ibid.*, p. 59.
[52]*Ibid.*, pp. 59-60.

The English railways were built piecemeal. . . . In the late thirties the main lines out of London were built, and a phase of local construction in different parts of the country culminated in the railway boom of 1845-7, by which time some 200 railway companies had been established and 5,127 miles opened for traffic (1848). The consolidation of local lines followed, and the building up of thorough communications.

* * * * * * * * *

To summarize the services rendered by the railways to the community is a large task. . . . But even in the first half of the century they did big things. They brought a mitigation of the long distress of the post-Waterloo period by opening up new avenues of permanent employment; it was not the revision of the Poor Law but the expanding employment directly on work of construction and then of operation, and indirectly on the various trades which contributed to railway initiation and maintenance, which enabled the workers to leave behind the hunger of the thirties and forties.[53]

Inventions

Inventions played a tremendously important part in the technological progress made during the Industrial Revolution. Whether they were the cause or effect of advances is problematical. One thing is certain, however, without them technological development would have been trivial or at least greatly retarded. The field in which the breakthrough occurs is also of secondary importance due to the previously mentioned interdependency. An advance in prime movers, transportation, mining or machinery affected many industries once it proved effective. The development of the steam engine, the improvement of deep well pumps for use in mining, the laying of iron rails for railroading, and the inventions of the fly shuttle and the spinning jenny are typical examples.

In looking at *invention* and the primary role it played in the Industrial Revolution one should keep the facts in mind that the time was ripe for innovations and that improvements took place across the board in many fields of endeavor and not just in the textile industry. As Professor Beales further pointed out:

New inventions were, so to speak, in the air: the environment was favorable to industrial progress. The inventions, the improved communications, the amplifying of the financial system — all the achievements of the revolution in industry represent one movement. They were mutual determinants and all worked together for the economic good.[54]

To place the inventions of the period covered in this chapter (1750-1850) in perspective, one needs to be mindful of the tech-

[53]Beales, *op. cit.*, pp. 60-61.
[54]*Ibid.*, p. 49.

nological advances made in the preceding sixteenth and seventeenth centuries. It might also be well to compare the accomplishments of the following century (1850-1950) during which time technology outstripped the progress made during the Industrial Revolution but, similarly, this later progress could not have been possible without the previous innovations. This perspective is indicated by Lewis Mumford:

> In short, most of the important inventions and discoveries that served as the nucleus for further mechanical development, did not arise, as Spengler would have it, out of some mystical inner drive of the Faustian soul: they were wind-blown seeds from other cultures. After the tenth century in Western Europe the ground was, as I have shown, well plowed and harrowed and dragged, ready to receive these seeds; and while the plants themselves were growing, the cultivators of art and science were busy keeping the soil friable. Taking root in medieval culture, in a different climate and soil, these seeds of the machine sported and took on new forms: perhaps, precisely because they had *not* originated in Western Europe and had no natural enemies there, they grew so rapidly and gigantically as the Canada thistle when it made its way onto the South American pampas. But at no point — and this is the important thing to remember—did the machine represent a complete break. So far from being unprepared for in human history, the modern machine age cannot be understood except in terms of a very long and diverse preparation. The notion that a handful of British inventors suddenly made the wheels hum in the eighteenth century is too crude even to dish up as a fairy tale to children.[55]

Summary

The Industrial Revolution was the prelude to technological advances throughout the world. Although it is usually thought of as a period in English history from about 1750 to 1850, it might be more desirable to think of it as an evolutionary movement covering a much longer period of time which transformed an agrarian society to an industrial one and involved a change from custom to mass production methods of manufacturing. Even though technological progress was probably most spectacular in the textile industry, breakthroughs in this industry would have been impossible without similar strides in other industries such as agriculture, mining, metalworking, ship building, power production, finance, and transportation. The Industrial Revolution occurred when it did because of numerable favorable conditions including sufficient raw materials, available finances due to relatively affluent times, an acceptance of

[55]Lewis Mumford, *Technics and Civilization* (New York: Harcourt, Brace and Company, 1934), pp. 108-109.

innovation, a propitious intellectual atmosphere, and advantageous governmental regulations and political influences.

The Industrial Revolution had tremendous social impact on society of a nature both desirable and undesirable in terms of available goods and services and working conditions. However, neither the Industrial Revolution nor the factory system should be blamed for the prevailing deplorable working conditions, for the human degradation of slavery and serfdom had been condoned and tolerated long before this era of technological advancement.

Invention played a primary role in the evolution of technology. In fact, if it were not for the success of the inventors of this period, there would have been little progress of coking of iron ore, the steam engine, the spinning jenny, the puddling and rolling mill, the power loom, the steamboat, and the locomotive might be singled out; but one should be mindful of the dependency of these inventions on technological advances in the preceding centuries. Just as the great accomplishments of the century following the Industrial Revolution were dependent on the progress made with previous innovations, so too was the advance made in technology during the Industrial Revolution made possible because of earlier developments, as will progress in the future be dependent upon present day achievements. The concept of the interdependency and inter-stimulation between various industries should receive primary consideration as well as the overall effect of technological advancement.

Selected Bibliography

Abbot, Charles Greeley. *Great Inventions,* Vol. 12 of the Smithsonian Scientific Series. New York: Smithsonian Institution Series, Inc., 1943, p. 383.

Ashton, T. S. *The Industrial Revolution 1760-1830*. A Galaxy Book. New York: Oxford University Press, 1964.

Beales, H. L. *The Industrial Revolution 1750-1850 An Introductory Essay*. New York: Reprints of Economic Classics; Augustus M. Kelley, Publishers, 2nd ed., 1958, first published by Frank Cass & Co., Ltd., 1928.

Beard, Charles. *The Industrial Revolution*. London: George Allen & Unwin Ltd., 1936.

Bowen, Harold G., and Kettering, Charles F. *A Short History of Technology*. West Orange, New Jersey: The Thomas Alva Edison Foundation, Inc., 1954.

Burlingame, Roger. *Backgrounds of Power*. New York: Charles Scribner's Sons, 1949.

Encyclopaedia Britannica Volume 12. Chicago: Encyclopaedia Britannica, Inc., 1950.

Fairchild, Fred, Furniss, Edgar S., and Buck, Norman S. *Elementary Economics*. New York: The Macmillan Co., 1930.

Flinn, M. W. *An Economic and Social History of Britain 1066-1939*. London: MacMillan & Co. Ltd., 1965.

Forbes, R. J., and Dijksterhuis, E. J. *A History of Science and Technology*, Vol. 2 The Eighteenth and Nineteenth Centuries, Pelican Books A499. Baltimore, Maryland: Penguin Books, 1963.

Hamilton, Henry. *The Industrial Revolution in Scotland*. London: Frank Cass & Co. Ltd., 1966.

Heaton, Herbert. *Economic History of Europe*. New York: Harper & Brothers, 1948.

Leithauser, Joachim G. *Inventors' Progress*, Translated from the German by Michael Bullock. New York: The World Publishing Co., 1959.

Mantoux, Paul. *The Industrial Revolution in the Eighteenth Century*, an outline of the beginnings of the modern factory system in England. Harper Torchbooks, The Academy Library. New York: Harper & Row Publishers, 1961.

Meredith, H. O. *Economic History of England*. London: Sir Isaac Pitman & Sons, Ltd., 1958.

Moffit, Louis W. *England on the Eve of the Industrial Revolution*. New York: Barnes & Noble, Inc., 1964.

Mumford, Lewis. *Technics and Civilization*. New York: Harcourt, Brace and Co., 1934.

Pound, Arthur. *Transportation Progress*, A Story of Self-Propelled Vehicles from Earliest Times Down to the Automobile. Detroit: General Motors Corp., 1934.

Tawney, R. H. *Religion and The Rise of Capitalism*, A Mentor Book. New York: The New American Library, Inc., 1954.

Taylor, Philip A. M. (ed.). *The Industrial Revolution in Britain Triumph or Disaster?* Boston: D. C. Heath and Co., 1958.

Toynbee, Arnold. *The Industrial Revolution*. Boston: The Beacon Press, Paperback Ed., 1956.

Wells, H. G. *The Outline of History Vol. II*. New York: Garden City Books, Doubleday & Co., Inc., 1961.

World Book International. "Automation," *The World Book Encyclopedia*, 50th Anniversary Edition. Chicago: Field Enterprizes Educational Corp., 1966, Vol. A-1, p. 917.

CHAPTER FIVE

Machine Technology

Clois E. Kicklighter
Eastern Michigan University

Tools vs. Machines

Presumably the most characteristic aspect which identifies man and sets him apart from the other primates is his ability to create and use tools. Because tools extend the power of human muscles or refine the perception of human senses, they have played one of the leading roles in metamorphous of *homo sapiens*. In fact, a study of the origins of man inevitably is based on artifacts which include tools. Tools are, therefore, of evident importance to us.

Since the mechanical equipment of any given society consists largely of tools and machines, questions to be considered in this section will include: (1) What are tools? (2) What are machines? (3) What are the characteristic differences between tools and machines?[1]

The word "tool" has many synonyms — implement, utensil, machine, instrument, etc. Or, by definition, a tool is "any contrivance held in and worked by hand, for assisting in work."[2]

This has apparently been the traditional definition and is therefore similar to some of the oldest definitions of tools known.

Klemm quoted an early contrast of tools and machines presented by Torlais in his book Reaumur:

> Some (machines) are moved mechanically, others are used like tools. There seems to be this difference between machines and instruments, that many people work at machines which need more power, for example, projectile engines or wine presses. But instruments carry out their purpose by the careful handling of a single workman, such as the

[1]Abbott P. Usher, *A History of Mechanical Inventions* (New York: Harvard University Press, 1954), p. 116.

[2]Clarence L. Barnhart (ed.), *The American College Dictionary* (New York: Harper & Brothers Publishers, 1953), p. 1276.

turning of a hand balista or of screws. Therefore both instruments and machinery are necessary in practice and without them every kind of work is difficult.[3]

This contrast of tools and machines was originally written when mechanical power was beginning to be utilized more and was therefore susceptible to analysis.

Usher wrote in his book, *A History of Mechanical Inventions,* concerning the definition of tools:

In the restricted sense that is most useful for historical study or mechanical analysis, the term "tool" may best be confined to implements for direct execution of certain kinds of work, notably cutting, striking, or rubbing.[4]

He further explained that although tools were originally used in the hand, many have been adapted to machinery without significantly changing their form or purpose.[5]

Mumford was concerned with the misconception that machines are necessarily more complex than tools. He wrote that

the degree of complexity is unimportant: for, using the tools, the human hand and eye perform, complicated actions which are the equivalent, in function, of a well developed machine; while, on the other hand, there are highly effective machines, like the drop hammer, which do very simple tasks, with the aid of a relatively simple mechanism. The difference between tools and machines lies primarily in the degree of automatism they have reached: The skilled tool-user becomes more automatic, in short, more mechanical, as his originally voluntary motions settle down into reflexes, and on the other hand, even in the most completely automatic machine, there must intervene somewhere, at the beginning and the end of the process, first in the original design, and finally in the ability to overcome defects and to make repairs, the conscious participations of a human agent.[6]

The preceding comments indicate that devices which fall into the "tool" category might be simple or complex, large or small, used in the hand or attached to some other mode of power. Therefore the tool might be conceived of as the instrument which actually does the cutting, scraping, beating, etc.

Concerning machines, Chase wrote that they are

any non-living contrivance to extend or modify the power of the body, or to refine the perception of the senses. Its commonest function is to

[3]Friedrick Klemm, *A History of Western Technology* (New York: Charles Scribner's Sons, 1959), p. 47.

[4]Usher, *op. cit.*

[5]*Ibid.*

[6]Lewis Mumford, *Technics and Civilization* (New York: Harcourt Brace and World, Inc., 1963), p. 10.

> transform random energy into disciplined energy. It thus includes tools of all kinds, and mechanisms, for more careful recording and measurement — the transit for instance, or the telephone receiver.[7]

Note that Chase includes tools in the category of machines.

Mumford recognized that confusion does exist in determining a precise distinction between tools and machines. He wrote that

> apart from the simple machines of classic mechanics, the inclined plane, the pulley, and so forth, the subject remains a confused one. Many of the writers who have discussed the machine age have treated the machine as if it were a very recent phenomenon, and as if the technology of handicraft had employed only tools to transform the environment. These preconceptions are baseless. For the last three thousand years, at least, machines have been an essential part of our older technical heritage. Reuleaux's definition of a machine has remained a classic: "A machine is a combination of resistant bodies so arranged that by their means the mechanical forces of nature can be compelled to do work accompanied by certain determinant motions": but it does not take us very far. Its place is due to his importance as the first great morphologist of machines, for it leaves out the large class of machines operated by man-power.[8]

Mumford went on to contrast the tool and machine when he stated that

> the essential distinction between a machine and a tool lies in the degree of independence in the operation from the skill and motive power of the operator: the tool lends itself to manipulation, the machine to automatic action.[9]

In describing a machine, Karl Marx listed three different parts essential to all fully developed machinery: "the motor mechanism, the transmitting mechanism, and finally the tool or working machine."[10] It is quite clear that Marx saw the machine as something quite different from a tool.

In defining a machine, O'Brien indicated that the term machine includes "all mechanical and electrical devices that extend or refine human powers."[11]

[7]Stuart Chase, *Men and Machines* (New York: The Macmillan Company, 1929), p. 24.

[8]Mumford, *op. cit.*, p. 9.

[9]*Ibid.*, p. 10.

[10]Karl Marx, *Capital* (First published in 1906, Chicago: Charles H. Kerr & Company), p. 407. Reprint (New York: The Modern Library, Random House, Inc., no date given).

[11]Robert O'Brien *et al.*, *Machines* (New York: Time-Life Incorporated, 1964), p. 10.

If the definitions and descriptions presented here are analyzed for some clue as to the grouping of mechanisms into classes, the following impressions may be derived. The term "machine" refers to a class of devices which may or may not include tools. In other words, tools may be made to function using man as the source of power and direction, or they may be attached to some mechanical, chemical, electrical, or other mode of power. In both cases, the tool is an element of the machine. In the first instance the machine is, in essence, man. In the second case, some mode of power and mechanism other than man is the machine. The tool, in either situation, does the actual cutting, scraping, or beating while the machine only guides the action.

This discussion is further complicated, however, by the introduction of another device which is defined as "machine tools" and is a kind of combination of both the machine and tools. Mumford stated that

> between the tool and the machine there stands another class of objects, the machine-tool: here, in the lathe or the drill, one has the accuracy of the finest machine coupled with the skilled attendance of the workman. When one adds to this mechanical complex an external source of power, the line of division becomes even more difficult to establish. In general, the machine emphasizes specialization of function, whereas the tool indicates flexibility; a planing machine performs only one operation, whereas a knife can be used to smooth wood, to carve it, to split it, or to pry open a lock, or to drive in a screw. The automatic machine, then, is a very specialized kind of adaptation; it involves the notion of an external source of power, a more or less complicated inter-relation of parts, and a limited kind of activity. From the beginning the machine was a sort of minor organism, designed to perform a single set of functions.[12]

But at the same time that Mumford's discussion of machine tools sheds some light on the problem it also clouds the issue. For instance, he says that the function of a knife is to smooth, carve, or split wood, pry open a lock, or drive a screw. But one might question whether this is truly the function of a knife. A simple blade has but one function — to cut. Certainly a knife could be used for these other things, but it is not designed for such purposes. It would seem, therefore, that the number or complexity of functions involved would not discriminate sufficiently to form a basis for classification.

If there is, in reality, a distinct group of devices that deserve the name machine tools, it would seem logical, from their designated term, that they are somewhere between tools and machines. Our

[12]Mumford, *op. cit.*

modern-day power tools seem to fit this description. If one were to analyze an electric drill, for example, he would no doubt come to the conclusion that the drill or bit did the actual cutting while the motor mechanism supplied the power. The tool (bit) and motor together would be useless without the skilled guiding hand of man to manipulate, or position the mechanism so that it might function. The discriminating feature of a machine tool would seem, therefore, to be that it possesses a built-in source of power which while affording certain motion to the tool still requires man to supply the remaining motion necessary for functioning.

In summary, the implements for increasing man's power and precision in doing work might be classified into three groups—tools, machine tools, and machines. It is not too difficult to distinguish between the two extreme groups (tools and machines) but a classification between machine tools and machines becomes less certain.

The Factory System

A discussion of the factory system could logically begin with the advent of man and be followed by his technological developments, but for obvious purposes the analysis will begin many centuries later.

During the eleventh century western Europe was characterized by an immobile, self-sufficing agrarian economy of the feudal system. Around the time a gradual relaxation and transformation took place. As a result, trade and commerce increased and, since towns created markets, trade and commerce helped develop towns. Independent artisans, producing for the market, began to band together and form guilds.[13]

The mode of production of the guild system was predominately handicraft. However, machinery was being developed and used in crude forms during the beginning of the guild system. Labor in the guild was not specialized, routinized, standardized, and mechanized.[14]

Bowen and Kettering reported that one of the world's great industries (the textile industry) began to take shape during the Middle Ages, or about the time the guild system was predominant.[15]

[13]Eugene V. Schneider, *Industrial Sociology* (New York: McGraw-Hill Book Company, Inc., 1957), p. 33.

[14]*Ibid.*, p. 34.

[15]Harold G. Bowen and Charles F. Kettering, *A Short History of Technology* (West Orange, New Jersey: The Thomas Alva Edison Foundation, Inc., 1954), p. 38.

The guild system, according to Ashley, reached its climax in the thirteenth century at which time it was strongly entrenched in all branches of industry. He further stated that some guilds survived into the nineteenth century and that even today traces of this system remain.[16]

But by the sixteenth century the guild system was showing signs of decay. Some of the factors operating to weaken the guild system were presented by Schneider. He listed the following:

1. The harmony of the system was gradually destroyed by increasing difficulty in attaining the rank of master.
2. The very strength of the guilds and their monopoly in certain areas of manufacturing aroused the hostility of other groups in society. Eventually these hostile groups were able to use the state to strike at the guilds.
3. In the course of time, wealth accumulated in the hands of certain masters. In some cases this capital was used to employ workers and to engage in manufacturing for profit outside the guild system.
4. As wealth accumulated in the hands of certain masters, some craft guilds were transformed into merchant guilds.
5. As the market for manufactured goods, particularly overseas, widened gradually, the guilds became dependent on the exporting merchants. The exporters possessed the necessary capital to finance the process of manufacturing for a foreign market, which involved a long interval between production and final sale. . . . Thus the guilds were reduced to the position of manufacturing not for a market but for an entrepreneur.
6. Beginning with the sixteenth century, widening horizons and increasing trade led to a demand for new products. The manufacture of these products often necessitated expensive imported raw materials, entailing increased costs which the guilds could not bear. . . . Thus the guild workers became, in effect, employees of a merchant entrepreneur.[17]

The entrepreneurs attempted to exert control over production in a number of ways. Their most successful means was to separate the place of work from the home and bring the workers together in a central place. In essence, the entrepreneurs were trying to reconstitute the old shop industry of the guild, but on a different basis. They now owned the means of production — the capital, tools, raw materials, plant, and labor. A new productive system had been formed — the factory system.[18] Weber defined a factory as a shop

[16]William J. Ashley, *An Introduction to English Economic History and Theory* (New York: Longmans, Green and Company, 1925), p. 76.

[17]Schneider, *op. cit.*, p. 36.

[18]*Ibid.*, p. 39.

industry with free labor and fixed capital under one roof.[19] It was the factory system, therefore, which created the conditions for the use of machinery and mechanical power, and not vice versa.

The factory system was destined to engulf almost all mankind before it. It was successful because of a combination of economic factors and favorable external conditions. The factory system first swept England and then moved into western Europe and America.[20]

The factory system did not develop simply because production moved from the home to a central location. The factory was preceded by a scientific revolution. Concerning this revolution, Bowen and Kettering wrote:

> The scientific revolution started in Italy with Copernicus (a Pole) and his exposition of the solar system, Galileo with his telescope and defense of the Copernican against the Aristotlean system which incidentally earned him a prison sentence. Vesalius who founded anatomy and found errors in the work of Galen, and Giordano Bruno was burned at the stake for his unorthodox views about the universe. If the notebooks of Leonardo da Vinci had come to light at that time, extreme punishment would have been meted out to him as well.[21]

Martha Ornstein discussed the role which scientific societies played in their relation to the development of the scientific revolution:

> It was the unmistakable and magnificent achievement of the scientific societies of the seventeeth century, not only to put modern science on a solid foundation, but in good time to revolutionize the ideas and methods of the universities and render them the friends and promoters of experimental science instead of the stubborn foes they had been so long.[22]

In these societies, instrumentation and the theoretical tools were developed: "the telescope, the microscope, the thermometer, the barometer, and the air pump, the new clocks moved by escapement and pendulum, and also the scientific tools such as mathematical symbols, logarithms, and calculus."[23]

Mees contrasted the role of the scientific societies in the development of science with that of the universities of that period:

[19]Max Weber, *General Economic History*, translated by Frank H. Knight (Glencoe, Illinois: Free Press, 1950), p. 163.

[20]Schneider, *op. cit.*

[21]Bowen and Kettering, *op. cit.*, p. 49.

[22]Martha Ornstein, *The Role of Scientific Societies in the Seventeenth Century* (Chicago: University of Chicago Press, 1938), p. 263.

[23]R. J. Forbes, *Man the Maker* (New York: Henry Schuman, Inc., 1950), pp. 139-140.

The development of science in the seventeenth century, and indeed in much of the eighteenth, was the work of the scientific societies rather than the universities. These societies assumed responsibility for the progress of science and developed the experimental method which found no welcome in the universities of that period, steeped as they were in the spirit of tradition.[24]

The conquest of Western Civilization by the machine was not accomplished without much resistance from institutions, habits, and impulses which did not at that time lend themselves to organization geared to the machine. From the very beginning, the machine provoked hostile reactions. "Resistance to mechanical improvements took a wide variety of forms. The most direct and simple form was to smash the offending machine itself or to murder its inventor."[25]

Concerning the primary considerations of the first factories, Mumford wrote the following:

One of the first products of the machine was the machine itself. As in the organization of the first factories the narrowly practical considerations were uppermost, and all the other needs of the personality were firmly shoved to one side. The machine was a direct expression of its own functions: the first cannon, the first crossbows, the first steam engines were all nakedly built for action.[26]

The factory system reflected a rational view of life. The system was based on a rational technique of production, rational accounting, rational budgeting, and rational rules of operation.[27] The machine afforded regularity, order, certainty, and a more definite, calculable behavior than had been the case before. These two factors — the factory system and the development of more sophisticated machines — worked hand in hand to push the new productive system forward.

The development of new prime movers also played a great role in the development of machine production. Singer pointed out the importance of prime movers.

During the last 250 years five great new prime movers have produced what is often called the Machine Age. The eighteenth century brought the steam-engine; the nineteenth the water-turbine, the internal combustion engine, and the steam-turbine; and the twentieth the gas-turbine.[28]

[24]C. E. Kenneth Mees, *The Path of Science* (New York: John Wiley and Sons, Inc., 1946), p. 87.

[25]Mumford, *op. cit.*, p. 284.

[26]*Ibid.*, p. 344.

[27]Schneider, *op. cit.*, p. 41.

[28]Charles Singer *et al.*, *A History of Technology* (Oxford: Clarendon Press, 1958), p. 148.

The machine took a firm grip on industry in England, first in the textile industry and then spreading to other industries. This movement was the so-called Industrial Revolution. Coupled with the role of a new organization and new prime movers, greater use of machines was the result of machine-tools. Singer spoke about their significant part in the movement.

> The invention and development of machine-tools was an essential part of the industrial revolution. The steam-engine, the railway, and textile and other manufacturing machinery required machine-tools for their progress; and it was this demand that stimulated the great progress in the invention of machine-tools that took place.[29]

Large scale industrialism spread from these beginnings in two directions. Externally, it spread from one nation to another.[30] Internally, it conquered one field after another. Probably one of its most important advances was its spreading to the manufacture of capital goods, such as iron and steel.[31]

Economically, one of the basic factors in the industrial revolution was the remarkable expansion of overseas trade. The new markets came, and the inventions followed. The inventors worked within the limits forced upon them both by the changing society and by the new materials that were becoming available.[32]

Singer summed up the four basic technical achievements of the industrial revolution. They were:

1. *Replacement of tools by machines.* Both enable man to perform certain operations more dexterously than with the bare hand. The chief difference is that the tool is set in motion by man's physical strength, the machine by some natural force.
2. *The introduction of new prime movers . . .* Wind was cheap but unreliable, water was limited by local conditions, but steam suffers neither disadvantage. It is independent of the weather and the seasons. The invention of the steam-engine is the central fact in the industrial revolution.
3. *The mobile prime mover.* The power of the steam-engine could be created where needed and to the extent desired. This mobility is the most characteristic feature of the Machine Age, and made possible the industrialization of many countries that had no great resources of water-power.

[29] *Ibid.*, p. 417.
[30] Schneider, *op. cit.*, p. 48.
[31] G. D. H. Cole, "Industrialism," *Encyclopedia of the Social Sciences*, VIII (New York: The Macmillan Company, 1930), p. 21.
[32] Singer, *op. cit.*

4. *The factory as a new form of organization of production.* Thus the early textile mills and ironworks were of this type rather than of the workshop type so characteristic of medieval and earlier technology.[33]

These four achievements — the replacement of tools by machines, the introduction of new prime movers, the advent of mobile prime movers, and the evolution of the factory system as a new form of organization of production — state the uniqueness of machine technology as contrasted with handicraft technology.

Mass Production

As the factory system moved from its birth place in England over to America, it became stronger and more refined. Today it has evolved as *the* system of production. Bound up in this system is the primary method of actually producing goods — mass production. Currently mass production is the term usually applied to manufacturing.

Peter F. Drucker defined this term in his book, *The New Society* as

> a basic principle for the organization of all manufacturing activities. Today it has become abundantly clear that the mass-production principle is not even confined to manufacturing, but is *a general principle for organizing people to work together*.[34]

Even though Ford signed an article which claimed that "in origin, mass production is American and recent; its earliest notable appearance falls within the second decade of the twentieth century"[35] — there is no doubt that the concept of mass production goes back much further than Henry Ford or Eli Whitney.

Ford's statement would seem to indicate that mass production were some kind of mechanical principle; Drucker, however, attacked that point of view. He stated that

> the mass production principle is not a mechanical principle. If it were, it could never have been applied beyond manufacturing, and independently of assembly line, conveyer belt and interchangeable parts. It is a *social* principle — a principle of *human* organization. What was new in Ford's plant was not the organization of mechanical forces, but the

[33] *Ibid.*, p. 150.

[34] Peter F. Drucker, *The New Society* (New York: Harper & Row, 1959), pp. 2-3.

[35] Henry Ford, "Mass Production," *Encyclopaedia Britannica*, 13th ed., Vol. II (1926), p. 821.

organization of human beings performing a common task. And this explains the shattering impact of the new principle on traditional cultures, on the relationship between man and society, and on the family.[36]

In his book, *Backgrounds of Power*, Roger Burlingame discussed the concept of mass production. He identified five aspects or principles of mass production which will serve as a structure for the following discussion on mass production. Burlingame's list included:

1. Precision.
2. Standardization.
3. Interchangeability.
4. Synchronization.
5. Continuity.[37]

In addition to these five, Burlingame cited a few other specific features such as prime mover, ratio of volume to time, and automaticity in terms of sequences of machines and operations developed. It was clear, however, that the five principles mentioned above are, in his estimation, the prevailing reference points for historical and philosophical interpretation.[38]

Burlingame's list was selected for presentation in this chapter because, after a review of other literature on the same topics, the author felt his work seemed to represent the most conclusive and inclusive thinking on the subject.

1. PRECISION. "The skills which made possible the elaboration and accuracy of modern machinery stemmed from the long, patient, stubborn effort to perfect the time-spacing machine."[39] Another evident cause for necessitating the attempts to measure time more accurately was the study of astronomy. Devices ranged from non-mechanical clocks — shadow clocks and star clocks — to the invention of the clepsydra, or water clock, and finally to the true mechanical clock.[40]

Burlingame wrote about the important role of the clock in the refinement of precision methods of manufacture.

> The use of gear ratios, a development of leverage function, is too familiar to need explaining to a modern reader. Its abundant exercise in the mechanical clock has, however, an important bearing on the evolution of technics into the machine age. The growing understanding of the principle, the almost infinite patience with which, with increasing

[36]Drucker, *op. cit.*, pp. 4-5.

[37]Roger Burlingame, *Backgrounds of Power* (New York: Charles Scribner's Sons, 1949), p. 15.

[38]*Ibid.*

[39]*Ibid.*, p. 17.

[40]*Ibid.*, p. 19.

accuracy, it was applied were, for centuries, almost exclusively in the clock-maker's province. The skill necessary to the final refinements into the watch seems nearly miraculous as we see it in eras otherwise backward in mechanics. Virtually every phase of modern mechanism has the clock or a clockmaster's ingenuity and craftsmanship somewhere in its ancestry. But the whole machine complex seems to have grown out of the first train of geared wheels because full clock accuracy eventually demanded machine tools such as the lathe and the miller when the human hand and eye were found inadequate. Finally, as the clock and watch became democratic, quantity production was imposed upon the art and in early American clock wheel manufacture and assembly we see one of the first imitations of modern mass production of machines.[41]

Even though the first clocks were very inaccurate, the advance toward mechanical accuracy was inevitable. In effect, the precise measurement of time has brought together the principles of precision measurement. This term, precision measurement, is a term "applied to the field of measurement beyond the scope of non-precision line-graduated measuring instruments, such as the rule and scale."[42] Precision measurements are usually measured in at least thousandths of an inch.

The element of precision, with respect to mass production, may be thought of as being limited to measurement. It may also be viewed, however, as a broader concept. Burlingame didn't indicate which he had in mind, but most likely he was referring to the broader concept, as it will be interpreted here.

The work of at least two people stands out sharply in the early development of precision methods. One could hardly mention precision measuring without referring to Joseph Bowen (vernier) and Lucien Sharpe (gage blocks). Their contribution to precision measurement was epoch making.

2. Standardization. The concept of standardization, as associated with mass production, has spread in many directions. Standardization was first introduced in the field of measurement in an effort to add precision to manufacturing. The progress of measurement moved from the cubit — the earliest known unit of measure — to the foot, and finally the yard.[43] The problem with the reliability of these measures was their variation from time to time and from place to place. For instance, in the sixteenth century the

[41]*Ibid.*, p. 21.

[42]International Business Machines Corporation, *Precision Measurement in the Metal Working Industry* (Syracuse, New York: Syracuse University Press, 1952), p. 1.

[43]*Ibid.*

foot varied from 9¾ inches to 19 inches.[44] In 1878 the British standardized the yard, a measurement which is still in use today. In 1927 the meter was defined by the French. Today the basic standard of linear measure is housed at the International Bureau of Weights and Measures at the Pavillion de Breteuil in France. All standardized measurement is based on that platinumiridum bar[45] — except for measurements made in the United States. The United States since 1893 has had a duplicate (meter #27) as the only standard of length authorized.

Standardization also entered the broad area of standards — an area which includes dimensional standards to allow for interchangeability of supplies, parts, or interrelated apparatus; specifications for materials and methods of tests; definitions of technical terms used in industry, industrial safety codes to make possible uniform requirements in safety devices, industrial health codes; and specifications for consumer goods. The United States of America Standards Institute (formerly the American Standards Association) is the agency through which these standards are coordinated and developed.[46]

Standardization plays a large and important role in mass production activities. For without standardized measurements, parts, and codes it would be impossible to mass produce mating parts in different areas of the country and have them function perfectly as they must.

3. INTERCHANGEABILITY. Probably the most well-known name associated with interchangeable parts is Eli Whitney. Bowen and Kettering wrote about Whitney's important contribution to the field of standardization. They stated that "Whitney carried interchangeability to its logical conclusion . . . and at the same time laid the foundation for mass production."[47]

Manning also noted that Eli Whitney's invention of interchangeable parts manufacturing made mass production possible. He even went so far as to state that Whitney was the first to conceive the idea of standardizing and making the parts interchangeable of a complete article and eliminating hand measurement through the use of jigs and fixtures.[48]

[44] *Ibid.*, p. 2.
[45] *Ibid.*
[46] *Ibid.*, p. 5.
[47] Bowen and Kettering, *op. cit.*, pp. 71-74.
[48] Harold G. Manning, *Inventive America* (Federalsburg, Maryland: The J. W. Stowell Printing Company, 1940), pp. 14-16.

The importance of the concept of interchangeable parts was pointed out in a book entitled *Technology and Social Change*. "The basic principles of mass production . . . in essence are just two things: (1) the making of standard, interchangeable parts; and (2) the assembling of these parts into a completed unit with a minimum of handicraft labor."[49]

Prior to World War I, interchangeable parts were confined primarily to a single plant, but the sudden demand for war material and the inability of a single plant to produce a complete unit thereby necessitated making parts at many different places. Evident difficulties arose from the fact that there were no universal standards of length and that the parts from one plant would not fit parts from another. The National Bureau of Standards helped solve the problem by giving guidance and checking master gage blocks at the various plants, thereby setting a single standard.[50] Today industries make constant use of the Bureau and its facilities.

4. SYNCHRONIZATION. Synchronization may be defined "as occurring together or happening at the same time."[51] In its relation to mass production, synchronization involves a tremendous amount of planning. Not only must parts and materials be at the right place at the right time, but the worker's actions must also be synchronized with the flow of materials.

The flow or transfer of materials and parts is accomplished through the use of conveyors. Rather than having the men go from place to place, the conveyors (using various means — belts, chains, screws, buckets, etc.) bring the work to the men.

The idea of automatic conveyance of work probably had its origin with Oliver Evans. He designed power conveyors for an automatic grain mill which he built. In setting up his automatic mill, he evolved the idea that is typical of American industry today — *production in continuous flow*.[52]

Mass production would obviously not be possible if the total operation were not synchronized.

5. CONTINUITY. The concept of continuity was perhaps initially and best illustrated in the stamped clay objects produced in early China and in the Egyptian hieroglyph. The stamping tools

[49]Francis R. Allen *et al., Technology and Social Change* (New York: Appleton-Century-Crofts, Inc., 1957), p. 256.

[50]International Business Machines Corporation, *op. cit.*, p. 4.

[51]Barnhart, *op. cit.*, p. 1228.

[52]Ford Motor Company, *Evolution of Mass Production* (Dearborn, Michigan: Ford Motor Company, 1956), p. 19.

repeated a standard symbol over and over in exactly the same manner each time.

Burlingame, in relating the importance of continuity, stated that

> in mass production, the factors of synchronization and continuity must enter — either through successive operations performed upon the same material or through the simultaneous production of groups of identical parts which are successively assembled into identical wholes.[53]

Mass production, as we have tried to show it, refers to a way of organizing people to accomplish a task. This organization involves precision, standardization, synchronization, and continuity. Although not necessarily limited to manufacturing, the total concept is vividly illustrated in our present-day productive system.

Conclusion

The objective of this chapter has been to examine a number of factors related to machine technology. The function and description of tools and machines were discussed to form a perspective for a brief examination of the factory system. Machine technology was found to be intimately related to the factory system and mass production. It was determined that mass production is founded on five principles — precision, standardization, interchangeability, synchronization, and continuity. Industry provides a framework within which the current mode of production — mass production — operates.

Selected Bibliography

Allen, Francis R. and Associates. *Technology and Social Change*. New York: Appleton-Century-Crofts, Inc., 1957.

Ashley, William J. *An Introduction to English Economic History and Theory*. New York: Longmans, Green and Company, 1925.

Barnhart, Clarence L. (ed.). *The American College Dictionary*. New York: Harper & Brothers Publishers, 1953.

Bowen, Harold G. and Kettering, Charles F. *A Short History of Technology*. West Orange, New Jersey: The Thomas Alva Edison Foundation, Inc., 1954.

Burlingame, Roger. *Backgrounds of Power*. New York: Charles Scribner's Sons, 1949.

Chase, Stuart. *Men and Machines*. New York: The Macmillan Company, 1929.

Cole, G. D. H. "Industrialism." *Encyclopedia of the Social Sciences*, Vol. VIII. New York: The Macmillan Company, 1932.

[53]Burlingame, *op. cit.*, p. 30.

Drucker, Peter F. *The New Society*. New York: Harper & Row, 1959.
Fairchild, Fred R., *et al. Elementary Economics*. New York: The Macmillan Company, 1927.
Forbes, R. J. *Man the Maker*. New York: Henry Schuman, Inc., 1950.
Ford, Henry. "Mass Production." *The Encyclopaedia Britannica,* 13th ed. Vol. II. New York: The Encyclopaedia Britannica, Inc., 1926.
Ford Motor Company. *Evolution of Mass Production*. Dearborn, Michigan: Ford Motor Company, 1956.
International Business Machines Corporation. *Precision Measurement in the Metal Working Industry*. Syracuse, New York: Syracuse University Press, 1952.
Klemm, Friedrick. *A History of Western Technology*. New York: Charles Scribner's Sons, 1959.
Manning, Harold G. *Inventive America*. Federalsburg, Maryland: The J. W. Stowell Printing Company, 1940.
Marx, Karl. *Capital*. Edited by Frederick Engels. (From the translation of the Third German Ed. by Samuel Moore and Edward Aveling — Revised and Amplified According to the Fourth German Edition by Ernest Untermann). New York: The Modern Library, Random House, Inc., no date given. (First Published in 1906, Chicago: Charles H. Kerr & Company.)
Mees, C. E. Kenneth. *The Path of Science*. New York: John Wiley and Sons, Inc., 1946.
Mumford, Lewis. *Technics and Civilization*. New York: Harcourt, Brace and World, Inc., 1963.
Muther, Richard. *Production-Line Technique*. New York: McGraw-Hill Book Company, Inc., 1944.
National Association of Manufacturers. *The Growth of American Industry*. New York: National Association of Manufacturers, 1962.
———. *The Role of Marketing*. New York: National Association of Manufacturers, 1962.
O'Brien, Robert, *et al. Machines*. New York: Time-Life Incorporated, 1964.
Ornstein, Martha. *The Role of Scientific Societies in the Seventeenth Century*. Chicago: University of Chicago Press, 1938.
Schneider, Eugene V. *Industrial Sociology*. New York: McGraw-Hill Book Company, Inc., 1957.
Singer, Charles and Associates. *A History of Technology*. Oxford: Clarendon Press, 1958.
Usher, Abbott Payson. *A History of Mechanical Inventions*. Cambridge: Harvard University Press, 1954.
Weber, Max. *General Economic History*. Translated by Frank H. Knight. Glencoe, Illinois: Free Press, 1950.

CHAPTER SIX

Capitalism as an Economic System

Joseph Abromaitis
University of Maryland

Introduction

Capitalism is based on private property, profit motivation, competition, and economic freedom. Under modern capitalism there is no more government control than is necessary, while individuals and enterprises are given as much freedom as possible. In a capitalistic society individuals may own property and do with it what they like, provided that its method of use is not in conflict with public interests. The free price system also serves an important function in this mechanism — if a shortage occurs, prices rise and thus stimulate production; if an overabundance occurs, prices fall, production decreases, and consumption increases.

Capitalism has been a means of opportunity for many minority groups and has allowed them to make greater progress than they could have made under other systems. Friedman reported that the existence of discrimination in societies is usually found in areas that are most monopolistic in character; whereas discrimination against groups of a particular color or religion is least in those areas where there is the greatest freedom of competition.[1]

Capitalism has provided a vehicle for the rapid change in our society and has led to a marked increase both in man's average income and in his general standard of living. Ayres expressed his belief that the existence of the industrial system as well as the

[1]Milton Friedman, *Capitalism and Freedom* (Chicago: The University of Chicago Press, 1962), p. 109.

development of its present level of high productive efficiency is the result of the capitalists' acquisition and exercise of money power.[2]

The term laissez-faire was adopted to describe an economic system characterized by minimum government action and restrained only by competition and price mechanism.[3] This policy was the direct opposite of mercantilist planning; and when free competition came into effect, public intervention was considered harmful. Adam Smith wrote that government should do little to fix minimum wages, regulate working conditions, or control competition.[4]

John Maynard Keynes believed in an economic system of private enterprise run for a profit, but which would have the state responsible for maintaining stability and full employment. Keynes was concerned with the economic systems in operation during the time of the great depression. He believed that government investment could be the necessary stabilizer for capitalism. Keynesian supporters argued that government spending could have a "multiplier" effect on economy which could conceivably support itself. Money spent by government to put men to work on public roads would recirculate partially as consumption and partially as savings.[5]

Keynes emphasized the importance of a balance between saving and investment. He stressed the fact that if planned saving and planned investment were different at the beginning of a period, they might be brought into equilibrium by unemployment and change in the level of income rather than by a shift in the interest rate.[6] The Keynesian system established a framework to sort out economic data; the system is encompassed by a set of questions one can ask when predicting or diagnosing the behavior of an economic system.

Work

"To say we work because we must is to beg the question. Only a part of man's daily labor is necessary to maintain life in his body. The rest he does to preserve, not his life, but civilization."

Hayward and Johnson[7]

[2]C. E. Ayres, *The Industrial Economy* (Cambridge, Massachusetts: Houghton Mifflin Company, 1952), p. 120.

[3]Rendigs Fels, *An Introduction to Economics: The Challenge to the American Economy* (Boston: Allyn and Bacon, Inc., 1966), p. 75.

[4]J. H. Dodd, *Introductory Economics* (Cincinnati: South-Western Publishing Company, 1940), p. 35.

[5]From Chamberlains's *The Roots of Capitalism* Coypright 1966, D. Van Nostrand Company, Inc. Princeton, New Jersey.

[6]H. A. Silverman, *The Substance of Economics* (15th ed.; London: Sir Isaac Pitman and Sons, Inc., 1960), p. 268.

Capitalism

Miller stated there is no one definition for American capitalism because, since it is continuously evolving, it has to be defined in its condition at a particular time. The essential characteristic of capitalism is that mid-twentieth-century American capitalism participates in producing economic progress through social justice by democratic means.[8] The Council for Advancement of Secondary Education pointed out that "free enterprise assumes that individuals are in the long run the best judges of their own interests, and that an economic system that makes it possible for them to pursue those interests will achieve the greatest welfare for all."[9] This economic system is based on private property, profit motivation, competition, and economic freedom. Economic freedom contains within it freedom of enterprise, choice, and contract. The Council defined these particular economic freedoms as follows:

Freedom of enterprise — is the right of the individual businessman to decide what business to enter, and what goods to produce or what services to render. Once his business is established, it is his right to conduct his enterprise responsibly in pursuit of profits. His decisions, of course, are guided by free market conditions; they are not arbitrary ones.

Freedom of choice — assures a person the right to live where he pleases, to work at what he can do best, and to buy the goods and services he prefers. Many believe this to be the most fundamental economic freedom — the one that especially distinguishes a free-enterprise economy from others and that is most essential to a democracy.

Freedom of contract means the right of consumers, producers, workers, and owners of property to bargain with one another, and to exchange goods and services on terms acceptable to all concerned.[10]

Capitalism has been defined by Webster as "an economic system characterized by private or corporation ownership of capital goods, by investments that are determined by private decision rather than by state control, and by prices, production and distribution of goods that are determined mainly in a free market."[11]

[7]William R. Hayward and Gerald W. Johnson, *The Story of Man's Work* (New York: Milton, Balch and Company, 1925), p. 3.

[8]Raymond W. Miller, *Can Capitalism Compete?* (New York: The Ronald Press Company, 1959), p. 35.

[9]*Ibid.*, p. 9.

[10]*Ibid.*

The foundations of capitalism are private property, freedom of enterprise, freedom of contract, and freedom of competition. Capitalism operates under the assumption that people act from motives of self interest. The attitude of modern capitalism is that there should be no more control by government than is necessary and that individuals and business enterprises should be given as much freedom as possible.

Capitalism maintains that everyone who contributes to the production of goods and services should receive an income somewhat in proportion to the value of his contribution to the production of the national income. The landowner is entitled to rent; the owner of machinery, tools, and other equipment used in manufacturing and transportation is entitled to interest for and profits acquired from the use of his property. Those who contribute their labor are entitled to wages; and the more valuable one's contribution to production, the larger his income should be.[12]

Fels defined capitalism as an economic system characterized by private ownership of the means of production, a system roughly synonymous with free enterprise or free enterprise system. He described it as a mixed economic system combining private ownership of the means of production with government regulation of means of economic activity and some government ownership. It is an economic system in which a relatively few wealthy people are in control because of their ownership of capital.[13]

In order to make a living, men without property have had to work for men who held power over them, whether that power were military, political or economic. While capitalism furnished no exception to this rule, it did provide a new method of exercising the compulsion to labor. It gave the worker vastly important new liberties, but at the same time it exposed him to new dangers. With the disappearance of serfdom and the resulting changes in labor law, the worker became legally free; he was no longer legally obligated to work for any master. The necessity of making a living, however, compelled him to work for those who owned the means of production. Property owners as a group still held the power to control the labor of unpropertied workers.

Today, the rates of pay and conditions of employment in each specific industry are determined by a voluntary agreement between

[11]"By permission. From Webster's Seventh New Collegiate Dictionary, copyright 1967 by G. & C. Merriam Company, Publishers of the Merriam-Webster Dictionaries."

[12]Dodd, *op. cit.*, p. 39.

[13]Fels, *op. cit.*, p. 74.

employers and employees. The actual terms are fixed by their comparative bargaining strengths and their skills. The actual operation of the wage system is of evident importance in any consideration of the relation of capitalism to general well-being since the vast majority of men do not directly own any productive property.[14]

Capitalism is a system in which production is directed by the decisions of large numbers of separate businessmen, each acting either in his own interests or in those of the organization which he runs. Businessmen are dependent on a system of prices; within this system profit is the indispensable condition of survival in capitalism. Prices are set, on one side, by the desire and ability to pay of a hundred and thirty million consumers who divide their limited incomes among a variety of competing material goods and services. On the other side they are fixed by all the millions of businessmen who determine that this year four and a half million automobiles and three hundred and fifty million pairs of shoes will be produced and so on through the countless goods and services that will actually constitute the output of goods of the American economy during the year.[15]

The private ownership of capital equipment confers the power of employing other people, directly in one's own business or indirectly by the ownership of shares in joint-stock companies, and thus of obtaining profits which are the result of this privileged position.[16] Silverman defined capitalism as an institution and summarized its characteristics as those of private property, free enterprise, consumer's free choice, and price system. In a capitalistic society it is taken for granted that individuals may own property and do with it what they like, provided that their method of use is not in conflict with public interests. The owner may undertake any economic activity he chooses, providing it is not in conflict with public interest, or he may choose to refrain from putting it to any use at all. He may produce what he wants and he may sell it in the manner he chooses. Under the institution of consumer's free choice most production is undertaken in anticipation of the demand and ultimately must be ruled by it. The State imposes restrictions on certain forms of consumption just as it interferes with certain types of production. The free price system is an integral part of the

[14]Henry R. Mussey and Elizabeth Donnan, *Economic Principles and Modern Practice* (Boston: Ginn and Company, 1942), p. 16.

[15]Reuben E. Slesinger and Isaacs Asher, *Contemporary Economics* (Boston: Allyn and Bacon, Inc., 1963), p. 17.

[16]Silverman, *op. cit.*, p. 30.

capitalist mechanism. If there is a shortage of supplies, prices rise and thus stimulate production and discourage consumption. If there is an overabundance, prices fall, production diminishes, and consumption increases.

American capitalism can be described as an economic system having a highly developed machine technique. It is a system that is the property of individuals or corporations and in which production of goods is, in general, owned privately rather than publicly. The owner of the capital, or the man who can induce others to trust their capital to him, receives his power from our legal system to exercise a wide measure of freedom in deciding what shall be produced and how. Labor control is exercised through the wage system.[17]

Silverman reported that the essential features of American capitalism are the following: private property in production goods, free enterprise and competition, the wage system, control through price, and private profits. Capitalism is based on machine technique and quantity production, and its problems must be worked out without surrendering any untold advantages of the machine. The machine technique, or the extensive use of capital goods, is not unique to capitalism; the communists of Soviet Union have also directed much of their efforts to mechanization of their industries.

Though the machine is a relatively new item, it is the lineal descendant of that long line of tools and implements that have helped man since those primitive times when he was first learning to form a spear. Tools and weapons have almost always belonged to the men who used them. Producers' goods, or capital goods (the means of production) have been privately owned from a time long before the beginning of recorded history. Therefore since the owner, by virtue of his ownership, is in a position to dominate the productive process, ownership of producers' goods is perhaps the most fundamental means of organizing and controlling production of income.

"Free private enterprise" is a system under which property owners and their agents are free to carry on whatever enterprise they choose and in whatever manner they desire, subject only to the limitations imposed by the law. Under this system industry takes its shape and produces the kind and amount of goods it does because of the decisions of millions of independent persons, each acting primarily in what he conceives to be his own independent interest or that of the organization for which he acts.

[17]*Ibid.*, p. 21.

Cole wrote that capitalism was not born, as a child is born, at any precise moment of time. It did not come into existence at any definite period; rather it grew gradually out of the capitalistic elements which had existed in previous stages of economic development. There were many capitalistic features in the economic life of the Middle Ages. Some writers refused to recognize the existence of capitalism before the machine age which began towards the end of the eighteenth century; they see capitalism, therefore, as a child of the Industrial Revolution. The "domestic system," widespread although not universal in the seventeenth and eighteenth centuries, was a development of earlier capitalistic qualities and was based especially on the growth of the capitalist merchant. The advent of power-driven machinery produced on a large scale enabled Capitalism to spread directly from the sphere of commerce to that of industrial production in a growing number of its branches. It is, therefore, a matter of definition to state when the Age of Capitalism actually began. What can be said with assurance is that Merchant Capitalism rose to a position of economic predominance in the seventeenth and eighteenth centuries, while Industrial Capitalism rose later, in the nineteenth.[18]

Friedman (1962) wrote that the development of capitalism has been accompanied by a major reduction in the extent to which particular religious, racial, and social groups have operated under handicaps. Substitution of contract for status arrangements was the first step toward the freeing of serfs in the Middle Ages. Despite official persecution the preservation of Jews through the Middle Ages was possible because of the existence of a market sector where they were able to function and maintain themselves. Friedman felt that the Puritans and Quakers migrated to the new world primarily because they could accumulate the funds necessary in the market — despite disabilities imposed on them in other aspects of life.

A maintenance of general rules of private property and of capitalism has also been a major means of opportunity for Negroes and has permitted them to make greater progress than they could have made otherwise. Friedman believed that discrimination in any society can be found most frequently in the areas that are most monopolistic in character and that discrimination against groups of a particular color or religion is found least commonly in areas of the greatest freedom of competition. Friedman mentioned the following paradox of experience:

[18]G. D. H. Cole, *What Marx Really Meant* (London: Camelot Press Ltd., 1934), p. 46.

It is precisely the minority groups that have frequently furnished the most vocal and most numerous advocates of fundamental alterations in a capitalist society. They have tended to attribute to capitalism the residual restrictions to be as small as they are . . . the purchaser of bread does not know whether it was made from wheat grown by a white man or a Negro, by a Christian or a Jew. In consequence the producer of wheat is in a position to use resources as effectively as he can, regardless of what the attitudes of the community may be toward the color, the religion, or other characteristics of the people he hires . . . more important, there is an economic incentive in a free market to separate economic efficiency from other characteristics of the individual.[19]

The basic distinction between capitalism and socialism rests upon the extent of economic control by the state. A purely capitalist state may do little more than protect the rights of individual property owners and workers. But a socialist state typically owns all or most of the productive property and controls not only the allocation of economic resources among the various sectors of production, but the consumption and investment as well. A socialist state also typically controls the distribution of its resulting produce among individuals.[20]

Private ownership implies a legal system which not only protects private property but also defines individual rights. If individuals are to utilize their property effectively, they must be reasonably knowledgeable about their rights that will be protected.[21]

Fishman and Fishman stated that in a capitalist system the means of production are privately owned and the owners are able to decide how they shall be used. It is assumed that the owners' decisions will be directed toward maximizing their personal gain. Workers are free but, being without equipment, they can work only when they can find employment. They can, however, move from one employer to another. The use of large quantities of capital goods in production is also characteristic of, but not peculiar to, capitalism. Socialists have been equally interested in industrial methods of production involving the use of large quantities of capital goods.

The terms *capitalism* and *socialism* denote a polarized classification of economic systems. At the socialist pole are systems in which power over the means of production is concentrated in the state; while the capitalist pole consists of systems in which power

[19]Friedman, *op. cit.*, p. 109.

[20]Betty G. Fishman and Leo Fishman, *The American Economy* (Princeton, New Jersey: D. Van Nostrand Company, Inc., 1962), p. 764.

[21]*Ibid.*, p. 766.

over the means of production is diffused among many owners of property and land and, at least to some extent, among many workers as well.[22]

One of the strongest claims made for capitalism was that it provided a vehicle for rapid changes and reorganizations of economics which, in turn, led to a marked increase in man's average income and his general standard of living.[23] Behind all these changes may be a subdued feeling that rapid increase in the output of goods and services is of less importance now than in the days of mass poverty. There is still enough poverty to maintain an interest in production, but broad social considerations have come back into play to reduce inequalities of welfare and the risks of economic life for the poorer classes. Capitalist ideology still serves to place some restrictions on the proportion of economic resources devoted to the production of goods and services and more appropriately provided by government than by private enterprise. But capitalism in its purer form may already have served its purpose in the dynamic capitalist countries.

Miller asserted that those who believe that mid-twentieth century capitalism, with its flexibility and sensitivity, has value in North America should become emotionally inspired with this conviction, should point out its value, and contrast it with the disadvantages of communism. Miller believes that we should encourage others to adopt the underlying principle of freedom of opportunity for all and to work it out as their various circumstances permit. Capitalism in America today is not the capitalism of our forefathers; and the system's inherent flexibility and sensitivity will allow it to adjust and readjust itself continuously to new social needs — while at the same time preserving its basic freedom of opportunity.[24]

Wess wrote the following comparison of socialism, communism, and capitalism:

> Socialism and communism — like all forms of dictatorship — are frozen societies. The Nazis believed that they had achieved a society which would last a thousand years. The Communists believe the same. They believe that they have a system which is the ultimate in perfection and which will last forever. None of these systems tolerates any authentic change. Since change is the only constant in life, these systems must ultimately collapse or wither.
>
> Capitalism, on the other hand, is a way of life which has in it the inherent ingredients of growth and change. Capitalism adjusts to

[22]*Ibid.*, p. 765.
[23]*Ibid.*, p. 784.
[24]Miller, *op. cit.*, p. 8.

changing times and changing conditions. Because of its fundamental principles, capitalism makes possible peaceful resolutions like the change in the pattern of income distribution.[25]

According to Miller,[26] the essential ingredient of today's American capitalism is that of business responsibility and human or public relations. Miller considered this discovery (that business can function and still be friendly, and that goods can be honestly made, distributed, and sold to the consumer at a fair profit) as one of the greatest developments of the genius of America in the field of economics. The extent to which these ideas go beyond any legal requirements is reflected in the emphasis which today's industrialist places on the brand name he gives his products. He holds out his brand as a hallmark of his product's integrity and as one worthy of a certain quality and suitable price; each item is presumably designed to support the brand's reputation. American businessmen have learned that when they set prices at a low enough level to allow more people to buy their products, the resulting increase in the market for most goods returns an increased total profit. The new income of the additional workers needed for the increased production increases, in turn, the market potential. Their wages reflect a sharing of the cost savings from increasing productivity and enable workers to purchase goods which, in their grandparent's day, would have been the privilege only of the wealthy.

> Present-day responsible American Capitalism looks upon community and civic projects as something in which it should take an active part. This was an uncommon practice three decades ago. Today an increasing number of American businesses recognize that the employee who takes an interest in community development during his off-duty hours — and sometimes during working hours as well — can perform a service not only for himself and his company, but for democracy itself. This same thinking prompts business leaders to accept the call of the government to fill responsible posts despite the financial sacrifice to themselves and the loss of their leadership to their companies.[27]

Colonel Richard P. Crenshaw, Jr., a member of the Bar who has long been familiar with national and international affairs, sent the following correspondence to Raymond Miller regarding the value of the new capitalism:

> The competitive North American free enterprise system (modern capitalism) is absolutely indispensable to human freedom and the in-

[25]Harold B. Wess, "We Can't Have Freedom Without Capitalism," *Human Events,* XVIII (November 19, 1958), p. 40.
[26]Miller, *op. cit.,* p. 40.
[27]*Ibid.,* p. 41.

evitable future world-wide system, since no other system both (1) gives the individual full incentive to work and thus throw off the bondage of want, and (2) splits up economic and thus political power and prevents its concentration by providing many bosses and alternatives instead of (as in the Soviet) only one. A man given too much power will always abuse it and competitive free enterprise alone sees that no one man gets too much power.[28]

Henry Ford's decision to pay five dollars a day without raising the price of his car proved that the wage fund and the other preconceptions of British economics had little to do with industrial realities in a dynamic world. Although Ford's own administrative assistants and stockholders protested that "the crazy scheme will wreck the company," it had quite the opposite effect. According to Carl Snyder, the "crazy scheme" increased the output of the given machinery by some twenty per cent. By virtue of its "leverage" on worker attitude, the higher wage therefore paid for itself.

The social dividends were tremendous: with a five dollar wage a Ford worker could afford to get rid of his bicycle and make an investment in a "Tin Lizzy" of his own. Consumer capitalism had arrived, and with Ford's action 1914 became one of the most crucial years in the history of capitalism.

It was Henry Ford's pioneering that first permitted a departure from the idea that the cost of production must be covered on the sale of every unit as it left the factory, regardless of what "standard volume" was assumed to be. The money incentive for integration came to dominate the Ford organization in Henry Ford's later life. Elton Mayo later indicated, in his famous Hawthorne experiment, that human beings work best when they are interested in what they are doing. They often do better work for less money if their jobs offer variety, if there is a re-invigorating change of pace, or if — like soldiers in a platoon — they don't want to let each other down.[29]

Ayers described capitalism as a power system:

In designating our society as capitalistic, we are referring explicitly to its institutional aspect. In thinking of capitalism we assume the existence of the industrial system which is the technological aspect of the same society. That is what capitalists exercise power over.[30]

In speaking of our whole society as capitalistic, we also give expression to the common belief that we owe the existence of the industrial

[28]*Ibid.*

[29]E. H. Carr, *The Twenty Year Crisis* (London: Macmillan and Company, 1956), p. 202.

[30]Ayers, *op. cit.*, p. 120.

system as well as the development of its present level of high productive efficiency to the acquisition and exercise of money power by capitalists, not by plutocrats. A "plutocrat" is one who possesses and exercises money power, whether for good or bad — the implication being that it is for bad. A "capitalist" is one who by virtue of his possession and exercise of money power is believed to be an agent of industrial progress.

Dr. Tojurs Murai, Chief Editorial Writer of the Hokkahu Shimbun, and a lecturer at Toyama University and Kanazawa Women's College in Japan was interested in finding out if American capitalism was still of the exploitive type. Dr. Francis Brown of the American Council on Education arranged for him to spend a few days at Harvard Business School in 1956. They provided many other contacts for Dr. Murai, including John Kenneth Galbraith, Professor of Economics at Harvard, with whom he developed a warm and close friendship.[31] Dr. Murai's definition of capitalism is included in the following round-table discussion which he had with other educators upon his return to Japan.

"Capitalism is Already Exceeding Itself"

[Preface] . . . Capitalism is difficult to understand unless it is understood as something dynamic and different from what Marx defined. Particularly in the changing American society, it appears that a firm, new trend is being worked out by management executives, labor union leaders, and a number of leading scholars . . .

[Kobayashi] . . . If there is indeed something new in American capitalism, the big question is how to adapt it and use it in Japan. I would like all of you to give us your opinion with this background in mind. First of all, I shall call on Mr. Murai, in order to have him indicate the direction in which we should take our discussion.

[Murai] . . . I was first struck by his [Mr. Raymond W. Miller's] contention of the dynamic nature of American capitalism. The question is, of course, practically speaking, how did capitalism come to take a course different from that prescribed by Marx? Well, it seems to me that, first of all, in regard to labor, capital, management — all these important production factors in the capitalistic structure — an attitude of, what shall I say, a kind of social responsibility has been very strongly developed.

Specifically, capital, for instance, is not looked upon as one form of the right of absolute possession by an individual. It is looked upon as a wealth shared by society as a whole. Of course the starting point was the formation of an organization through which the individual would seek to gain profits. But as this concept progressed, it was looked upon simply as one factor within a common society. The main factor then

[31]Miller, *op. cit.*, p. 44.

came to be regarded as a whole. Management, for instance, in its relations with labor, came to look upon its ultimate aim as that of dealing with good citizens. I felt that America is proceeding and will proceed in that general direction. That is what will make capitalism dynamic, I feel.[32]

Laissez-Faire

Laissez-Faire — Economic system characterized by minimum government action and maximum reliance on production by profit-seeking organizations, restrained only by competition and the price mechanism.[33]

Mussey and Donnan described laissez-faire as a feature of capitalism, as the non-interference of government with industry. A complete laissez-faire economy is a scheme in which enterprisers are free to follow their own desires and make their own choices, and in which industry is controlled solely by economic forces such as prices and profits rather than by government regulation. This complete system has never actually existed and is, in fact, scarcely conceivable. When the laissez-faire policy is spoken of as a characteristic of capitalism, it is done with many reservations.[34]

The term laissez-faire was adopted from the French economists of the time of Louis XVI. It referred quite explicitly to the policy to which the ideas of classical political economy gave support and in which they found expression.

This policy was the direct opposite of that of mercantilist planning. A decline in the restrictive mercantilist policy came in the eighteenth century as a result of the decay of the guilds' regulation of industry and commerce.[35] A reaction took place against mercantilism — this reaction was the rule of free competition in which any attempt at public intervention was considered harmful. In the doctrine of "laissez-faire," what was good for the individual was proclaimed to be good for everybody; therefore, the impediments to the full operation of the natural law were removed and private enterprise was allowed to have free play.

This policy of non-interference was soon reflected in the legislation of the period, where it also facilitated the application of the new industrial methods. These innovations were of several kinds; Silverman listed four:

1. There were the discoveries of new resources such as ore supplies at home, and of new foods.

[32]*Ibid.*, p. 45.
[33]Fels, *op. cit.*
[34]Mussey and Donnan, *op. cit.*, p. 15.
[35]Silverman, *op. cit.*, p. 355.

2. There were the inventions of new processes so characteristic of the period: the development of the steam engine, the mild steel process, the flying shuttle and the power loom; in agriculture, scientific fertilization.

3. There was great progress in transport, without which the mechanical inventions could not have been so fully extended.

4. Important changes occurred in the country's economic structure.[36]

If the nation's economy was to be freed from all the regulations which had been set up in earlier generations to secure the wealth and power of Great Britain, Ayers asked by what it would then be guided. The whole theory of enlightened self-interest and the self-regulating market was the answer.[37] The central idea of laissez-faire was introduced to all trade from the restrictive regulations of the monopolistic trading companies.

It was not considered a coincidence that the *Wealth of Nations* and the Declaration of Independence appeared in the same year. It was, in fact, the American Revolution that brought a general revolt against mercantilism to a head and made Adam Smith's book a bestseller. His book became the last word in the argument against this now generally hated system of mercantilism.[38]

The ideas expressed by Adam Smith in his text constituted his philosophy of laissez-faire. He believed that people should be free to engage in production, that if people wanted a certain kind of goods and could obtain them, they should be allowed to produce what was wanted. He thought freedom of enterprise would result in the use of natural resources, machinery, and labor for the production of goods and services that the people wanted. Smith argued that government should leave business largely free to control itself. According to his concerns of laissez-faire, government should do little in the way of fixing minimum wages, passing laws for the regulation of working conditions, and/or for controlling competition.[39]

During the nineteenth century the world had become a rather well-knit, integrated economic organization. The world economic forces were dependent largely upon the industrial countries of northwestern Europe and with London as the dominant commercial and financial center. Hansen reported that these forces were based on international division of labor, and that trade among nations

[36]*Ibid.*, p. 10.
[37]Ayres, *op. cit.*, p. 32.
[38]*Ibid.*, p. 31.
[39]Dodd, *op. cit.*, p. 35.

was a direct consequence of the uneven distributions of technology, natural, and human resources.[40]

Belief in the philosophy of laissez-faire set in motion the trading machinery of these times. While there was occasional and sporadic government action in respect to international economic relations, such action was not yet motivated by any conviction of inherent weaknesses in this system. The role of government in international trade was one which attempted to remedy flaws in the system. In participating in such a system, the specific tasks of the state were the maintenance of defense, the enforcements of contracts, and the establishment and maintenance of stable currency.

This doctrine of laissez-faire, which dominated economic thought of the nineteenth century, considered the state and political system as somewhat separate and distinct from the economic system. Economic activity was considered to be the function of private enterprise, not to be interfered with nor handicapped by the limited activities to be carried on by the state. Theories concerning international economic affairs were merely extensions of reasoning about other economic activities. Private ownership and enterprise were taken for granted, and international trade was assumed to be the province of individuals motivated by the desire for profit.[41]

Hickman discussed the consequences of cooperating in an international trading mechanism within the framework of laissez-faire. He stated that the acceptance of the benefits of expanding world trade carried with it an obligation of each nation to accept and tolerate, in its own internal economy, the adjustments made necessary by its participation in a world economy. If movements of prices or improvements in methods of production brought sufficient changes in cost for the development of new sources of supply for international commodities, nations which formerly supplied such goods were expected to accept such circumstances as the inevitable result of a well functioning world economy. Resistance to such change by means of export subsidy, protective tariff, or other restraining devices was considered to be distinctly in violation of the rules of the game.[42]

In the nineteenth century the United States, under this economic system, accepted a principle that is usually attributed to the

[40]A. H. Hansen, "International Economic Relations," *Report on the Economic Stabilization in an Unbalanced World* (New York: Harcourt, Brace, and Company, 1932), p. 103.

[41]Herbert Feis, *The Changing Pattern of International Economic Affairs* (New York: Harper & Brothers, 1940), p. 1.

[42]C. Addison Hickman, *World Economic Problems* (New York: Pitman Publishing Corporation, 1947), p. 92.

words of Jefferson: "That government is best that governs least." The least amount of government did not mean no government. Besides such duties as maintaining law and order and providing for national defense, the government performed limited functions essential to the proper operation of the price system. It provided legal forms for business organization — corporations, partnerships, single proprietorships. It enforced contracts, adopted laws designed to foster competition, maintained the currency system, and regulated the banks. To finance its legitimate functions, it was necessary to impose taxes which interfered with private business. Such activities as listed above were considered in keeping with the principles of laissez-faire, free enterprise, and the price system.[43]

However, the government departed from these principles in order to encourage economic progress. To develop its great productive potential, the country in the nineteenth century needed cheap transportation; therefore, governments at all levels subsidized railroad building. The federal government also maintained a patent system to confer monopoly power for a limited time to inventors as a means of stimulating technological advance.

The chief source of revenue for the federal government was its tariff. But the tariff was used not only for revenue but to protect American producers from foreign competition as well. Tariff protection helped the iron and steel industry grow more rapidly than it could have in the face of unrestricted competition from British producers. The United States can be said to have had laissez-faire in the nineteenth century, therefore, only in the sense that interferences with the price system were small compared to the wide scope which was allowed at that time for unrestricted free enterprise and for the extensive regulative action of today.[44]

John Stuart Mill, in discussing the economic system of laissez-faire, argued in favor of government intervention in the following cases as quoted by William A. Scott, in his book, *Development of Economics*.

(1) Education. The general rule that the consumer is a competent judge of commodities does not always apply in this case. The very fact that he lacks education may unfit him to judge of its value to him. "Education" said Mill, "therefore, is one of those things which it is admissible in principle that a government should provide for the people. The case is one to which the reasons of the non-interference principle do not necessarily or universally extend.

[43]Fels, *op. cit.*, p. 48.
[44]*Ibid.*, p. 49.

(2) Persons exercising power over others. Government should intervene for the protection of children and other young persons and the lower animals.

(3) Contracts in perpetuity. The practical maximum of leaving contracts free, is not applicable without great limitations in case of engagements in perpetuity.

(4) Delegated management. Under this head Mill compared government of enterprises with that of joint-stock companies, and concluded that both are admissible, the former in cases of monopoly particularly, the latter — under government control — in most other cases.

(5) To give effect to the wishes of persons interested, as for example, the regulation of the hours of labor and the disposal of colonial lands.

(6) Care of the poor.

(7) Colonization, involving consequences to the interests of the nation or of posterity, for which society in its collective capacity is alone able, and alone bound, to provide.

(8) In default of private agency. Things in the general interest which principle private agencies should care for and which it is their interest to care for, should be undertaken by government if these private agencies default.[45]

Fels noted the paradox that laissez-faire and the gold standard grew together. Laissez-faire implied that prices were free to fluctuate according to supply and demand; the gold standard implied the existence of a fixed price for the commodity that underlies the entire monetary system. The "hey day" of the gold standard came at approximately the same time as the "hey day" of laissez-faire. Those Americans who most deplored the temporary departure from the gold standard in 1933 were the very ones who most deplored the departures of the New Deal from free markets. They are the ones who nowadays urge that the United States restore full gold convertibility and who generally fight against price fixing in any other market. Believers in free markets contend that money with a stable value is vital in order that free prices can do their job of guiding economic activity. "What a dollar can buy in any particular market must be free to vary as conditions change, but what a dollar can buy on the average in all markets must be stable."[46]

During the last fifty years — especially the last twenty-five — there has been an increasing amount of government regulation of

[45]William A. Scott, *Development of Economics* (New York: The Century Company, 1933), p. 183.

[46]Fels, *op. cit.*, p. 211.

business affairs. The old idea of freedom of enterprise and competition has had to be greatly modified.[47]

In the United States, the shift from the predominantly free enterprise, or laissez-faire economy of the nineteenth century, to the mixed economy of the twentieth century has been accompanied by a decline in the power of capitalists and a rise in the power of labor leaders. This shift raised the question of whether our system was possibly evolving into a laboristic economy, one with its power being concentrated in the hands of labor leaders.[48]

Keynesianism

Ayres (1952) wrote that many economists believe economics has entered a new era, as distinct from what has gone before, as the classical tradition inaugurated by Adam Smith was from the mercantilism of preceding centuries. Many believe that the new era was heralded by the publication in 1936 of *The General Theory of Employment, Interest and Money* (by another great British economist). No book since *The Wealth of Nations* has keynoted so important a change in the direction of economic thinking as this book has. Also significant is the date of the book's publication. Keynes' *General Theory*, appearing in the middle of the depression, bears as close a relation to those difficult times as *The Wealth of Nations* did to the economic situation in 1776.

John Maynard Keynes was born in the same year that Karl Marx died. He has been one of the most influential writers of this century; indeed, few men have had or are having more effect on government action than he. Keynes was born in 1883, the son of Florence Ads Brown and John Neville Keynes. His father was a well-known teacher of political economy and a man of considerable, inherited wealth. He was raised in an intelligent, English, commercial middle class, an environment which has given many great men to its country and to the world. His outlook remained essentially that of the utilitarian, scientific, non-conformists from whom he came.

Keynes worked in government service and teaching. He was one of the English experts during the negotiation of the treaty of Versailles — it was in that position that he first moved from academic distinction to public fame.

With the publication of his book *The Economic Consequences of the Peace* in 1919, Keynes established himself as the world's most famous living economist. His hostile attack, which gave the

[47]Dodd, *op. cit.*, p. 35.
[48]Fels, *op. cit.*, p. 137.

Versailles Treaty the bad name it has retained to this day, paved the way for later reductions of the absurdly great reparations the Allies had imposed on defeated Germany.

In 1936 his book *The General Theory of Employment, Interest, and Money* was published in order to expound the Keynesian System. Its text is difficult to comprehend: the book is disorganized and complicated and is written with a special, tricky terminology. The real obstacle in explaining his works is deciding what Keynes' system actually was. Every competent economist uses his income approach for analysis and forecasting, even though that approach has to be supplemented by a good deal more material. Keynes can be misunderstood very easily. Wright wrote that

> when Keynes took twenty-four chapters to explain his system, he thought that it was a job requiring 24 chapters; that when he put in qualifications it was because he thought they were needed; and that when he put apparently contradictory chapters into the same book, it was for the purpose of having them read together.[49]

Keynes was editor of the *Economic Journal* from 1911 to 1944. He continued to achieve ever-increasing power and influence in World War II. In 1942 Lord Keynes was granted a title by the British government, thereby being elevated to nobility as Baron Keynes of Tildon.

His death, shortly after the war ended, was believed by many to be largely the result of his overwork and exhaustion during the war.

Keynes was the prophet of "state capitalism" — that phase of capitalism in which the state must intervene to keep the economy going. His advocacy of state intervention in the economy did not make Keynes a socialist, as some "die-hard" laissez-faire adherents charged. On the contrary, Keynes had no use for socialism. He championed private enterprise, but at the same time he opposed laissez-faire. Keynes recognized that in his time private enterprise needed state intervention and support in order to survive; whereas, the classical economists had argued that the state must keep "hands off" the economy in order to give free reign to private enterprise. His ideal was an economic system of private enterprise run for profit, but with the state responsible for maintaining its stability and full employment. Even as 150 years earlier Adam Smith had been the prophet of laissez-faire capitalism, so Keynes was hailed as a prophet by "New Dealers" and other non-socialistic advocates of

[49]David McCord Wright, *The Keynesian System* (New York: Fordham University Press, 1961), p. x.

national economic planning. They detected in his theories a justification for their respective systems of intervention in the economy of the nation.[50]

Taylor (1960) viewed this economic system as follows:

The Keynesian prescription is: adjust the impacts of the government's finances, taxes, borrowing, and spendings upon the total income-flow in the economy, as required to keep the latter at all times just sufficient to ensure equality of total demand with total supply or the national output of all goods and services, under conditions of approximately full employment of the labor force and resources and equipment of the national economy. If the income-flow is threatening to contract or fail to grow in step with the growth of output under full employment, let the government reduce taxes and/or increase public spending, add more through spending to the incomes of the people than it takes away through taxes, and thus increase the total flow of income and spending or demand in the system to match the growth of output, and keep the price level stable. And if or when, on the contrary, the income-flow threatens to grow faster than the full employment output and cause inflation or a rising price level, let the government reduce its spending and/or increase its tax rates, take more through the latter out of the income-flow . . . to equality with that of output, and so again stabilize the price level.

But it is not so easy in practice for a democratic government dealing with the kind of economic system and society and interest pressure groups that typically exist today, to carry out that prescription effectively in both directions as occasions require. . . . There is here a real dilemma that has not been resolved thus far.[51]

The large number of unemployed was a serious problem which tormented the world in the 1930's. Keynes was determined to find the reason for this unemployment; he sought first the reason that our economy had ceased to grow. Growth has always been a keystone to the life of capitalism — bringing with it all the benefits of a higher living standard while at the same time keeping the system fully employed and dynamic.[52]

Keynes was not the only economist who proposed remedies for depression, nor is his suggested remedy — government investment — the only device we have for combating an economic slump. Keynes suspected that interruptions to investment were likely to occur from time to time, and that they were the reason capitalism had grown in leaps and bounds rather than evenly. What troubled

[50]Anstol Murad, *What Keynes Really Means* (New Haven, Connecticut: United Printing Services, Inc., 1962), p. 18.

[51]Overton A. Taylor, *A History of Economic Thought* (New York: McGraw-Hill Book Company, Inc., 1960), p. 507.

[52]Slesinger and Archer, *op. cit.*, p. 47.

him was that each investment slowdown extracted a great price from economy; when investment faltered, unemployment grew. Keynes suggested that private investment be supported by a form of investment that would not be deterred by the pitfalls facing private risk takers. He believed government investment could be the great stabilizer for capitalism.

The outstanding factor now is that the government is not a passive onlooker who anxiously hopes that all will turn out all right. In modern capitalism the government stands by, ready and prepared to help when necessary, realizing its responsibility to aid and preserve our economic health by positive action.

The great depression caused serious concern to the whole Western community, confronting Western society with a state of motionless poverty. For the first time doubts began to be felt. For the first time students of economics, professional and semi-professional, began to question the adequacy of the law of "supply and demand," and a considerable amount of economic heterodoxy (now called the "new economics") began to appear. It was during this period that Keynes published his *General Theory*. This writing has done more than any other single work to establish "the new economics" as a permanent trend and as a set of ideas worthy to be dealt with in the future.[53]

> The depression provided the spectacle of great numbers of people in complete destitution. It also showed vast sums of money lying idle. At the same time industry was seen to be operating at an appallingly low level of production with many plants shut down completely, and virtually all the rest working only part time. Both were due to unemployment and in both cases the unemployment was due to the low level of industrial operations. But to what was the low level of industrial operations due?
>
> As the depression deepened, and neither the army of the unemployed nor the vast hoard of uninvested funds seemed to provide the incentive that was needed for a renewal of production, it became more and more evident that industry was prostrated because businessmen who managed it were unable to sell the goods that it produced, and agriculture was prostrated because farmers were likewise unable to sell the goods they were unable to stop producing; and in both cases they were unable to sell because, with something like one-fifth of the people unemployed, the community was unable to buy.[54]

This quotation shows that inequality of wealth and poverty was not the key to progress, as economists had believed it to be up

[53] Ayres, *op. cit.*, p. 132.
[54] *Ibid.*, p. 133.

to that time, but was rather its direct opposite — an almost fatal depressant. "The one luxury the rich cannot afford is the poverty of the poor."[55]

But the problem of eliminating unemployment still remained. The traditional "classical" weapons against unemployment are said to be monetary policy and wage cutting. The forceful impact Keynes has had on economics lies in his success in casting doubt on the efficacy of such policy measures, and in his suggesting instead that the government practice deficit financing by spending on public works.

Keynes' predecessors did not ignore the need for compensatory public works expenditures, nor did they advocate wage cutting as a cure for unemployment. Keynes' influence on the analysis of these questions was one of degree, not of kind; the surge of Keynesian economics was to strengthen the case for public works and to place the burden of proof on anyone who would propose to remedy unemployment by manipulating the wage rate.[56]

According to Seymour Harris, one of the early American Keynesians, Keynes approved of the New Deal's monetary expansion and reduced rates of interest, its program to raise farm incomes, its encouragement of collective bargaining, its high tax progression, and its relief projects. Keynes also warned President F. D. Roosevelt that mere pump-priming was not enough to ward off depression. The government must sustain an increased investment in durable goods such as housing, public utilities, and transport through a long period of time to keep the economy growing.

Keynes stated that high wages could not in themselves be the cause of unemployment since they are part of the consumption power that keeps other people at work. Unemployment, as he argued, must come because some money leaks out of the system. Production caused the money to be put in the consumption-investment system in the first place to be spent on consumption, or to be invested. Therefore investment can do two things: it can either put new consumer-producers to work, or it can make old employees more productive on their jobs. There will be no failure of demand whether the money flows into consumption or investment.

In the United States little is said about the first possible effect of investment — enlarging productive capacity. Technological progress is wanted as the creator of investment opportunities, and

[55]*Ibid.*

[56]M. Blaug, *Economic Theory in Retrospect,* (Homewood, Illinois: Richard D. Irwin, Inc., 1962), p. 593.

investment is wanted because it generates income and creates employment. It is wanted for its multiplier effect.[57]

Keynes argued that government spending (or "investment") could have a "multiplier" effect on the economy which might, under ideal circumstances, pay for itself. Money spent by government to put men to work on roads, public monuments, cleaning up the forests, or building big dams would turn up partly as consumption and partly as savings. The exact division would be in accordance with the "marginal propensity to consume." (In the case of previously unemployed men, the propensity to consume would be strong.) The new consumption money would circulate in the economy, "leaking" a little into savings with each turn of the spending cycle.

To determine in advance just what will happen throughout the economy when the government spends money poses a more difficult problem. Keynes himself made no effort to provide the actual statistical underpinning for his system. His "multiplier" might work, but it might also be cancelled if government spending should happen to have adverse effects on investment generally.

Keynes thought of "government investment" as merely "something extra," an emergency flywheel which, running concurrently with other wheels, would keep the whole machine spinning. Government spending is channeled into what Isabel Paterson calls a "dead-end appliance." It leads to consumption, but it contributes nothing to the common stock for future consumption.

"The level of employment depends on past expectations still working themselves out, and present expectations just acted upon. But the *General Theory* is relatively silent on what 'Keynesianism' does to 'trade out' diversified future investment for an inefficient and unimaginative deployment of funds in the present."[58]

Burns wrote that when J. M. Keynes "discovered" that savings and investing are not done by the same people, he was not merely concerned with identifying the savers and investors. He was concerned, rather, with the important fact that saving does not necessarily result in investing. One of the major "discoveries" of the depression was that of the enormous discrepancy which sometimes occurred between investment and saving.

Keynes' *General Theory* was the most important single factor in shifting the emphasis of economic theory from prices to incomes. Keynes reasoned that a nation's income consisted of two great

[57]Evsey D. Domar, *Essays in the Theory of Economic Growth* (New York: Oxford University Press, Inc., 1957), p. 107.

[58]Chamberlain, *op. cit.*, p. 205.

classes of expenditure, first on consumer goods, second on investment goods.

Next he argued that aggregate consumer spending depended mainly on the amount of aggregate income, while investment expenditures were not tied down to any category of receipts but depended instead mainly on the state of business sentiment. He showed that if variations in consumer spending of a given level of income are provisionally neglected, several conclusions of great importance immediately follow.

"(1) Consumer spending can respond to changes of income but cannot initiate them.

(2) National income — or its correlative, the volume of employment — cannot increase unless investment increases nor decrease unless investment decreases.

(3) Since investment depends on business confidence, which is notoriously unstable, our economic system is liable to wide fluctuations.

(4) Since "far-reaching change in the psychology of investment markets" cannot be expected, "the duty of ordering the correct volume of investment cannot safely be left in private hands."[59]

Keynes' economic theory provided a different view on the subject of industrial fluctuations. In order that full employment be maintained (using the Keynesian approach), it is necessary that the effective demand for goods and services should be sufficient to absorb all the output of the economic system.[60] The total costs of industry and commerce must be covered by the income of industry and commerce. Since all costs consist in the final analysis of payments to individuals, all the income received by individuals must be returned into the system.

The individual can use income for two purposes: spending or saving. The money he spends goes back into the system directly in the form of demand for goods and services, so no longer concerns this argument. The income which he saves is, in effect, held back from immediate circulation and is either hoarded or is put into the hands of some agency (such as a bank or an insurance company) to keep for him. In the latter case the money is available for loan to firms or individuals, and much of it goes for the purchase of capital goods (such as machinery and factory goods).

When individual incomes are saved and investment follows there is no problem, but when saving is not translated into invest-

[59]Slesinger and Archer, *op. cit.*, p. 146.
[60]Silverman, *op. cit.*, p. 267.

ment the demand for goods is insufficient to cover all that is being produced. Output must therefore be reduced, and unemployment results.

This approach to the problem emphasizes the necessity for equality between saving and investment. In practice these functions are performed by different groups of persons, and it would only be accidental if the results of their respective decisions to save and to invest should involve equal amounts of money. Usually the trend has been that the amount of money that people decide to save tends to be in excess of the volume required for the maintenance of plant and the provision for normal development and expansion. It is only in times of very rapid technical change (such as during the greater part of the nineteenth century when great technical advances were taking place) that investment must necessarily equal savings. During the recent period between World Wars, savings at times exceeded investment and had adverse effects on employment.

The question asked by Silverman arises: what happens when, under conditions of unemployment resulting from this deficiency of investment, an increase of investment takes place? Silverman answered his own question: "The increased demand for capital goods is followed by greater employment in the capital goods industries. This is followed by a larger demand for consumer goods by further employment in the consumer goods industries." The operation of the "multiplier effect" thus tends to spread throughout the economy.[61]

Keynes wanted to impress upon economists' minds the fact that if planned saving and planned investment were different at the beginning of a period they might be brought into equilibrium by unemployment and a change in the level of income rather than by a shift in the interest rate, as the earlier orthodox or classical economists had supposed. It was not savings plans or investment plans that Keynes thought were always equal but rather the results obtained by totaling the national accounts at the end of any space of time. Genuine balancing in this process, he pointed out, may as well be attained by changes in income as by changes in interest.[62]

One of the most widespread errors resulting from an incautious reading of Keynes is the notion that without the existence of money there could be no rate of interest. Although this mistake is a very fundamental one, Wright showed how easily it may be refuted.

[61] *Ibid.*, p. 268.
[62] Wright, *op. cit.*, p. 40.

Suppose a primitive island in which the main economic activity is fishing. We may suppose that there has been no technical change for some time and that the economy is pretty well adjusted. Now suppose that some fisherman gets the idea that a new kind of hook would be much more efficient and enable him to catch far more fish. But to hammer out the new design would take, say, a month. Yet in the meantime, let us suppose that he would have nothing to live on. What shall our designer of a new type of hook do? The answer is clear. Persuade someone else to lend him part of their fish during the period in which he is making the new hook. In return, let us say, our man with the new type of hook, promises to return to those who supported him while he was working, twice, say, as many fish as those it took to keep him alive during the time of hook making.[63]

The described transaction is a genuine case of interest, saving, and investment — though no money has been used. The man who supported the hook maker is a "saver;" the hook maker is an investor. The ratio between the fish eaten and the fish returned, as a result of the more productive process, is the rate of interest. Still more in line with our analysis, the expectation of a greatly increased yield of fish through the use of a more productive process is the marginal efficiency of capital. It is clumsy, however, to figure out rates of return without money, but the essentials of the process are clearly visible.

Keynes has pointed out that the mere existence of a physically productive plant is not enough in itself to explain the permanent existence of a rate of interest. For if there were no further new ideas or population growth and the process of investment and competition were allowed to continue, the costs of making the new machines would gradually rise; and the prices at which their products could be sold would gradually fall. The net return over cost from adding to plants or expanding operations, as well as the rate of interest, would gradually fall. However, all of these events depend upon the assumption of a "frozen" economic system. Once one assumes continued change, a rate of interest will persist indefinitely. It is necessary, therefore, to consider whether either the assumption of a frozen system or of continual change is ever justified.[64]

The orthodox economists before Keynes had not been afraid of long range unemployment, for they had thought that as "saturation" was reached profits and interest would automatically fall while consumption would automatically rise. There would evidently be a transfer of workers from investment to consumption, but no

[63] *Ibid.*, p. 43.
[64] *Ibid.*, p. 45.

unemployment was expected. Keynes broke through these illusions by showing that interest need not fall as profit prospects fell, and that consumption need not rise as investment declined sufficiently to maintain continuous, full employment. Keynes showed that an unemployment stalemate seemed clearly possible, especially if price and wage change were ruled out.[65]

When John Maynard Keynes first invented the term "propensity to consume," he laid down what is now known as Keynes' law: When income rises people increase consumption by a smaller amount than the increase in income. In other words, the marginal propensity to consume is greater than zero but less than one. At the same time, Keynes introduced the hypothesis that the marginal propensity to consume is less than the average propensity, implying that people consume a lower percentage, as well as a lower absolute amount, out of a higher income. The exceptions to Keynes' law are rare enough to disregard, but the hypothesis that the marginal propensity is lower than the average has been verified only for the short run. In the long run the evidence points in the opposite direction: the percentage of income saved has shown some tendency to fall. How to explain this apparent inconsistency has been a main problem for research in recent years.[66]

Keynes believed that the level of employment was determined by the interaction of the propensity to consume and the inducement to invest. A question an economist forecaster might ask first is what level of gross national product (GNP = consumption + investment + government spending) would give full employment. He might then look at his "propensity to consume" schedule to see what the levels of consumption would be at various outputs, and what the multipliers might be. From those relations he would try to figure out the flow of saving that would be attempted at the desired or full employment output, and he would next ask whether the "inducement to invest" would be sufficient under expected conditions to absorb this flow. This outlined procedure is followed today by nearly all economists whether they call themselves Keynesian or not.[67]

The inducement to invest is shaped by the interaction of the marginal efficiency of capital and the rate of interest. The marginal efficiency of capital is a schedule or curve showing the rates of prospective profit expected for various amounts of current investment under given conditions. There is also a long-run marginal efficiency

[65] *Ibid.*, p. 10.
[66] Fels, *op. cit.*, p. 272.
[67] *Ibid.*, p. 273.

of capital curve relating expected profit under fixed conditions to the total capital stock. But it is the short-run curve which is most important.[68]

Whatever the level of the rate of interest may be, the marginal efficiency of capital on the last small amount of investment actually being made must conform to the rate of interest. "For if men have to pay 7 per cent on borrowed money but only expect to make 5 per cent on a new prospect they will not start the new prospect. Other points on the marginal efficiency of capital curve may be either above or below 7 per cent in our example, but the last bit of investment actually being made must have an expected profit rate exactly equal to the rate of interest."[69]

Why is it that discrepancies between the actual level of economic activity and the potential maximum level occur? What determines the nature and the extent of these departures from the potential maximum level of economic activity that cannot be attributed to seasonal or random factors?[70] Most professional economists in this country now agree that the framework of ideas first developed and presented by John Maynard Keynes in the 1930's, and subsequently elaborated upon by others, is essential to an adequate understanding of these problems.

The term "aggregate income" is often used in Keynesian analysis as if it were virtually equivalent to gross national product. Following this practice it may be said that consumption expenditures plus investment expenditures equal aggregate income. Using Keynesian symbols, economists sometimes represent aggregate income by the equation $C + I = Y$. The level of aggregate income is the sum of all consumption expenditures.[71]

Income may be spent for goods which are to be consumed, or it may be saved. Thus we may also say that consumption plus savings equal aggregate income. Using Keynesian notation economists represent aggregate income by the equation $C + S = Y$.

Fishman stated that there is a relationship between family income and consumption and savings. The higher the level of family income, the larger is the proportion saved and the smaller that is spent for consumer goods of all types. Keynes pointed out that, all other things remaining constant, the same is true with respect to aggregate income: the larger an aggregate income is, the larger the proportion which is saved and the smaller the proportion which is

[68]Wright, *op. cit.*, p. 37.
[69]*Ibid.*, p. 38.
[70]Fishman, *op. cit.*, p. 205.
[71]*Ibid.*, p. 209.

used for consumption expenditures. The relation of aggregate saving to aggregate income may be referred to as the average savings function and may be expressed symbolically as $\frac{s}{Y}$. Similarly the relation of aggregate consumption function, or alternately as the average propensity to consume may be expressed symbolically as $\frac{c}{Y}$. The average savings function tends to rise as income rises, while at the same time the average consumption function tends to fall.

The following employment problem is presented by Wright as it would appear to the sophisticated, modern Keynesian who has assimilated into his thinking the lesson of post World War II experience and criticism. From Keynes and from ordinary observation, he will have received a great deal of skepticism as to the effectiveness of mere price and wage reduction to cure unemployment in a reasonable time in our society of pressure groups and security-conscious unions. He will also have learned from experience that Keynes' usual emphasis on lack of consumption as the chief cause of depressions is incredibly one-sided. If money wages are pushed up faster than productivity adjustments make it possible to digest them, the result must be unemployment or inflation. The causal sequence runs as follows: Excessive wage increases cut off, or greatly reduce, the perspective of profit especially on new investment. The reduction of perspective of profit on investment is a cause of unemployment. The public is apt to see the problem merely as a storage of "spending" or "purchasing power," being unwilling to look more fundamentally into the problem. A demand is raised for more spending or for easy money. The new money wage level is unwritten by an increase in the quantity of money; but then we get more inflation, more wage demands, and so on forever. The various pressure groups become more militant when they learn that there will be deficit finance to take care of them. A political leader, therefore, has to balance maintaining income stability on the one hand against encouraging inflation on the other. We are far from the simple problems of "effective demand."

Koepke has gone directly to the heart of Keynes' deficiencies as a social and political scientist. He attacked Keynesianism where it is weakest: in its failure to understand that reversible counter-cyclical action is virtually impossible in a democratic political system, especially in an election year. A dictator can cancel inflation. But in a democracy politics tends to go by a ratchet-action. It is difficult to retract that which has been granted.

The real objection to Keynesianism is not that it cannot form an "input-output" balance, but that it corrupts men morally. Since the ratchet action of politics makes a return to the voluntary society more and more unlikely, people become more and more cynical. With every increase in pressure group socialism there is a corresponding increase in the psychology of "what's in it for me."

> The drive of American life, the enthronement of the consumer, has made Veblen economics "old hat." Once upon a time it was the rich who had "conspicuous leisure" in which to indulge in "conspicuous waste." But now both leisure and waste are virtually every man's portion. Veblen hated sport, and he lashed out at wealthy yacht owners and polo players. But who are the sportsmen of today? Who throngs the motels of New England ski areas at the height of snow season? Who plays shuffleboard at St. Petersburg, Florida, all winter? It is the common man who has been the main beneficiary of the capitalist order.[72]

The Keynesian system, properly understood, is neither radical nor conservative. It is simply a framework by which to sort out economic data, a set of questions to ask oneself in predicting or diagnosing the behavior of the economic system. All competent economists today use this framework regardless of whether they call themselves "Keynesian" or not.[73]

Selected Bibliography

Arnold, Thurman W., *The Folklore of Capitalism.* New Haven, Connecticut: Yale University Press, 1933.

Ayres, C. C., *The Industrial Economy.* Cambridge, Massachusetts: Houghton Mifflin Company, 1952.

Blaug, M., *Economic Theory in Retrospect.* Homewood, Illinois: Richard D. Irwin, Inc., 1962.

Boulding, Kenneth E., *Economic Analysis.* New York: Harper & Brothers, 1941.

Burns, Arthur F., *The Instability of Consumer Spending.* New York: National Bureau of Economic Research, 1952.

Carr, E. H., *The Twenty Years Crisis.* London: Macmillan and Company, Limited, 1956.

Chamberlain, John, *The Roots of Capitalism.* Princeton, New Jersey: D. Van Nostrand Company, Inc., 1959.

Council for Advancement of Secondary Education, *American Capitalism: An Introduction for Young Citizens.* Washington, D.C., 1958.

Cole, G. D. H., *What Marx Really Meant.* London: Camelot Press Limited, 1934.

72Chamberlain, *op. cit.*, p. 213.
73Wright, *op. cit.*, p. 79.

Dodd, J. H., *Introductory Economics*. Cincinnati, Ohio: South-Western Publishing Co., 1940.

Domar, Evsey D,, *Essays in the Theory of Economic Growth*. New York: Oxford University Press, Inc., 1957.

Ely, Richard T., *Studies in the Evolution of Industrial Society*. New York: Macmillan Company, 1903.

Feis, Herbert, *The Changing Pattern of International Economic Affairs*. New York: Harper & Brothers, 1940.

Fels, Rendigs, *An Introduction to Economics: The Challenge to the American Economy*. Boston: Allyn and Bacon, Inc., 1966.

Fishman, Betty G. and Leo, *The American Economy*. Princeton, New Jersey: D. Van Nostrand Company, Inc., 1962.

Friedman, Milton, *Capitalism and Freedom*. Chicago: The University of Chicago Press, 1962.

Gove, Philip B. (Ed. in chief). *Webster's Seventh New Collegiate Dictionary*. Springfield, Massachusetts: G. & C. Merriam Company, 1965.

Hansen, A. H., "International Economic Relations," *Report on the Economic Stabilization in an Unbalanced World*. New York: Harcourt, Brace, and Company, 1932.

Hayward, William R., and Johnson, Gerald W., *The Story of Man's Work*. New York: Milton, Balch and Company, 1925.

Hickman, C. Addison, *World Economic Problems*. New York: Pitman Publishing Corp., 1947.

Keynes, J. Maynard, *The General Theory of Employment, Interest and Money*. New York: Harcourt Brace and Company, 1936.

Miller, Raymond W., *Can Capitalism Compete?* New York: The Ronald Press Company, 1959.

Murad, Anstol, *What Keynes Really Means*. New Haven, Connecticut: United Printing Services, Inc., 1962.

Mussey, Henry R., and Donnan, Elizabeth, *Economic Principles and Modern Practice*. Boston: Ginn and Company, 1942.

Scott, William A., *Development of Economics*. New York: The Century Company, 1933.

Silverman, H. A. *The Substance of Economics*. London: Sir Isaac Pitman and Sons, Inc., 1960.

Slesinger, Reuben E., and Asher, Isaccs, *Contemporary Economics*. Boston: Allyn and Bacon, Inc., 1963.

Taylor, Overton A., *A History of Economic Thought*. New York: McGraw-Hill Book Company, Inc., 1960.

Wess, Harold B., "We Can't Have Freedom Without Capitalism," *Human Events*, XVIII (November 19, 1958), p. 40.

Wright, David McCord, *The Keynesian System*. New York: Fordham University Press, 1961.

CHAPTER SEVEN

The Role of Management

George R. Merrill
University of Maryland

Management

The term management is rather broad and somewhat difficult to define. It is a term which may be found in the literature of several major academic fields. The field of Industrial Arts uses the term to describe those duties of the teacher which are directed towards keeping his laboratory in an on-going, operating condition — laboratory management. The field of Home Economics uses the term to describe the activities of a housewife running a home — home management. The field of Business and Public Administration uses it to describe a special area of academic study — industrial management. It is the definition of this more specific term, industrial management, that is the major concern of this chapter.

Industrial Management

There is extensive literature in the field of Industrial Management which more than adequately satisfies the criteria of academic respectability. In addition to the extent or scope of its literature, this designated field of study has extended for a length of time sufficient to give it a history suitable to meet one of the criteria for a profession.

A quick review of the history of industrial management will help one obtain a clearer definition of the term. One of the first concepts of management was that of a leader responsible for all aspects of an entire society: examples of that concept existed in the manorial system of Western Europe and our own southern plantations. But questions remained concerning the sources of authority and the limits of responsibility for such leaders. Mahoney explained it in this way. "First the manager owned virtually all the economic resources of the society, often including the manpower of the society as slaves."[1] This ownership provided the necessary authority.

> Second, the manager belonged to a privileged social class as a result of his assumed inheritance of unusual capacities and abilities for leadership in all spheres of activity. As a member of this priviliged clan, the manager assumed a certain moral obligation for the welfare of the less fortunate members of his society.[2]

Thus the first managers were cast in the role of trustees of society.

The second phase in the development of management came with the growth of the apprentice system whereby the master assumed a paternal role towards his apprentices. He was responsible for their moral and spiritual well-being as well as for teaching them a craft. His authority was vested in the fact that he possessed a skill that someone else wished to acquire.[3] This concept of paternalism in management is still to be found in some rather large international, family-owned businesses.

The next phase of management grew out of the period of rapid industrial growth. As industry became more formalized and swift expansion took place, men of rather humble origins rose to the top positions in industrial leadership. This was the day of the common man — when all roads were open to an individual, no matter what his background. It was a day when industrial leaders became leaders in other areas of life. "Thus economic and industrial success began to replace social heritage as the determinant of social influence, and the successful manager was increasingly viewed as a champion of the people."[4]

In the United States the next movement was that of scientific management, as developed by F. W. Taylor.[5] According to Taylor, management could apply scientific techniques to production problems, thus increasing efficiency and improving industrial output. Through the use of job analysis the best methods for performing individual production tasks could be determined and applied with a resultant increase in productivity. There were no social implications in the management role; it was purely an economic resource. Management was really an applied science: that of researching the best way of doing something and doing it that way. At first glance it would seem impersonal, cold and almost inhuman. In practice,

[1]Thomas A. Mahoney, *Building the Executive Team* (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., ©, 1961), p. 2.

[2]*Ibid.*, p. 3.

[3]*Ibid.*

[4]*Ibid.*, p. 5.

[5]Frederick W. Taylor, *Scientific Management* (New York: Harper & & Brothers, 1954), p. 112.

however, it was not, for many industrial tasks were made easier and, of perhaps even more importance, safer through these techniques.

Scientific management led into the phase of management which is often referred to as professional management and "focuses attention upon the manager's job in society and upon the manager's approach to this job."[6] "The professional manager is an agent for ownership interests, but he is also an agent for employees, consumers, and citizens in the community who are affected by the activity of the enterprise."[7] It is the manager's job to go beyond the mere operation of his plant, to look ahead and relate his activities to the activities of society so that economic and social progress may be attained. Perhaps the most significant aspect of professional management is its obligation and responsibility to discover and apply new principles in managerial roles, operations, and functions.[8]

The five phases or concepts of management briefly outlined here give no more than an indication of the history of management and how it has evolved and developed. They provide, however, a basis for attempting to derive a satisfactory definition of management. Drucker's view of management shed some light on the definition of the term. "Management is not an end in itself. It is an organ of the business enterprise. And it consists of individuals."[9] This definition of management humanizes it and places it as a distinct part of an enterprise. But it does not clearly define the specific function of management. Drucker has stated that "it is management's specific job to make what is desirable first possible, and then actual. . . . To manage a business means, therefore, to manage by objectives."[10] Both to know what should be accomplished and then to succeed in having it accomplished seems to be the function of management. Defining management by its function seems to provide a satisfactory definition. At least it provides a usable definition which seems to have some acceptance. Mahoney seems to agree with Drucker; he wrote that "the primary function of management is the establishment, maintenance and provision of an organization. It is the planning, staffing, directing, and coordinating of a group of people for the achievement of certain common goals."[11] Both men

[6]*Ibid.*, p. 6.

[7]*Ibid.*, p. 7.

[8]*Ibid.*

[9]Peter F. Drucker, *The Practice of Management* (New York: Harper and Brothers, 1954), p. 112.

[10]*Ibid.*, p. 12.

[11]Mahoney, *op. cit.*, p. 22.

apparently use the term in a way which implies that management is made up of more than one person.

Levels of Management

1. *Executive.* Clearly differentiating between and defining precise levels of management is a difficult if not an almost impossible task. Many attempts have been made to analyze the business institution with the intent of obtaining a clear-cut structure acceptable to all persons in the field, but as yet little agreement has been reached. Perhaps an analysis in terms of functions provides the best vehicle for an examination of levels of management. Such an examination does have its limitations, however, because of the great amount of overlapping of functions which exist in the business world.

The executive role basically is to assume ultimate responsibility and authority for the administration of the affairs of the enterprise. This role includes both the internal and external affairs which affect the successful operation of the enterprise. More specifically, Schneider set forth three kinds of executive functions: (1) setting the general policy of the organization, (2) establishing proper relations between the industrial plant and important external forces, (3) guiding or directing the internal organization of the plant.[12]

One of the basic policies with which the executive must deal is the establishing of objectives. Drucker stated: "It is, then, the first responsibility of top management to ask the question. 'What is our business?' and to make sure that it is carefully studied and correctly answered."[13] Sometimes the answer to this question is so simple, so uncomplicated and so narrow that it appears to be misleading. A story was told by the manager of an automobile stamping plant concerning his answer to the oft-asked question, "What do you do for a living?" His answer was simple, "I load boxcars."[14] The objective for this particular plant manager was to ship twenty boxcars of left automobile doors and twenty boxcars of right automobile doors each day. If they did not leave by a certain hour they would have to be flown to the several auto assembly plants (at a considerable increase in cost), or the assembly lines would have to stop. In this particular case, therefore, while the specific objective

[12]Eugene V. Schneider, *Industrial Sociology* (New York: McGraw-Hill Book Company, Inc., 1956), p. 101.

[13]Drucker, *op. cit.*, p. 50.

[14]Guy J. Bates, "Industry's Viewpoint of Graduates," First Annual Conference on Industrial Technology in American Higher Education, Kent State University, October 30, 1965.

offered by the manager seems almost ridiculous at first glance, a more careful examination reveals that this objective is not only correct but also far from ridiculous. For anything in that plant which hindered those forty boxcars from leaving on time, each day, interfered with the purpose for having that plant. Supplies, personnel, machine tools, faulty lay-out, and all aspects of their acquisition, training, maintenance and design (to mention but a few), could affect getting those forty boxcars loaded on time. As a manager this man's attention was focused on the true objective of his role, and all his efforts were directed towards a specific end result.

The second major function of the executive is to relate his organization not only to the external forces which will affect it but to the external forces it will affect as well. Other firms, the government, labor unions, and the public at large are but a few of the external forces he must contend with. It is his task to set management policies which will allow the enterprise to function profitably through constant economic and social change. To use Mahoney's words again, "the professional manager is an agent for ownership interests, but he is also an agent for employees, consumers, and citizens in the community who are affected by the activity of the enterprise."[15] It is apparent, therefore, that the executive decisions must be based upon internal as well as external conditions.

Finally, the executive must set up the basic organization of the enterprise. The specific hierarchy is determined at a lower level, of course, but the basic structure and chain of command is established at the executive level. Variation of external conditions should be reflected by some variation in the internal organization of an enterprise; and it is the responsibility of the executive to be cognizant of external change, interpret it correctly, and compensate for it by an internal organizational adjustment. Thus while the executive is overtly responsible for changes within the enterprise, he is not, however, the determining cause for the change.

Setting the objective, to some extent, influences the formulation of other general policies (specifically those concerning the means by which the basic objective will be achieved). The executive is primarily responsible for establishing the main purposes of the enterprise; within these major purposes are minor aspects which are relegated to persons concerned only with the internal aspects of the enterprise.

2. *Middle Management.* The role of middle management is equally difficult to define precisely. Basically, middle management implements the action necessary to fulfill the objective of the busi-

[15]Mahoney, *op. cit.*, p. 7.

ness. This is its function, but it is too broad a description of the role of middle management to be of much real value. Perhaps Tannenbaum, Weschler and Massarik provided a more specific and workable description: "all managerial activities are included in three functions: organization, direction and control."[16] Grouping the activities in such a way provides a means for a systematic if not precise examination of the middle management role.

Organization is broken down into two basic concepts. First, by definition of the term there are two or more parts or units involved; and second, there is a relationship between these units. Simply stated, management's task is to determine how many parts or units are necessary to meet the objectives of the enterprise and how they may best be arranged to meet the objectives in the most efficient manner. In a small enterprise the task is not very difficult; but as the enterprise gets larger, greater numbers of specialists are added. Therefore establishing the proper relationships for the most efficient accomplishment of the purposes of the enterprise becomes more difficult. The "town meeting" in a village of two hundred people could satisfy the demands of organization in relation to the objectives of the village; but a city of one million people, having almost the same objectives, could not possibly operate within the "town meeting" organizational framework.

Another of management's activities, direction, is also affected directly by the number of people in the enterprise. Direction involves devising both the purposes of action and the methods of procedures to be followed in achieving them.[17] In a small organization the basic objectives of the enterprise are rather clear and are kept in sharp focus because everyone has an almost daily encounter with them. With greater numbers of specialists, however, the basic purpose of the enterprise is seldom viewed as an immediate problem. Therefore, the basic purpose must be subdivided down through the structural hierarchy until each individual has his own purpose. Obviously this subdivision creates the problem of relationships, and efficient relationships are essential for successful organization. In the interest of efficient relationships, direction also involves methods or procedures for achieving individual purposes. Once these methods or procedures have been devised, the organization can work toward the basic purpose smoothly and efficiently. Methods and procedures imply standards of performance which can

[16]Robert Tannenbaum, Irving Weschler, and Fred Massarik, *Leadership and Organization: A Behavioral Science* (New York: McGraw-Hill Book Company, Inc., 1961), p. 254.

[17]*Ibid.*, p. 258.

also serve as criteria of action, thus indicating any weak spots in the organizational system.

The third management function, control, is directly related to the other two. "Control is the use of formal authority to assure, to the extent possible, the attainment of the purposes of action by the methods or procedures which have been devised."[18] To some extent good control is a part of good organization and good direction. If proper relationships have been worked out and proper methods and procedures devised, the means of control has been partially created as an integral part of the system. The basic problem is the fact that the units of the organization are actually people and the methods and procedures must be applied by people. It is not always possible, however, to find exactly the right person for every specific task within the organization. Careful selection of personnel can do much to alleviate the problem, but in itself this selection is often inadequate. The only other solution is to train the person for his specific task. In Drucker's words, "who is a manager can be defined only by a man's function and by the contribution he is expected to make. And the function which distinguishes the manager above all others is his educational one."[19] It would almost seem that by definition a manager is a trainer, that he controls the situation partly through the system and partly through training and development of people. The system supplies criteria for determining what people must do and how well they must do it, and training makes it possible for them to meet the criteria.

The Formal Organization

The brief description of these three functions of management provides a background for a closer examination of one function that seems to cut across all levels of management, organization. Many industrial leaders have felt that a good organization is the most important single resource an enterprise can have.[20]

In the early days of the industrial revolution most industrial enterprises were small and the organization of the enterprise was relatively simple. The owner of the producing firm supervised all activities and performed all the tasks necessary for the efficient use of the workers. He purchased the raw materials, the tools, and the supplies needed for production. He also hired and fired workers, and in general coordinated the relationships between all the functions

[18] *Ibid.*, p. 260.

[19] Drucker, *op. cit.*, p. 350.

[20] Claude S. George, Jr., *Management in Industry* (2d ed.; Englewood Cliffs, New Jersey: Prentice-Hall, Inc., ©, 1964), p. 65.

that contributed to the profitable operation of the firm. However, as the industries became larger and the organizations grew, the problem of relationships also increased. At first the line organization merely extended itself vertically to provide for all the service functions a producing unit needed. Eventually, however, the structure of the organization was so tall that it became unwieldy. The answer to the problem was found by setting up non-producing units that would handle a specific service function common to several or all producing units within the enterprise, thus shortening the line structure. These service units became known as staff activities. (Today most modern industrial organizations are of the so-called line and staff structure.)

Typical staff functions are personnel, security, safety, inspection, quality control and purchasing. These functions are necessary for most producing units; it is, however, more efficient to have one purchasing department perform the purchasing function for all producing units than to have each one perform its own purchasing function on an individual basis. In this way, the formal organizational structure of an enterprise is developed.

The Informal Organization

The organization chart of any industry is actually a picture or graphic representation of the formal organization of that industry. It shows the careful planning, and in some cases the research, that has been employed to enable an industry to function most efficiently. It does not show, however, how the industry functions in reality, because an organization chart cannot reflect the informal organization that exists in every enterprise. Mahoney has stated that informal organization "refers to the behavior of members of the organization, behavior which may or may not conform to the planned behavior set forth in the position descriptions and organization manual."[21] The human element in the situation, in other words, alters the roles and functions depicted by the organizational chart. Several reasons have been advanced for this phenomenon, most of them based upon the human characteristic of interpretation.[22] A person in a specific place in an organization will function according to how he interprets the basic objectives of the enterprise, the structure of the organization, his own immediate objectives, his social needs and his long-range goals — to mention but a few.

[21]Mahoney, *op. cit.*, p. 37.

[22]Leonard R. Sayles and George Strauss, *Human Behavior in Organizations* (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., ©, 1966), p. 83.

The opportunity to participate in the establishment of the organizational structure has been suggested as one means of satisfying the social needs of the members of the organization.[23] It would also work toward aligning the informal structure of relationships with the planned structure of relationships. This alignment is obviously important as the formal relationships have been established for efficiency or as the means of satisfying pressures from an external source. But there are other ways in which these social needs may be met.

The informal organization is actually composed of groups, and in the words of Sayles and Strauss, "since management can achieve its ends only through working with people, it must also work through groups."[24] The groups serve many functions within the organization. From a positive point of view the small group helps fulfill many of the social needs of the individual belonging to it. In addition, it serves to orient new people into an organization by providing a kind of "guide to correct behavior," particularly in terms of unwritten policies of the organization.[25] Usually these unwritten policies are nothing more or less than the interpretation of the formal written policies.

On the negative side, the informal groups may exercise strong control over their members and may even force the individual to conform to the informal group norm. This conformity may not be to the best interests of management. In reality, both the amount of work performed per day by each individual worker and the length of the workday may be set by the informal group, not by management. Both the amount of work and length of workday then become informal group norms. An example of the latter situation can be illustrated by the following case. The normal workday in an automobile agency was from eight in the morning until five-thirty at night. The official policy was to have the men go to work at eight o'clock and quit at five-twenty, thus allowing them ten minutes to put their tools away and clean up so they could be ready to leave at five-thirty. The informal group norm, however, was not to do any productive work after five o'clock. Any means of establishing this informal norm, short of absolute verbal refusal, was allowable. Stretching a job past five o'clock, road-testing a car at five minutes to five, or merely standing at a bench looking busy were all ways of avoiding a new work assignment. Many jobs on an automobile require only ten to twenty minutes, and both management and the

[23]Mahoney, *op. cit.*, pp. 37-38.
[24]Sayles and Strauss, *op. cit.*
[25]*Ibid.*

mechanics knew that an assignment of this kind at five o'clock was legitimate under existing official policy. But any new person joining the group soon learned that the informal group norm required that he be unavailable for these "end of the day" assignments. The group's workday, then, was actually twenty minutes shorter than management had set as policy.

Management does not, of course, have to accept existing group standards. There are many ways in which they may be overcome. A good supervisor can, in fact, strengthen his tools of leadership immeasurably if he knows the "status structure of the group, its informal leaders, its standards, and values."[26]

To be aware of the informal group and the fact that it may set informal norms for the individual within the group is the first requisite for controlling this group for acceptable ends. The formal organization may be designed for absolute efficiency for attaining the organization's basic objectives, but unless the informal organization is also working rather efficiently towards the same objectives, the enterprise has little chance for success.

Industrial Bureaucracy

Industry has grown from small scale, single plant manufacturing and service enterprises into huge, industrial complexes with plants throughout the world. As the industries grew their organizations grew, and gradually most of the large industrial organizations took on a certain social form. "This form most closely resembles the type of organization which social scientists call a bureaucracy."[27] The bureaucratic form of organization has a long history and has been used by varying social institutions in many cultures.

Basically, all bureaucracies have certain universal characteristics, but it is impossible to predict that all features of one bureaucracy will be exactly the same in another bureaucracy. Schneider, in an attempt to outline these universal characteristics, listed four basic elements which seem to be found in all bureaucracies. First, "there is a distinction between the administration, or 'hierarchy,' of the bureaucracy on the one hand, and the masses of people who are administered to or governed, the 'laity' on the other."[28] The distinction in industry is between salaried management people and the hourly paid employee. Second, "the hierarchy of a bureaucracy consists of a series of offices, or positions, each of which has more

[26]Sayles and Strauss, *op. cit.*, p. 106.
[27]Schneider, *op. cit.*, p. 75.
[28]*Ibid.*, p. 76.

or less carefully specified duties and areas of competence."[29] In industry this is typically the line and staff organization. It is also critical that the relationships between the office or position be more or less carefully specified. Third, Schneider pointed out that most bureaucratic offices or positions require specialized knowledge.[30] This would mean specialized training or formal education as well as considerable experience in the organization in order to acquire certain specific skills. "Finally, the bureaucracy is marked by certain types of relations between the office and the official or bureaucrat who fills the offices."[31] The office has the prestige and authority as well as the longevity. The official serves in the office for a given period of time, but he does not own it and it will continue to exist and function when he is no longer there. The holding power of a bureaucracy as far as personnel is concerned is their advancement through the offices. The career pattern for an official in the bureaucracy is begun at a relatively low level, in an office having little prestige, little responsibility, and a relatively low salary; and is then continued with an upward movement through higher level offices with a corresponding increase in prestige, responsibility, and salary. The advancement is rather predictable so that a young official can be relatively certain of the level in the bureaucracy he may aspire to in ten or twenty years.

Bureaucracy as a form of organization in industry would not continue if it did not fill certain industrial needs. Schneider identified six basic reasons that such an organization has been so prevalent in industry: (1) growth in size, (2) specialization, (3) expertness and technical knowledge, (4) mechanized technology, (5) long-range planning, and (6) discipline.[32] While in some cases only one of these reasons would seem sufficient to cause industry to adopt the bureaucratic form of organization, all six are usually present.

The growth of industry in size has been phenomenal in a relatively short period of time. It is big and seems to be getting bigger, and the administration of such huge enterprises understandably increases in difficulty at an accelerating rate. The bureaucratic organization provides an excellent framework for accomplishing the many specialized tasks such as centralized planning, efficient communication, and an elaborate record keeping system demanded by a large enterprise.

[29]*Ibid.*
[30]*Ibid.*
[31]*Ibid.*, p. 77.
[32]*Ibid.*, pp. 79-80.

The bureaucracy also allows for a high degree of specialization necessary for the competitive operation of industry. The various offices have within themselves carefully defined limits of activity and responsibility which provide an ideal setting for the development of a high degree of specialization, with full attention to the specialty. In addition, a high degree of expertise and technical skill can be obtained by an official who can concentrate all his time and effort on one specific aspect of the industry.

Advanced mechanized technology in industry also requires the bureaucratic form of organization. For many parts of the enterprise are geared directly to huge complexes of machines which in turn require a constant source of raw material, coordinated human talent, and accurate timing of many tasks if efficiency is to be maintained. Machines dictate to man in a rather impersonal way, and the impersonal structure of a bureaucracy provides an environment where such conditions are tolerable. People accustomed to working in a bureaucracy can rather readily accept the idea that man can work without air conditioning, but an electronic computer cannot.

The successful enterprise today must have one or more segments oriented to the future. Long-range planning and research require a rather stable organization characterized by predictability. A bureaucracy has this element, for in a bureaucratic organization the offices, not the officials, have the actual power and are arranged with sufficient checks and balances to maintain a consistent pattern of operation. The relationships between the offices are established so that no one office can disrupt a long-range plan through the whim of an official serving in that office.

Finally, any organization which must handle the administrative functions of an enterprise as large as many industries are today must have strong discipline and rigid control over its personnel. Here again the bureaucracy fulfills the need. Since the personnel do not own any of the materials, equipment, or artifacts used to operate the enterprise, they are completely dependent upon the bureaucracy for their economic existence. Moreover, through specified lines of authority and the definite assignment of responsibility, quality and quantity of work can be accurately measured and the performance of any one individual can be rather quickly assessed and appropriate action taken. All of these characteristics of a bureaucracy result in the necessary control over the individual which is needed for the efficient and effective operation of a large enterprise.

Conclusion

Management is the controlling element of any industrial enterprise. It has become more sophisticated and precise as it has evolved, and it has called upon an ever-increasing number of academic fields in its search for better "tools." One reason for turning to other fields is that management is not "hardware," or a commodity that can be bought and sold. Management is people, and a better understanding of people should help toward a better understanding of management.

There are specific units of management responsible for specific functions, but these units are composed of people with specific knowledge and skills and therefore can never be "interchangeable parts," or manipulated like parts on an electronic "breadboard," Because of the organizational structure of today's industries, and the varying functions within that structure, management people must be trained and developed constantly in order to meet the new demands of inevitable change industry must contend with. Young people must be prepared to assume the management responsibilities of the future and to do it with the management "tools" of the future which are certain to be affected by our expanding technology in all areas. They must also be prepared to cope with our changing social patterns, as for example, the professional employee as described by Drucker. In his words, "professional employees constitute the most rapidly growing group in the business enterprise."[33] They must be trained and developed as professionals with a truly professional attitude towards their employment. Industry cannot buy machines to fulfill all the functions necessary for efficient, competitive production. The human element will always be present and as such it must be allowed to grow in order to meet the change of new demands that only humans can satisfy. Previously it has been said that the executive causes change, but is not the change agent; the change agent is the man who trains and develops the professional employee and in Drucker's words, "we need recognition, position and reward in the business enterprise for that rarest but most valuable of professionals, the inspiring teacher."[34]

[33]Drucker, *op. cit.*, p. 329.
[34]*Ibid.*, p. 337.

Selected Bibliography

Bates, Guy J. "Industry's Viewpoint of Graduates." First Annual Conference on Industrial Technology in American Higher Education, Kent State University, 1965.

DePhillips, Frank A.; Berliner, William M.; and Cribbin, James J. *Management of Training Programs*. Homewood, Illinois: Richard D. Irwin, Inc., 1960.

Drucker, Peter F. *The Practice of Management*. New York: Harper and Brothers, 1954.

George, Claude S. *Management in Industry*. 2nd ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., ©, 1964.

Glover, John G. and Cornell, William B., ed. *The Development of American Industries*. New York: Prentice-Hall, Inc., 1951.

Henry, Jules. *Culture Against Man*. New York: Random House, 1963.

Holden, Paul E.; Fish, Lounsbury S.; and Smith, Hubert L. *Top—Management Organization and Control*. New York: McGraw-Hill Book Company, Inc., 1951.

Lewis, Bernard J. and Pearson, William W. *Management Guide for Industrial Supervisors*. New York: John F. Rider Publisher, Inc., 1961.

Mahoney, Thomas A. *Building the Executive Team*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., ©, 1961.

McLarney, William J. *Management Training: Cases and Principles*. 3rd ed. Homewood, Illinois: Richard D. Irwin, Inc., 1959.

Sayles, Leonard R. and Strauss, George. *Human Behavior in Organization*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., ©, 1966.

Schneider, Eugene V. *Industrial Sociology*. New York: McGraw-Hill Book Company, Inc., 1956.

Scott, Walter D.; Clothier, Robert C.; and Spriegel, William R. *Personnel Management*. New York: McGraw-Hill Book Company, Inc., 1949.

Tannenbaum, Robert; Weschler, Irving; and Massarik, Fred. *Leadership and Organization: A Behavioral Science*. New York: McGraw-Hill Book Company, Inc., 1961.

Taylor, Frederick W. *Scientific Management*. New York: Harper and Brothers, 1947.

CHAPTER EIGHT

Organized Labor and the Production Worker

Kenneth Stough
University of Maryland

Workers' Psychological Need

> The beliefs that work is an unpleasant necessity, that the individual is basically competitive; that society consists of a mass of unorganized individuals, each at war with the other; that the human body is a machine to which a mind is somehow attached; that fear of starvation is the main negative incentive and money the main positive one — all of these are products of a certain type of society at a certain stage in its development. . . . However, they were never true of more than a minority of the members of an industrial society.[1]

Unfortunately, industrial management practices have been based on the above assumptions. In the early days of this country's industrialization, the workers tolerated hard work, long hours, and unfavorable working conditions. They received a great deal of pride and satisfaction from the mere process of survival in the days when survival was not easy. Moreover, those were days of deep and simple religious convictions; this life was looked on merely as a preparation for eternity and happiness was not something to be enjoyed until after death. Today, the workers want pleasure here and now.[2]

To the modern man, industrial activity is a frontier against which he presses. Strengthened by each preceding success, he applies himself to conquer new frontiers. Such a process is never-

[1]J. A. C. Brown, *The Social Psychology of Industry* (Baltimore: Penquin Books, 1964), p. 276.
[2]*Ibid.*, p. 277.

ending. In the fever of this activity, man commonly loses sight of any possible life to come. Even if he does not formally deny its existence, the only world he cares about is the one in which he lives and works. This attitude advanced our industrial society in the United States; but it now shows symptoms of exhaustion. New emphasis is being placed on recreation, pleasure, amusement, comfort, and convenience.[3]

In attempting to meet the desires and/or demands of the modern day workers, management has improved the physical conditions of the plant, shortened the work week, and added fringe benefits to make work more tolerable and permit leisure time so that workers might enjoy life when they are not at their jobs. These features may make work more tolerable, but they do not make work more enjoyable. Production workers still work eight hours a day in a sterile place, from which everything they really care for has been left out. Giving the workers "welfare" does not appreciably improve the situation. An object is valued according to what the individual has sacrificed in order to get it.[4]

The physical conditions of work do influence the individual, but there are more important human needs which have not been met. An adult's most basic psychological need is the need for social status and function — "the awareness that he belongs within the scheme devised by this culture and has a part, however humble, to play in that scheme."[5]

The present day's large industrial organization has destroyed the workers' primary group — the small group of fellow workers in which he had status and from which he received prestige. Instead, he must function in large formalized secondary groupings whose ideology conflicts with his, and which are too large to arouse in him any real feeling of loyalty. The increased demand for technical skill necessary for adaptability in our ever-changing industrial culture, when added to the workers' feeling of not belonging, has forced them to turn elsewhere for security. The logical solution to this psychological need has been their banding together into organizations — labor unions, so as to have primary groups to which they belong and in which they feel secure.[6]

[3]Adriano Tilgher, "Work Through The Ages," *Man, Work and Society*, ed. Sigmund Nosow and William Form. (New York: Basic Books, Inc., 1962), pp. 22-23.

[4]Brown, *op. cit.*, p. 278.

[5]*Ibid.*, p. 281.

[6]*Ibid.*, p. 282.

Labor Union Development

Labor unions received their greatest impetus during the period from the Civil War to 1900 — when industrialists often operated in monopoly situations, accumulated great wealth, and imported foreign immigrants; when American laborers refused to work for extremely low wages and in undesirable physical conditions. As a result of the repulsive conditions of work and job insecurity, the workers joined into unions in an effort to wield more power when dealing with management for job security and higher wages.

The organizing process was not accomplished easily, nor was it an unmixed blessing. The first such organizations were frowned upon by government, management, and the public to such a degree that their success in meeting the needs of labor often failed; hence the organization lost its membership and collapsed.

The first union that succeeded in organizing a sizable number of workers was the Knights of Labor, founded in 1869. In its early years it was a secret organization and its most valuable weapon was the boycott. By 1881, it had discarded its secrecy policy and began thereafter to grow rapidly. At its peak in 1886, the Knights of Labor had a membership in excess of 700,000. In the same year (1886), the American Federation of Labor was founded as the successor to the Federation of Organized Trades. There was an attempt to merge the Knights of Labor and the American Federation of Labor; but this attempt failed, so they competed for membership — a common union practice. The well-known Haymarket Affair in Chicago on May 4, 1886 turned such a large segment of the population, union and non-union, against the Knights of Labor that its membership decreased rapidly. By 1900, the Knights of Labor was no longer an effective union. The American Federation of Labor, when formed, was more soundly based, was under more capable leadership, and was more selective in its membership. It grew slowly but steadily, and today it is one of the two largest unions in the United States; its counterpart is the CIO.[7]

The American Federation of Labor is a national or international union, and its emphasis has been on the organization of the skilled trades. Many positions in the modern industrial plant do not require skilled tradesmen; therefore, many workers have not been welcome into AFL membership. In 1935, the AFL held a convention to correct this membership problem. The discussions were very heated and a number of unions withdrew from the AFL. In

[7]Henry Pelling, *American Labor* (Chicago: University of Chicago Press, 1960), pp. 48-78.

1936, those that withdrew from the AFL formed a Committee for Industrial Organization — later changed to Congress of Industrial Organization. The CIO organized whole plants or industries; therefore, it was called an industrial union. The CIO, as a result of organizing whole plants rather than just the skilled tradesmen, grew rapidly. By 1945, membership in both unions was almost equal. The two unions continued to raid each other's membership until, in 1947, they encountered a common problem: Congress passed the Talf-Hartley Act which drastically reduced the unions' power in dealing with management. Both unions realized their need to unite in order to wield more strength in opposing anti-union legislation. Thus the AFL and the CIO merged in 1955, and while they still generally work together, they have continued to maintain separate identities and have experienced occasional conflicts. Only since the New Deal legislation of the 1930's, and particularly the Wagner Act of 1935, have the unions been granted the freedom to organize and represent the industrial workers in dealing with management. However, much of their freedom was abrogated by the Talf-Hartley Act. Aside from the AFL-CIO, there are such independent unions as the Railroad Brotherhoods, Teamsters, and others. Presently, at least one fourth of the total labor force are members of some labor union.[8]

Today, despite the fact that major unions command huge treasuries, can demand much from industrial management, and have distinct political influence; their strength in recent years has been decreasing. Raskin wrote that

> each day brings compelling reminders that labor's strength is in the down grade and that, like the colonial powers of Europe, its leaders may soon be presiding over the dismantling of their own empires unless they can find imaginative new approaches to the challenges thrust on them by automation, intensified foreign competition, and a dramatic shift in the composition of the work force.[9]

Raskin went on to point out that

> the march of technology is like a pincer movement in the impact on unions. It eliminates large numbers of blue-collar jobs in manufacturing and transportation, thus chipping away the bedrock of union enrollment. To the extent that new jobs are created, they involve hard-to-organize engineers, technicians, and white collar workers.[10]

[8]Eugene V. Schneider, *Industrial Sociology* (New York: McGraw-Hill Book Company, Inc., 1957), pp. 219-241.

[9]A. H. Raskin, "The Squeeze on Unions," *Labor and the National Economy*, ed. William G. Bowan (New York: W. W. Norton and Company, Inc., 1965), p. 1.

[10]*Ibid.*, p. 4.

Functions of Union Organizations

The chief objectives of the union organization in the American industrial system are to increase the security of the wage earners' jobs and gain for the wage earners a larger share of the production profits. Thus the union has two chief functions: (1) "The union must operate as an instrument of power; that is, it must function as an army in order to bring its opponents to terms,"[11] and (2) "The union functions as an instrument for changing certain economic and social conditions in the factory."[12]

Instrument of Power

"The inherent militancy of unionism arises, in the first place, from a very real clash of interest between management and labor in several spheres."[13] Labor seeks to maximize wages and other benefits and seeks relief from the disciplines of factory life and the machine. Secondly, the union is relatively weak on the political scene, and has not yet become fully institutionalized in our culture; therefore, a union can only function in relation to the power it can wield. When speaking of this instrument of power, one should not conclude that such instruments are commonly employed; but rather that they are employed only if needed. The amount of militancy and power employed by a union depends on many factors: the ideology of union leaders and members, present and past management abuses, worker backgrounds, size of union membership, public opinion towards the union, economic conditions at the time, present government attitudes towards the union, and the amount of cohesion within the union are all factors which the union must evaluate to determine when and what power should be exercised. The union seldom, if ever, wishes to destroy management; its chief desire is to create and maintain a state of cooperation between management and labor.[14]

The union exercises power in many different ways unique to the specific situation and need that arises. If management is hostile to the union, usually some type of force will be employed. If management considers the union to be extremely powerful and desires to avoid a major conflict, the union might succeed in achieving its goals with some form of persuasive power. The following are a few of the most common types of power used by unions:

[11]Schneider, *op. cit.*, p. 271.
[12]*Ibid.*
[13]*Ibid.*
[14]Joseph A. Bierne, *New Horizons for American Labor* (Washington, D.C.: Public Affairs Press, 1962), pp. 60-74.

1. *Organizing Drive* — The drive to organize labor or the threat of such a drive often brings management to terms as well as increases the size of the union membership. The success of such drives are directly related to the degree of worker dissatisfaction. As a result of the Taft-Hartley Act and the Wagner Act, management must recongize the union as the bargaining agent when a majority of the workers have become members of the union and the union has been certified by the National Labor Relations Board.

2. *Primary Boycott* — This involves a concerted refusal by the employees of a given firm to purchase the products they manufacture. This tactic can be effective only when the employees of a given industry consume a sizable portion of the goods they manufacture.

3. *Sabotage* — Sabotage would be deliberately doing something wrong to slow down production or increase the cost of production. This is a relatively ineffective method of bringing management to terms.

4. *Strike* — This is by far the most important union tactic. No other tactic can inflict as much damage on management so quickly as a strike. It cuts out the creation of profit and allows industrial competitors to take over the market while the strike is being settled. There are four types of strikes common in the United States. The most common is the "economic strike" — the strike for higher wages, shorter hours, and other economic benefits. A second type, "Strike for recognition," is an effort to get management to recognize the union as the bargaining agent for labor. A third type, "demonstration strike," is a temporary work stoppage to impress management that the union has control of the workers and can inflict a full scale strike if management does not come to terms. The fourth type, "wildcat strike," is a threat to both management and the union. In this type, the workers go on strike without the sanction of the union, depicting their dissatisfaction with both union leadership and management.

5. *Picketing* — Token picketing is commonly used in conjunction with a strike in an effort to advertise the strike and persuade workers not to enter the plant, and customers not to purchase the products of the struck plant. Both union and management try to influence the public to support their side of the dispute. Management is usually more successful in gaining the support of the public.[15]

Some of the formerly used union tactics have since been outlawed by the Taft-Hartley Act of 1947. Such outlawed tactics include the secondary boycott, the sympathetic strike, jurisdictional strike, and the closed shop. Many states have outlawed mass picketing as well.[16]

[15]Schneider, *op. cit.*, pp. 271-287.

[16]Gordon F. Bloom and Herbert R. Northrup, *Economics of Labor Relations* (Homewood, Illinois: Richard D. Irwin, Inc., 1961), pp. 760-775.

It is evident, therefore, that the first major function of the union is to bring management to terms, either by force or by the threat of force.

Collective Bargaining

The second major function of the union is to bargain collectively with management in an effort to get an agreement between management and labor. Collective bargaining is not a tactic to be used if the above tactics are unsuccessful. Collective bargaining generally follows one or more of the above tactics. However, if management considers the union to be powerful, the union may be able to bargain collectively with management without applying any of the forces discussed above. Collective bargaining involves negotiating, administering, and enforcing a treaty between the union and a second organization, usually industrial management.

> Collective bargaining is not just a means of raising wages and improving conditions of employment. Nor is it merely democratic government in industry. It is above all a technique whereby an inferior social class or group carries on a never slackening pressure for a bigger share in the social sovereignty as well as for more welfare, security, and liberty for its individual members. As such, it is not confined to a single arena, the industrial one, where employers and labor unions meet directly, but manifests itself equally in politics, legislation, court litigation, government administration, religion, education and propaganda. . . . Collective bargaining as a technique of the rise of a new class is quite different from the class struggle of the Marxians. . . . It derives its emotional impetus not from the desire to displace or "abolish" the "old ruling class" but from the wish to bring one's own class abreast of the superior class; to gain equal rights as a class and equal consideration for the members of the class with the members of that other class; to acquire an exclusive jurisdiction in that sphere where the most immediate interests, both material and spiritual, are determined, and a shared jurisdiction with the older class or classes in all other spheres.[17]

The content of collective bargaining agreements vary from industry to industry and from plant to plant, but three major goals of the union are always included. These goals are union security, practical or economic goals for the workingmen, and an acceptable procedure for handling grievances.[18]

In relation to union security, the union would prefer "the closed shop" situation where everyone would have to be a union

[17]Selig Pearlman, "The Principles of Collective Bargaining," *The Annals of the American Academy of Political and Social Science*, LXXIV (1936), pp. 154-160.

[18]Schneider, *op. cit.*, pp. 303-304.

member before being employed. The Taft-Hartley Act outlawed the "closed shop," so the most common union security arrangement today is the "union shop" where all new employees must join the union within a stipulated time. In order to have a "union shop," a majority of the plant workers must have voted for it in a secret ballot. The deduction of union dues from paychecks must also be authorized by the workers.[19]

From the standpoint of the workers, the most important function of the union is the attainment of practical or economic ends. The union is expected to achieve for the worker (1) better wages, (2) more favorable hours, (3) job tenure, and (4) congenial work rules and conditions of work. A union must fulfill this function if it is to maintain its membership.[20]

The grievance procedure must be an efficient and validly functioning procedure for settling management-labor disputes according to the contract. For the worker, it represents an assurance of fair treatment and a communication channel to higher authority. For union and management, the grievance procedure is a means by which the collective bargaining agreement can be made to work and a means of locating the sources of dissatisfaction can be established.[21]

Collective bargaining is usually carried on by a committee composed of labor representatives and management representatives. Neither labor nor management wishes to use force to achieve an acceptable contract. Collective bargaining is a peaceful relationship, although it is based on the underlying power of both management and labor to apply force, particularly economic force, on each other. The committees which negotiate a new agreement are carefully chosen or hired teams. It is believed that careful selection of a capable team is the most effective means of bringing the other group to terms. The typical union bargaining committee of today would include representatives of local union officials, hired economists, and lawyers. Much work precedes the actual day the committees meet at the bargaining table. It is necessary to make a study of the corporation's economic situation, other recent contracts, inflation trends, employment trends, consumer market, competitors' prices, etc. Each committee goes to the bargaining table with a thoroughly planned strategy to out-maneuver its opponents.[22]

[19]Bloom and Northrup, *op. cit.*, p. 768.
[20]Schneider, *op cit.*, pp. 305-309.
[21]*Ibid.*, p. 311.
[22]*Ibid.*, pp. 320-329.

Union Success or Failure

"Labor's share of (production) income, industry by industry, has fared no more favorably in unionized industries than in non-union."[23] Trade-Unionism in the United States has had no important or lasting effect on increasing labor's share of the national income. It has, however, encouraged an employee-oriented national economic policy with emphasis on full employment and supported price control. And it has put wage pressure on employers and furthered progressive income taxes.[24]

Trade unions have been successful in exerting cost pressures on management by their strikes or threats of strike at strategic times. They have, to some degree, been able to reserve jobs for union members, to control the supply of qualified tradesmen by their seniority clauses in contracts, and to direct apprenticeship and training programs. Verbally, at least, they have encouraged the acceptance of minority groups or races and have supported public education. Some of the union gains have hindered a sizable number of the membership: the seniority systems and pension plans have hampered both worker mobility and promotion on the basis of qualification. In many cases, management has been able to offset these union gains by accelerating technical changes which simplify and mechanize the production processes, thereby increasing productivity and decreasing the skill level of the jobs. Thus an unskilled or semi-skilled worker can replace the union's skilled tradesman.[25]

One can only surmise what would have happened had labor unions not existed. With advancing technology and automation, production per man hour of work has increased tremendously. As a result, labor's share of the production might have significantly decreased were it not for the pressures employed by the unions. Furthermore, a large segment of our culture, especially industrial management, takes a dim view of unionism; therefore, management prefers to give non-union labor an equal or better agreement than union labor in an effort to decrease the organizing power of the union and create in union members dissatisfaction towards their union. In other words, the union may have been as effective in

[23]Clark Kerr, "Trade-Unionism and Distributive Shares," *Labor and the National Economy,* ed. William G. Bowan, (New York: W. W. Norton and Company, 1965), p. 74.

[24]*Ibid.*

[25]George H. Hildebrand, "The Present Position of American Unionism," *Man, Work and Society,* ed. Sigmund Nosow and William Form (New York: Basic Books, Inc., 1962), pp. 22-23.

aiding non-union labor as it has been in aiding union labor. It is therefore practically impossible to determine the value of unionism to the industrial labor force.[26]

Organizational Structure

Managing a union is somewhat like that of running a political or religious organization. A union is a non-profit organization having a few elected and paid officials at each of the different levels, but it relies heavily on the unpaid services of members. At the local level, the president is usually reimbursed only for his expenses; the secretary-treasurer holds a part-time position and receives pay in accordance with the time he spends keeping the records. Shop stewards generally receive no salary from the union. Much of the union work (including recruitment) is accomplished by the free services of dedicated members. Just as a political or religious organization varies its emphases in different localities, so does the union. In order to maintain its membership and recruit new members, the union must adapt the specific needs of the local membership; therefore, no set organizational pattern is common to all unions. There are local unions which are not affiliated with any other unions. Some local unions are affiliated with only city or district federations. Other locals may be affiliated with a national union or the AFL-CIO federation, or both. There are locals which have a very small membership (some painters' locals have less than 100 members), while other locals have a very large membership (The Ford Motor Company Rouge plant local of the United Auto Workers has a membership in excess of 50,000). In some locals, the total membership is employed in one plant, such as the Rouge plant local just mentioned. In other locals, the membership works in a city or area labor market, but few of the members work for the same employer. Even with all this complexity, there is a distinct pattern to union organization. For most of the labor unions, there are three primary elements of organization: the local, the national or international, and the federation.[27]

The Local

The local is, to the membership, the most important level of trade unionism. This is where the union member votes, pays dues, has his grievances heard, and associates with his fellow members. Contacts are normally between the local and the employer. If a

[26]Kerr, *op cit.,* pp. 74-77.

[27]Orme W. Phelps, *Introduction to Labor Economics* (New York: McGraw-Hill Book Company, Inc., 1961), pp. 206-208.

member is to move up in the union, the action is initiated at the local level. He is also disciplined, if necessary, at the local level. Local organization varies from union to union depending on geographical distribution and the constitution of the national organization. However, practically all locals have a president, a secretary-treasurer, and sometimes additional officers, depending on the size of the local. The election of officers has, in the past, been handled poorly in many cases; but the Labor Reform Act of 1959 has eliminated many of the unfair election practices. Elections must be held at least every three years and announced at least fifteen days prior to election. Nominations must be permitted from the membership, each member has one vote, and election data must be saved for one year and must be available for inspection if election procedures or results are questionable. The Labor Reform Act has accomplished a great deal in making the union leaders responsible, democratic, and representative of its members.[28]

All union members are not loyal supporters of all union activities; many have joined for the sole purpose of keeping their jobs. A union member may protest union activities even to the point of suing the union if he has legitimate reason to do so.

> Unions have as many disaffected members as any other type of organization. It would be naive to think that some of them will not take advantage of the act's (Labor Reform Act's) invitation to correct what they consider bad management, disregard for their personal rights or privileges, or undue attempts to persuade them to conform to union policy.[29]

Although Labor leaders must be elected at least every three years, they are generally elected every year. This keeps the leaders responsible to their constituents. Few organizations submit as many policy decisions to the membership for ratification as do the trade unions. Decisions on trade agreements, membership policies, dues changes, assessments, grievance decisions, etc. are regularly put before the local meetings for a majority vote before being adopted. The job of the labor leaders is to turn a complicated, formal agreement into a mutally satisfactory working relationship between the membership and the corporation management. But in the contract interpretation the real test of collective bargaining takes place. It is relatively easy to call a strike; but it takes a clever, well-informed leader to get concessions from industrial management without such loss to the workers as would result from a strike. The contemporary union leader is an educated business-type individual rather than

[28] *Ibid.*, pp. 208-210.
[29] *Ibid.*, p. 211.

the autocratic, emotionally-moving-type leader of the past. Aside from his interpreting the contract and mediating in worker-management problems, the union leader must keep in mind recruitment, handle finances, conduct meetings, cooperate with other locals, prepare for conventions and elections, and have a regular program of political action. "It is no job for the unconvinced, the short of wind, or the slow of mind or action."[30]

The National or International Union

A national union may, but need not be, nationwide in scope and coverage. It is customarily called a national union when it consists of more than one local. No American internationals have locals outside of North America; the term international is used when there are locals in Canada and/or Puerto Rico as well as in the United States. Over eighty percent of all union members in the United States belong to union locals, which in turn belong to national or international unions; these in turn belong to the AFL-CIO federation. There is no hard and fast rule which determines the relationship between the local and the national union. The main factor in determining this relationship is the character of the market for the goods or services produced by the local. If the market for the goods produced is local, such as the building trades, the local union will have considerable autonomy. If the market is national in scope, as in the case of automobiles, the local union's area of decision is much more limited; the national union makes the important policy decisions, and the local union interprets the decisions in the local environment. The reasons for such arrangements are fairly simple. In the building trades, the local union can control the supply of builders. A local of the United Auto Workers has little control of the total production of automobiles. If such a local goes on strike, the manufacturers will simply import automobiles from other plants. A majority of trade unionists are employed in industries with more than local markets; therefore, in most cases, policy decisions are made at the national union level while the local unions concentrate on day-to-day details of recruitment, membership, finance, bargaining, and grievance procedures. And despite the fact that even these decisions are somewhat standardized, the local unions are not powerless. A national union is only as strong as its locals. It is financed by the locals and is operated by representatives from the locals. Furthermore, a local has the power to secede from the national union if it is so desired.[31]

[30]Florence Peterson, *American Labor Unions* (New York: Harper & Brothers, 1952), pp 78-82.

[31]Phelps. *op cit.*, pp. 217-220.

In most cases the union dues, which can be as high as ten dollars a month per member, are collected and dispersed by the local union which first keeps its allotment and then sends the other allotments to the national union and the AFL-CIO federation respectively. The Labor Reform Act of 1959 requires that financial records be kept at all union levels and must be reported annually to the Secretary of Labor. They must also be presented for audit upon request. These records of membership, dues, assets, and expenditures may no longer be withheld from the public. A union official either refusing to comply with the regulations of the Act or one found guilty of misrepresenting the facts on these records can be fined up to $10,000 or be imprisoned for one year, or both.[32]

National union officers have the same responsibilities as do the local officers; the only difference between the two groups is that the national union is the higher level and has a larger geographical area of operation. They both work with wage demands, union security, extension of the union to non-organized industries or plants, the hiring of a capable staff — a critical requisite for collective bargaining, publicity within and outside the union, and obviously with pleasing their constituents so that they can be re-elected.[33]

Federation

The federation is the highest level of the union organization. The federation resulted from a merger of the American Federation of Labor and the Congress of Industrial Organization in 1955. These were and still are the two largest national or international unions in the United States. Since, at the time of the merger, the AFL had almost twice as many locals as the CIO; the organization was, and has continued to be, heavily weighted in favor of the AFL. The executive council is composed of the president, secretary-treasurer, and twenty-seven vice presidents. All are former AFL officials except ten of the vice presidents who represent the CIO. Of the six main departments, five were divisions of the AFL for many years; only the Industrial Union Department has been added. Each department has a president and a secretary-treasurer, holds its own convention, and maintains one or more publications.[34]

The Industrial Union Department, which represents the CIO, has more officers, more affiliated unions, more members, more income, and more influence than any other department. It has the same president and secretary-treasurer as the CIO. It has twelve

[32] *Ibid.*, pp. 221-228.
[33] *Ibid.*, pp. 229-234.
[34] *Ibid.*, pp. 234-237.

department vice presidents, a membership in excess of eight million, and more than seventy affiliated unions.[35]

The AFL-CIO has very little constitutional power; a member union can withdraw its membership at will for any reason. It is basically a service organization. The AFL-CIO can expel or place member unions on probation if it disapproves of their practices. It can and does set policies which tend to be followed by member unions, although it has no way of enforcing these policies. Its legislative activities have been among its foremost responsibilities; its officers can and do represent labor as a whole. The AFL-CIO gives a great deal of attention to inter-union relations, the organizing of the unorganized, publicity, and research. It hires lobbyists to follow the work of Congress and it puts pressure on legislators for bills favoring labor. Its officials testify before Congress, meet with the President of the United States, governors, and other political leaders. They even frequently assist in the drafting of labor-related bills on the state and national level.[36]

The AFL-CIO has a gross, nontaxable income of nine to ten million dollars a year. With such a sizeable income, it is capable of supporting the many activities which small locals cannot support alone. Recent emphasis has been placed on research and publicity. This emphasis has taken the form of employment of complete staffs of technical specialists: economists, statisticians, public relations experts, educators and lawyers who work with member unions. Besides providing employment, it also aids in the development and operation of training programs for workers.

The Industrial Worker

> Machines alone do not give us mass production. Mass production is achieved by both machines and man. And while we have gone a long way toward perfecting our mechanical operation, we have not successfully written into our equation whatever complex factors represent Man, the human element.[37]

The industrial worker's job and his work environment seldom remain constant throughout the worker's lifetime — as it did but a few decades ago. Nor does a worker today usually complete a product from start to finish. He only completes some small minute detail — the process of which, as a result of mechanization, is ever

[35] *Ibid.*

[36] *Ibid.*, pp. 237-243.

[37] Charles Walker and Robert Guest, *The Man on the Assembly Line* (Cambridge, Massachusetts: Harvard University Press, 1952), p. 1, quoting Henry Ford II.

subject to change and automation. Each year an enormous number of new inventions and new products are put on the market. The invention and manufacture of these new products mean that the worker's function is ever changing. Each year a larger percentage of workers perform semi-skilled tasks, such as machine tenders, where but a few decades ago these tasks would have required the skill of a machinist. The worker's task is so minute that many times the worker himself is ignorant of how the work he does fits into the manufacturing of the end product; an end product which may in fact be completed at a distant plant.

The worker not only needs to adapt to in-plant changes; many times his function becomes extinct and he needs to find a new function to perform. Concerning the changing labor force, Phelps reported that from 1930 to 1960 clerks and sales people positions increased 31%, semi-skilled positions increased 12%, service work positions increased 71% while unskilled positions decreased 62% and skilled positions decreased as a percent of the total labor force.[38] These statistics point out that there is little need in our modern society for unskilled labor. If a worker's function is no longer existent, he needs to find another function and/or develop new skills which are salable if he is to regain employment. Many times, he will have to accept a semi-skilled job rather than a skilled one.

The manufacturing of many of life's needs has become so mechanized and automated that, even with the present population growth, a small segment of workers are capable of supplying the necessities of life. Therefore a large segment of our society is left to produce goods which are not necessities. The demand for such unnecessary products is obviously subject to greater fluctuations than is the demand for life's necessities. Therefore as the demand for one product decreases, workers must find employment elsewhere — in the manufacturing of more desirable products or services. This country has people, technical skill, and natural resources in quantities and combinations to yield the highest standard of living in the world today. It is evident that in such a situation the function of the worker is ever-changing.[39]

It is apparent from the need for the worker to be ever changing jobs that he must remain mobile. Dubin reported that one in five citizens change their residences each year.[40] Mobility involves

[38]Phelps, *op. cit.*, p. 37.

[39]*Ibid.*, pp. 40-42.

[40]Robert Dubin, *Human Relations in Administration* (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., ©, 1961), p. 64.

moving into new environments and different work groups either within a plant or in other plants. Living a life of such mobility means that the worker must function in groups having different values, sentiments, and attitudes than were held by the previous group from which he came. Communications then become difficult. Misunderstandings can easily arise. Many times the worker finds it difficult to accept the group's values, thereby hindering his acceptance into the group. Other factors such as the class from which he came, his nationality and racial origin, etc. also affect the degree to which he will be accepted. He is in a relatively insecure position and will not, therefore, ordinarily out-produce his peers. In many cases the group might, and quite likely will, reject him.[41]

Management attributes the worker's limited production to laziness or dislike for work, but Allison Davis pointed out, in reference to the underprivileged worker, that his attitudes and value system are products of the environment to which he is accustomed.

> The habits of shiftlessness, irresponsibility, lack of ambition, absenteeism, and of quitting the job, which management usually regards as a result of the innate personality of the underprivileged white and the Nergo workers, are in fact normal responses that the worker has learned from his physical and social environment. These habits constitute a system of behavior and attitudes which are realistic and rational in that environment in which he has been trained.[42]

The Plight of the Employee

1. *The Job Dilemma.* The first word of industrial concept learned by a production worker is "efficiency of production." Since the rise of industrial enterprises, management has been concerned with the maximum production in the minimum time and for the lowest cost. Everything centers around the clock and the "profit pie." A well-known time and motion study figure, Frederick W. Taylor, advocated splitting a job into its component operations and perfecting the most efficient procedure for accomplishing each operation. This idea was known as "scientific management." In 1899 at a Bethlehem Steel Plant, Taylor achieved fame when he taught a man to shovel forty-seven tons of pig iron per day when previously he had shoveled only twelve and a half tons per day. Every detail of the man's job was specified: the size of the shovel, the bite into the pile, the weight of the scoop, the length and num-

[41]Burleigh B. Garner and David G. Moore, *Human Relations in Industry* (3rd ed.; Homewood, Illinois: Richard D. Irwin, Inc., 1955), p. 42.

[42]Allison Davis, "The Motivation of the Underprivileged Worker," *Industry and Society*, ed. William F. Whyte, (New York: McGraw-Hill Book Company, Inc., 1946), p. 86.

ber of rest periods, the distance to walk, and the arc of the swing. By systematically varying each factor, Taylor arrived at the optimum combination. This concept was extended further by Frank Gilbreth who studied the different human movements required to do a job and arranged them in their most efficient order.[43]

Many industries plan the jobs of their workers according to production efficiency and show little concern for the workers, beyond their immediate safety. Fortunately for the worker, Elton Mayo, in the famous Hawthorne studies at a Western Electric plant in Chicago during the 1930's, found that the welfare of the workers, their relationships with other workers, and their attitudes towards their superiors and the company grossly affected their production rate. Mayo's conclusions were that the factory is a social system in which each worker lives; the executive must ensure the acceptance of company policies by the subordinates; and when changes upset the equilibrium of the organization, the executive must make adjustment in order to redress the balance. Since then others, such as W. Whyte, L. Warner, and B. Garner, substantiated Mayo's findings that recognition, pride, status, and belongingness affect one's work.[44]

Today, at least some industrial leaders accept the philosophy that the way to higher productivity no longer lies only in improved machinery and techniques, but also in improved labor response. Western Electric, the manufacturing division of American Telephone and Telegraph, has spend more than a million dollars over a ten-year period to study workers' behavior on the job. The Ford Motor Company allocated a half million dollars for just one research project on "human relations." Sears Roebuck, the Container Corporation of America, and many others, especially large corporations, have followed suit. This is not to say that industrial management no longer considers mechanical and production efficiency; it only infers that it has come to realize that people are not machines, and if they are to work efficiently, they must be dealt with as fellow humans.[45]

2. *Formal Role and Status.* There was, prior to the modern assembly line type production, a varying degree of skill needed to perform different production jobs. Relative pay was based on the skill required to perform a job. A worker's in-plant status and, to a

[43]Danial Bell, *Work and Its Discontent* (Boston: Beacon Press, 1956), pp. 1-9.

[44]Danial Bell, "Adjusting Men to Machines," *Commentary*, III (January, 1947), 79-88.

[45]*Ibid.*

degree at least, his community status resulted from his skill and the related size of his paycheck. In the modern assembly line this varying degree of skill has been tremendously decreased.

> The destruction of the skill hierarchy . . . is a characteristic of the changing conditions in American industry. . . . As jobs become increasingly specialized and divided into smaller, composite units, they become more and more alike because the simplified operations and knowledge required in them are reduced to a series of repetitive actions which have a larger number of common elements. Several important consequences derive from this process of specialization; the learning task in acquiring the "skill" is easy, the period necessary to acquire proficiency short, and, once a job has been simplified and routinized, its processes can be incorporated into the actions of a machine and the machine substituted for the worker. . . . The skill once "owned" by the worker and sold as a service is now possessed by the manager in the form of the machine.[46]

The simplification of jobs and the replacement of workers with machines is the typical evolution of a modern production plant. Consequently, new plants incorporate modern machines when the plant is built. When touring a modern automobile assembly plant recently, it was learned that most jobs on the Line could be learned in a few hours and that even the more difficult line jobs could be learned in two weeks. With so little skill required, there is little wage differential between workers, and an individual worker can be easily replaced. Very little status can be realized from such jobs; and since the worker does not have a skill to sell, as an individual he has little or no bargaining power with management.

Since all jobs on the line are of similar difficulty, there is little opportunity for vertical mobility — moving up through the ranks. The only significant promotion would be from production worker to foreman, and because of the limited need for foremen this opportunity can be made available to only a few workers. In the past, a worker could move from laborer to semi-skilled jobs, to skilled jobs, and there were further break-downs within each of these classifications. A worker had something for which to strive. Today, the majority of the workers are simply classed as semi-skilled workers.

A study of such a production line revealed that a new automobile assembly plant employing 1,068 production workers was successfully opened with less than seven percent of the workers having had previous experience on line production work. The workers were recruited from a thirty-five mile radius and their past experiences ranged from those with no previous experience to a few

[46]W. Lloyd Warner and J. O. Low, *The Social System of the Modern Factory* (New Haven, Conn.: Yale University Press, 1951), pp. 189-190.

who had some trade skills. Despite this conglomeration of inexperienced workers, after only a few months these workers were able to assemble more than 350 automobiles during an eight-hour day. The typical job cycle for one worker took less than two minutes and involved completing an average of two tasks. The wage differential from the lowest line job to the highest line job was only $3.60 per week.[47]

There would be very little opportunity for vertical mobility in such a plant. There was, however, considerable horizontal mobility: workers, when given an opportunity, would move either to less repetitive jobs or to jobs off the main line where they would be free from the mechanically paced work. Production workers, unlike professional workers, do not generally select their jobs because of strong interest in the work they do. Production workers usually take a job either because its pay is higher than that of their previous work or because of a desire to escape some undesirable characteristic of the previous job. Only ten per cent of the semi-skilled workers expressed, as a reason for applying for a job at the above-mentioned assembly plant, an actual interest in automobile work.[48]

The main route to vertical mobility today is, therefore, through education:

> The American school system has been organized largely to teach people the necessary skills to get ahead. The worker's mobility may be blocked at the present time, but his children's chances to rise (he believes) are still good. Once again the American precept of working hard, applying oneself, and learning what one needs to know to get ahead are the guiding codes for the worker and his child. The child can climb upward on the several rungs of the primary, secondary, and college levels of education and reach positions of power and prestige in the ranks of industry, business and other social hierarchies.[49]

The role of the worker is largely determined by management. If management assumes that the worker is a human machine needing continuous prodding, he quite likely will have an unpleasant work experience. If management assumes him to be a fellow human being, work will presumably be more enjoyable. Many of management's decisions are still based on traditional assumptions about workers which are:

1. People dislike work and will avoid it if possible.

Management can produce examples of feather-bedding, restricted output, or slow-downs, and a tendency to avoid work. Man-

[47]Walker and Guest, *op. cit.*, pp. 22-91.

[48]*Ibid.*

[49]Warner and Low, *op. cit.*, p. 183.

agement unfortunately overlooks the reason that employees take part in such activities and simply concludes that people work only when forced.

2. *Because people dislike work, they must be forced, directed, and threatened if organizational objectives are to be achieved.*

Management feels so strongly about this assumption that they are even reluctant to accept the theory of incentive pay. The current trend towards "human relations" and democracy in industry are rejected by management in many cases. Some management personnel did accept such trends but rejected them when all personnel problems did not, after their adoption, immediately disappear. They strongly believe that people only work when externally coerced and controlled.

3. *Workers prefer to be directed, wish to avoid responsibility, have little ambition, and want security for all.*

This assumption may never be stated so bluntly by an industrial manager, but management decisions reveal that it is frequently practiced in the handling of workers.[50]

When describing the type of employee he searches for, Charles Kettering included the following statement:

> I often tell my people that I do not want any fellow who has a job working for me; what I want is a fellow whom a job has. I want the job to get the fellow and not the fellow to get the job. And I want that job to get hold of this young man so hard that no matter where he is the job has got him for keeps. I want that job to have him in its clutches when he goes to bed at night, and in the morning I want that same job to be sitting at the foot of his bed telling him it's time to get up and go to work. And when a job gets a fellow that way, he's sure to amount to something.[51]

It is obvious that Kettering would not accept assumptions like the three just discussed. Kettering was talking about a thinking man who is continually searching for new ways to improve himself and his job. By contrast, the assumptions of traditional management consider the worker to be a human robot which must be manipulated and should unquestionably accept the organizational objectives, job relocations, cut back in pay, and personal criticism without rebuttal. There has, however, been a marked improvement in recent years in management's treatment of employees:

[50]Douglas McGregor, *The Human Side of Enterprise* (New York: McGraw-Hill Book Company, Inc., 1960), pp. 33-40

[51]Charles Kettering, "Double Profit System," *Coronet*, XXVII (December, 1949), p. 125.

Management has adopted generally a far more humanitarian set of values; it has successfully striven to give more equitable and more generous treatment to its employees. It has significantly reduced economic hardships, eliminated the more extreme forms of industrial warfare, provided a generally safe and pleasant working environment, but it has done all these things without changing its fundamental theory of management.[52]

During the past half century, social science has accumulated considerable knowledge about human behavior, thus making possible the formulation of a number of generalizations and providing a modest beginning for a new theory with respect to the management of human resources. A few of these generalizations are the following:

1. *The expenditure of physical and mental effort is as natural in work as in play or rest.*

The normal human being does not inherently dislike work. When properly assigned and controlled, work may be a source of satisfaction. But if work is considered punishment, it will be avoided if possible.

2. *If workers have high regard for their organizational objectives, coercion and threat of punishment are not necessary to achieve these objectives.*

3. *Workers support objectives from which they receive rewards or recognition.*

4. *Most human beings seek responsibility.*

Avoidance of responsibility is generally a consequence of experience, not an inherent human characteristic.

5. *Workers can solve problems too.*

All mental capacity has not been endowed to management. Workers are involved in production; and if permitted, they may devise ways to improve either the products or the means of simplifying production processes.

6. *The mental capacity of industrial workers is not fully utilized.*

If given little or no opportunity to make recommendations, the workers' ideas are wasted or lost.[53]

These assumptions have quite different implications than the traditional ones. These more recent views are based on the worth of the individual and on a belief that people will follow if given good

[52]McGregor, *op. cit.*, pp. 45-46.
[53]*Ibid.*, pp. 45-49.

leadership and fair considerations. These assumptions place the blame for poor worker relations and poor worker attitudes squarely on management. Of course, a more ingenious management than presently exists is required to coordinate production based on these assumptions. Unfortunately, a theory of management which includes these last assumptions is not yet widely accepted in industrial management.

While machines and mechanical devices have removed much of the physical strain from the production job, these same machines and devices have increased the repetitiveness and monotony of the job and have, at the same time, decreased the skill required of a worker to perform his job. There is little opportunity for worker ingenuity and, since each job involves a minute part of the product, pride in workmanship has been negatively affected. Line workers are expected to remain at their work stations except when relieved; therefore, their opportunities to associate and talk to other workers during work hours is quite restricted.

Informal Role

Work at his job or jobs fills a large portion of a worker's life time; no other activity occupies as great a portion of the adult male's waking hours. One's job is not only time consuming; it is also a purposeful activity expected of most adult males in our society. The productive system, of which the worker's job is a part, orients and controls him. The system not only sets the goals for the worker, but it also determines how such goals may be attained and what rewards are available for their achievement. But, even beyond his work life, the productive system affects the whole range of the worker's relationship to the society of which he is a member. In short, the job exerts an influence which pervades the whole of the human life-span.[54]

William Whyte discussed the cultural expectation of the individual in the following:

> All over the world most people must work for a living. But in some societies work is regarded as simply a means to an end. If one has enough money to live in the style of his own social group without working, then he doesn't work. He has others do the work for him.
>
> Not so in the United States. The millionaire playboy may be a familiar phenomenon in the newspaper, but he is also the butt of strong public censure. We wonder how he can justify his existence if he doesn't work. In fact, most millionaires keep right on working, piling up more money or giving it away — or both. Even when we criticize some

[54]Eugene A. Friedman and Robert J. Havighurst, *The Meaning of Work and Retirement* (Chicago: University of Chicago Press, 1954), pp. 2-3.

of the causes to which the millionaire gives his money, we recognize that he is working hard at giving it away and we respect him for that.[55]

In the United States any man may shine his own shoes, wash his own car, and care for his own lawn without fear of losing social status. In this country, doing physical work on one's own house and possessions is not considered beneath the dignity of man. It may even enhance his reputation. While in many countries, such activities would be degrading and would cause one to lose social status, in the United States man is expected to be industrious as a means of justifying his existence. Any able-bodied man who doesn't perform some type of work or service is considered a parasite and of little value to society. The workers carry this cultural attitude with them into the work place.[56]

His job serves to maintain the worker in his social group, to regulate his life-activities, to fix his position or status in society, and to determine the pattern and nature of his life-experiences. His job also provides the worker with a source of satisfaction and/or frustration.

If one conceives of a job in its relation to what it can do for the individual, one realizes that a job performs certain functions in the life of the individual. The level to which these functions are performed determines, in a large part, the individual's life. The first such function one might recognize is income. This economic return for work provides the worker with subsistence at the same time that it establishes the standard of living which the worker can afford. One's job, hours of work, and income determine where, when, and how he will spend a major part of his life. A job labels a person: the place of employment and the worker's role become common knowledge to his fellow workers, neighbors, and friends. This label has a great deal of influence in determining with whom the worker associates both inside and outside the plant. This label, identity, or role determines the worker's job status. Often when a stranger is introduced, his place of employment and type of work seem almost as important as his name. Generally a worker's job status determines his social status. A sizable change in the relative income of a worker would result in a sizable change in how he and his job are evaluated by others; therefore, the amount of pay a worker receives in relation to other workers is very important to him.[57]

[55]Reprinted by permission from William F. Whyte, *Men at Work* (Homewood, Illinois: Richard D. Irwin, Inc., 1961), pp. 59-60.

[56]*Ibid.*, pp. 63-67.

[57]Friedman and Havighurst, *op. cit.*, pp 3-4.

A culture-wide aspiration is to make more money. Since the social classes in the United States are less stratified than in many other cultures, social position or status is determined by one's achievements rather than by his birth. Hence, one's financial wealth is a factor in establishing his social status. From this desire for more money which is so characteristic of Americans, management people concluded that wages based on productivity (piece work) would be an incentive for workers to increase productivity. Piece work rate of pay has always had shortcomings, but it has become completely unrealistic in the mass production situation where one's work rate is determined by the speed of the line and everyone working along the line.[58]

Another function of work is that it offers the worker a set of meaningful life-experiences. The work place should be a source of contacts with persons, objects, and ideas, a place where the worker's life can be enriched through interaction with the world about him. It should be a place where he can hear others' ideas and hear their reactions to his ideas so that he might better understand the world in which he lives. Such interaction is difficult in an assembly line or mass production system where each individual has a work station apart from other workers. Another part of this same function is work satisfaction — the feeling of accomplishment, of having contributed something, of being of some worth to society, and of having an opportunity to test one's ideas. These are important life-experiences, if life is to be meaningful.[59]

A worker's formal role is almost entirely determined by management decisions. To a lesser extent a worker's informal role is also subject to management decisions. If management recognizes the need for workers to associate with each other, it can provide opportunities for such activities. There are numerous means available. On the automobile assembly line discussed earlier, Walker and Guest relate how informal relations improved in that one department which rotated workers from job to job. Each worker learned to know the other workers and to better understand their jobs. As a result, the workers had higher regard for each other, job satisfaction increased, and production rate was maintained or improved.[60] Friedman and Havighurst found the work environment improved when workers were organized into teams or groups. "A

[58]Whyte, *op. cit.*, pp. 69-71.
[59]Friedman and Havighurst, *op. cit.*, pp. 5-6.
[60]Walker and Guest, *op. cit.*, pp. 148-149.

strong feeling of interdependence and of responsibility for each other's welfare was evident in many interviews."[61]

Walker discussed the value of grouping workers in the following manner:

> An apparent effect . . . of crew or team loyalty in the Hot mills, has been to diminish the force of certain well-known divisive factors which in many cases split mill society into hostile and noncooperative groups. Perhaps the most important of such factors are nationality differences, job differences (based on pay or prestige), and length of service (old versus new men). The absence of discrimination or of division resulting from these differences was pointed out and emphasized by the workers and supervisors interviewed. On ethnic (or Nationality) discrimination considerable antipathy was expressed toward "foreigners" (even by workers of foreign birth) when speaking of other plants and other critics. But when speaking of ethnic differences within their own plant, workers minimized them.[62]

Other ways management might improve the informal roles of the workers are very careful selection of foremen, good communication channels throughout the chain of command, careful assignment of workers, long-term planning to avoid lay-off, the provision of auxiliary facilities (such as adequate rest rooms, cafeterias, medical aid facilities), and provision for the workers to suggest production changes.[63]

When management fails to provide a satisfactory relationship with the workers, they turn to the union. Since the union is the workers' own organization, it is more sympathetic to their demands or needs. The union provides protection from and a communication channel to management. To improve relationship between the workers, the union also provides social activities on the job and at the union hall. When worker and management relations are inadequate, the union gives the workers a feeling of unity as a group. Yet even as management is not always successful in providing for the welfare of workers, neither is the union always successful. In a study of three Swift meat packing plants, each having a different union affiliation, there was considerable variation in how well the different unions met the needs of the employees. The union in one plant was a member of the AFL; the union in the second plant was

[61]Friedman and Havighurst, *op. cit.*, p. 65.

[62]Charles R. Walker, *Steeltown* (New York: Harper & Brothers, 1950), p. 70.

[63]Theodore V. Purcell, *Blue Collar Worker* (Cambridge, Mass.: Harvard University Press), 1960. pp 99-114.

affiliated with the CIO; and the union in the third plant was an independent. The union affiliated with the CIO was the most receptive to Negroes; the one affiliated with the AFL was the least integrated. And while both these unions had at least three strikes between 1946 and 1959, the independent union had none. In the plant having the independent union, most grievanes were settled by the shop steward and the foreman. There was some indication that the independent union was meeting the needs of its membership with less inter-union dissatisfaction and less union-management difficulties. It had less officers, more simple organization, and less dues than the other two unions. The independent union's greatest problem was the continuous effort of the CIO union to raid its membership.[64]

Industrial management and unions don't normally create human relation problems. Management realizes that workers dislike production changes and that human relations problems arise during such changes, but production changes are inevitable if the company is to remain competitive. It is the responsibility of management to make these changes as painless to the workers as possible. There are other unavoidable problems in which management and the unions must use all their available ingenuity to devise solutions so that serious friction can be avoided. Racial and ethnic group integration are typical examples of such problems, and there is no available method of solving them that is foolproof for every situation. A solution must be designed which is appropriate for a specific situation. How much effort the workers expend in the dissolution to the human relations problems will depend on how they view management and the union.[65]

Concept of Work

The production workers are . . . human beings instead of statistical abstractions that most management men and many sociologists and industrial relations people see in their mind's eye when they say "worker." Further, workers are human beings who do not ever "like" everything, nor do they completely "dislike" everything. They discriminate. They are never "satisfied" but seldom totally "dissatisfied." They judge.

What they like and dislike, what satisfies them and what alienates them, are exactly the conditions, actions, and experiences that please or displease other Americans, including executives. By and large the conditions in the plant about which . . . blue collar workers complain are exactly the things management people themselves know to be wrong;

[64] *Ibid.*, pp. 27-28.
[65] Garner and Moore, *op cit.*, pp. 400-403.

the conditions that please them, exactly the things an intelligent management strives for.

Blue collar man knows a great deal about the plant and its people, the industry, its products and problems, and the community and society in which he lives. But he values different aspects of the same reality.

That the company has to make money to stay in business, he knows; and he need not be told that making a profit is not automatic. But this is to him a restraint, a necessary, imposed limitation; it is not something desirable or good in itself. He knows that his job depends on the firm's remaining competitive. But he does not see its success as a benefit to him, although its failure is a threat. The blue collar man (and I suspect that to be true for most white collar workers, too) is not, in other words, economically illiterate. And all the "economic education programs" which' a few short years ago, were the vogue miss the mark. . . . Rather than try the dubious job of "educating" him politically or economically managers might well be advised to try to educate themselves: what are the values, what is the Gestalt of the employee's economy and society?[66]

The worker's attitudes towards the company and the people with whom he works have a distinct effect upon the quality and rate of his output. If the worker, by choice or by enlightenment, has come to accept the company goals; he will generally produce a respectable output.

Factors which develop attitudes towards the job are:

1. *Willingness to enter the job:* If the worker selects the job and considers it to be an improvement over his previous jobs, he considers it an opportunity and has a good attitude towards it. If the worker considers the job to be distasteful but was unable to find a better job, he will probably have a poor attitude towards it.

2. *Opportunity to use special abilities:* If the job presents opportunities for the worker to apply and extend the skills he has previously developed, he will look favorably towards it. If the job requires less skill than the worker has developed, he may consider it to be monotonous and a demotion.

3. *Ease of adjustment to the role:* If adjusting to the job was made relatively easy by fellow workers and supervisors, the worker can feel comfortable in his role; but if other workers do not socially accept him and supervisors have little consideration for him, he will probably dislike the job.

4. *Pay check:* The size of the pay check is definitely important; but the relative size is more important than its actual size. If the worker is being paid as much or more than those with whom he

[66]Purcell, *op. cit.*, pp. x-xi, quoting Peter Drucker.

compares himself, he tends to be somewhat satisfied; but if he is paid less than his associates, he is apt to be dissatisfied — no matter how large his paycheck may be. This is assuming that the pay is above the bare subsistence level.

5. *Opportunities:* Some workers' aspirations are satisfied if they have continuous employment and a respectable income. Others desire opportunities for advancement in position or income, or both. How well the job meets their aspirations will affect their attitudes towards it.[67]

A job means working with people. How a worker gets along with fellow workers affects his concept of work, perhaps even more than do the skills he employs and the money he receives. That men work just to make a living is, therefore, obviously untrue. If it were true, as soon as food and shelter were assured, work would stop. A worker therefore expects much more from his job than a pay check.[68]

Different authors discuss lists of needs or drives which are involved in work in various ways. Cleeton lists food, bodily well-being, activity, mating, sharing thoughts and feelings, dominance over both people and elements, self-determination, achievement, approbation, and ideation.[69]

Maslow has a slightly different list. The differences he points out are more in terminology than in theory. He arranged man's needs into a hierarchy of prepotency. Man will exert himself to meet his first level needs. When the first level needs are met he will exert himself to meet the second level needs, etc. Maslow's list of basic needs with examples are as follows:

1. Physiological Needs — Food, Drink, Rest.
2. Safety Needs — Shelter, Health, Protection.
3. Need for Belongingness and Love — Affection, Acceptance.
4. Need for Importance — Respect, Self-Esteem, and Independence.
5. Need for Information — Inquisitiveness and Curiosity.
6. Need for Understanding — Relationships and Reasons.
7. Need for Self Actualization — Success in Work and Life.[70]

[67]Morris Rosenberg, *Occupations and Values* (Glencoe, Illinois: Free Press, 1957), pp. 125-128.

[68]Anna Roe, *The Psychology of Occupations* (New York: John Wiley and Sons, Inc., 1956), p. 23.

[69]G. V. Cleeton, *Making Work Human* (Yellow Springs, Ohio: Antioch Press, 1949).

[70]Abraham H. Maslow, *Motivation and Personality* (New York: Harper & Brothers, 1954), pp. 126-129.

It should not be inferred that all people have each of these needs to the same degree. Each person is an individual, different in some way from all other people. Yet in spite of their differing heredities and environmental factors, all people have each of these basic needs to some degree.

It is apparent, therefore, that the worker's concept of his job is based on many factors and that his hours of work and the size of his pay check are only two of such factors. Walker and Guest, when interviewing mass production workers in an automobile assembly plant, learned that the six most disliked characteristics of work for these workers were:

1. Mechanical pacing of work.
2. Repetitiveness.
3. Low skill requirement.
4. Tools and techniques were predetermined (worker had no choice).
5. Minute subdivision of product worked on.
6. Surface mental attention (no problems to be solved).[71]

Their interviews indicate that almost half the men keep these jobs solely because of the pay, but the others do find other satisfactions, or at least some compensations. Nevertheless, those who continue in such jobs as these must somehow be able to tolerate the conditions surrounding them. A number of these conditions could be alleviated to some extent, but little effort is generally made on the part of management to do so.[72]

Bolanovich studied 7,200 female employees on a similar repetitive assembly line. He used a 271 item questionnaire, and seven months later analyzed the replies to see which items would identify workers who had quit during the seven months. He found that 114 of the 271 items were discriminating. When using the instrument to select employees the turnover was reduced from fifty-four percent to thirty-one percent. The questionnaire identified workers who preferred simple activities with little thought and responsibility, and who held no strong dislike for repetitive work.[73]

Interests, work goals, and aspirations not only vary greatly from individual to individual but they also affect one's attitude towards his job. These interests and aspirations are affected by experiences (especially childhood and adolescent experiences), parental influences (and other adult influences such as those exerted by teachers), and social status assigned to the different occupa-

[71]Roe, *op. cit.*, p. 205.
[72]*Ibid.*
[73]*Ibid.*

tions. Occupational interests change fairly rapidly throughout the teenage years and taper off in one's early twenties. After age twenty-five, there is little change in an individual's vocational interest. Generally by age twenty-five, the individual is well on his way in achieving his chosen vocation or he has by that time resigned himself to the reality that he will not achieve it and has accepted the position in which he finds himself.

For many persons, the beginning job or jobs may have little or no relation to interests, choices, or eventual work history. Many adolescents hold down a series of unrelated jobs, often concurrently with school attendance. These are usually related to the availability of the job rather than to the interests of the worker. For those for whom education or other circumstances will open up opportunities for more consequential employment, this period may be a temporary one. For those who do not know what they want to do, it may be a period of trial and error. In these cases it may continue for several years, or the person may be lucky enough to happen upon work that interests him and that can become more or less permanent. There are some who never seem to get beyond this floundering period. Jobs available under these circumstances are usually directly related to fluctuating economic conditions, and the number of such jobs open may change over night.[74]

Only in the lowest level jobs is an adolescent able or permitted to do what he will eventually be doing as a mature worker. An adolescent aspiring to a higher level job, such as a skilled craftsman, must start at a lower level and work up through the ranks. All those holding low level jobs cannot advance to upper levels because there are fewer positions available on each level as one moves upwards; therefore, advancement is a selection process and some workers must always be left behind.

The age of the worker affects his concept of a job. The young worker of today has more education than did his older counterpart; thus, the young worker generally has higher aspirations. His dreams of wealth and social status have not had time to fade. Therefore, the young worker is more aggressive and less satisfied with a line production job — unless there is opportunity in it for advancement. In the study of the automobile assembly plant previously referred to, the average age of the workers was twenty-seven. In this plant of young workers, worker turnover and absenteeism was high. Approximately eight percent willingly quit their jobs each year. This percentage is among the highest turnovers in all manufacturing industries. Nearly twice as many workers left jobs with extreme mass production characteristics as those who left jobs with moderate

[74] *Ibid.*, p. 274.

mass production characteristics. The absentee rate was similar; the higher the mass production characteristic of the job the greater was the absenteeism.[75]

As a contrast, a study of a steel mill was made. In this mill the workers were older, had organized into teams, were skilled, and lived close to the mill. The study revealed that only one worker of the sixty-four interviewed desired to leave the mill. There were workers who wished to be moved to other jobs within the mill, but they had no desire to leave the plant. When the workers learned that the plant had to be closed, sixty-four percent of the workers under fifty years of age said they would consider moving to another city so that they might stay with the company.[76]

In a study of five occupational groups which included steelworkers, coal miners, skilled craftsmen, sales people, and physicians, Friedman and Havighurst concluded the following:

1. The workers of lower skill and socio-economic status are more likely to see their work as having no other meaning than that of earning money.

2. The five occupational groups all value "association" about equally as a meaning of work.

3. Work as a routine which makes the time pass is recognized about equally by all five groups.

4. All groups discover self-respect and secure respect or recognition from others by means of their work. This motivation appears highest among skilled craftsmen.

5. Work is important as a source of interesting, purposeful activity and as a source of intrinsic enjoyment for all five groups. This meaning of work was significantly higher for skilled craftsmen and sales people.[77]

Conclusions

Production workers have needs just like all other normal human beings. Industrial management has the responsibility of helping workers satisfy those needs. Where management has failed to do so, unions have attempted to fill the gap. Where management has been successful in helping to meet the workers' needs (such as with the white collar workers), the unions have had difficulty making inroads.

[75]Walker and Guest, *op. cit.*, pp. 120-122.
[76]Walker, *op. cit.*, pp. 59-171.
[77]Friedman and Havighurst, *op. cit.*, pp. 173-174.

Management, union, and worker relationships have tremendously improved, especially since the New Deal legislation of the 1930's; but as mass production practices have increased, the role of the worker has become more mechanical and less human.

The following are a few ideas management might consider in increasing worker satisfaction:

1. Organize workers into small groups and rotate each worker through the jobs performed by the total group. This rotation will increase each worker's understanding of the total job in which he is involved, avoid extreme repetition, and increase loyalty.

2. To help avoid monotony, increase the number of tasks performed by each worker.

3. As a result of the two items just presented, each worker will develop more skills and will be capable of performing the more difficult jobs.

4. When making production changes, encourage worker-participation in setting up the jobs. As was pointed out earlier, workers have ability too.

5. Be sure that each worker understands his role in the end product. Only after he realizes the importance of his job can he receive satisfaction from it.

6. Whenever possible use the worker's mind as well as his body. Surface mental attention is most conducive to boredom.

7. Have management personnel visit the production workers on the line — not just for the purpose of supervision, but to meet the workers and gain a more casual relationship with them.

8. Provide training and promotional opportunities for capable employees. If they have ability and ambition, provide an opportunity for them to move somewhere. If they cannot progress within an organization, they will frequently move out of the organization.[78]

Selected Bibliography

Beirne, Joseph A. *New Horizons for American Labor*. Washington, D.C.: Public Affairs Press, 1962.

Bell, Danial. "Adjusting Men to Machines," *Commentary*, III (January, 1947), pp. 79-88.

Bell, Danial. *Work and Its Discontent*. Boston: Beacon Press, 1956.

Berger, Peter L. (ed.) *The Human Shape of Work*. New York: The Macmillan Company, 1964.

[78]Walker and Guest, *op. cit.*, pp. 155-159.

Bloom, Gordon F., and Herbert R. Northrup. *Economics of Labor Relations.* Homewood, Illinois: Richard D. Irwin, Inc., 4th ed., 1961.

Bowen, William G. (ed.). *Labor and the National Economy.* New York: W. W. Norton and Company, Inc., 1965.

Brown, J. A. C. *The Social Psychology of Industry.* Baltimore: Penquin Books, 1964.

Carroll, Philip. *Timestudy for Cost Control.* New York: McGraw-Hill Book Company, Inc., 3rd. ed., 1954.

Cleeton, Glen V. *Making Work Human.* Yellow Springs, Ohio: Antioch Press, 1949.

Davis, Allison. "The Motivation of the Underprivileged Worker," *Industry and Society.* Edited by William F. Whyte. New York: McGraw-Hill Book Company, Inc., 1946. Chapter 5.

Doody, Francis S. (ed.). *Readings in Labor Economics.* Cambridge, Massachusetts: Addison-Wesley Press, Inc., 1950.

Dubin, Robert. *Human Relations in Administration.* Englewood Cliffs, New Jersey: Prentice-Hall, Inc., ©, 1961.

Friedman, Eugene A., and Havighurst, Robert J. *The Meaning of Work and Retirement.* Chicago: University of Chicago Press, 1954.

Garner, Burleigh B., and Moore, David G. *Human Relations in Industry.* Homewood, Illinois: Richard D. Irwin, Inc., 3rd ed., 1955.

Gross, Edward. *Work and Society.* New York: Thomas Y. Crowell Company, 1958.

Hildebrand, George H. "The Present Position of American Unionism." *Man, Work, and Society.* Edited by Sigmund Nosow and William Form. New York: Basic Books, Inc., 1962.

Kerr, Clark. "Trade-Unionism and Distributive Shares," *Labor and the National Economy.* Edited by William G. Bowan. New York: W. W. Norton and Company, Inc., 1965.

Kettering, Charles F. "Double Profit System," *Coronet,* XXVII (December, 1949), p. 125.

Kornhauser, Arthur, Dublin, Robert and Ross, Arthur M. (ed.). *Industrial Conflict.* New York: McGraw-Hill Book Company, Inc., 1954.

McGregor, Douglas. *The Human Side of Enterprise.* New York: McGraw-Hill Book Company, Inc., 1960.

Maslow, Abraham H. *Motivation and Personality.* New York: Harper and Brothers, 1954.

Moore, Wilbert E. *Industrialization and Labor.* Ithaca, New York: Cornell University Press, 1951.

Moore, Wilbert E. *Industrial Relations and the Social Order.* New York: The Macmillan Company, 1951.

Nosow, Sigmund and Form, William. *Man, Work and Society.* New York: Basic Books, Inc., 1962.

Pearlman, Selig. "The Principles of Collective Bargaining," *The Annals of the American Academy of Political and Social Science.* LXXXIV (1936), pp. 154-160.

Pelling, Henry. *American Labor.* Chicago: University of Chicago Press, 1960.

Peterson, Florence. *American Labor Unions.* New York: Harper & Brothers, 1952.

Phelps, Orme W. *Introduction to Labor Economics.* New York: McGraw-Hill Book Company, Inc., 3rd ed., 1961.

Purcell, Theodore V. *Blue Collar Worker.* Cambridge, Massachusetts: Harvard University Press, 1960.

Raskin, A. H. "The Squeeze on Unions," *Labor and the National Economy.* Edited by William G. Bowan. New York: W. W. Norton and and Company, Inc., 1965.

Roe, Anna. *The Psychology of Occupations.* New York: John Wiley and Sons, Inc., 1956.

Rosenberg, Morris. *Occupations and Values.* Glencoe, Illinois: Free Press, 1957.

Schneider, Eugene V. *Industrial Sociology.* New York: McGraw-Hill Book Company, Inc., 1957.

Tilger, Adriano. "Work Through the Ages," *Man, Work, and Society.* Edited by Sigmund Nosow and William Form. New York: Basic Books, Inc., 1962.

Walker, Charles R. *Steeltown.* New York: Harper & Brothers, 1950.

Walker, Charles and Guest, Robert. *The Man on the Assembly Line.* Cambridge, Massachusetts: Harvard University Press, 1952.

Warner, W. Lloyd, and J. O. Low. *The Social System of the Modern Factory.* New Haven, Connecticut: University Press, 1951.

Whyte, William F. (ed.). *Industry and Society.* New York: McGraw-Hill Book Company, Inc., 1946.

Whyte, William F. *Men at Work.* Homewood, Illinois: Richard Irwin, Inc., 1961.

CHAPTER NINE

Automation and Cybernetics

Edmund Crosby
University of Maryland

Introduction

The history of industrialization starts at a point in time when man desired to improve his environment. Throughout the known history of mankind there has been, on his part, an effort to make his life easier through the development of tools of industry, in order to increase and improve his ability to produce material goods. As this need for greater production increased, it became evident to him that in order to accomplish this greater production some power other than his own muscles would be needed. During the early periods of the factory system, animal and water power were used to supply the necessary power to operate the machines which, in turn, were making his dreams of greater production a reality.

However, with the population of the world increasing, greater demands for the products of his efforts and imagination were felt. As these demands increased, man was able to improve his methods of production and keep abreast of the demands. Just as it appeared that he would be able to rest on past accomplishments, new situations arose, creating new demands upon his ability as a producer of goods. World crises, such as wars, required new methods of production and new sources of materials. Newer methods could not be developed without increased sources of greater power. Sources of energy, such as electricity and later atomic power, increased production. With each new development, however, new problems arose: for as power and machinery became more compatible, their production capacities — through greater speed — were increased. It became apparent, therefore, that man was reaching the limits of his emotional, mental, and physical capabilities. While man was becoming less efficient, the machines were beginning to do more of his work — working faster and with a great deal more accuracy.

While several wars, scourges of the plagues, and natural causes depleted world population, each generation following these crises seemed to want to improve its record. Both the constantly increasing world population and the affluence of those in the industrialized countries have continued to place a strain on the production machinery, thereby creating a need for better means of production.

Improved machinery — with functions capable both of doing more and more of the muscle work and performing more of the operations requiring the skills and coordination of one's hands — continued to be developed. As the demands for greater accuracy and improved quality increased, still newer methods of production had to be developed. As each generation of machinery was developed, less and less of man's energies, skills, and attention were needed. Today we are in a phase of industrial expansion in which there is a continuing quest for machinery to supplant man's skills, energies, and even his thinking ability. Automation is the magic word today, a word which causes different reactions in different people.

The purpose of this chapter is to discuss automation and associated methods as they relate to the production of goods in industry.

Automation

1. Definition of Automation. To some extent, the meanings of "automation" are as varied and as numerous as there are people affected by this comparatively recent development in industrial production. The unskilled worker looks upon this development as a threat to his job, if he is not already a victim. For the production manager, it looms as a method of increasing line production at a greater speed, with increased accuracy, and with fewer rejections. For the plant managers and owners, automation promises greater profits. For the research and development divisions in industry, it provides greater opportunities and challenges to develop newer and better methods of production. Groups outside the industrial community also have their interpretations of and concerns for automation and its effects in their realm of operation and influence. While economists are concerned not only with the possible effects of unemployment but also with potential overproduction, social scientists are concerned with the problem of worker displacement and the prospects of greater leisure time and its possible effects on society. Education, whose problems ultimately arise from industrial, economic, and social changes, must find ways of preparing its students to meet these ever-changing conditions and demands.

Webster's *New World Dictionary* defines automation in manufacturing as "a system or method in which many or all of the processes of production, movement and inspection of parts and materials are automatically performed or controlled by self-operating machinery, electronic devices, etc."[1]

In 1947 Delmar S. Harder, then vice-president of the Ford Motor Company, was credited as the first person to use the term "automation." Harder used the term in explaining the use of assembly line equipment involved in the operations of transfer machines which mechanically unloaded metal stampings from body presses and positioned them on machine tools which then automatically drilled and bored holes for other parts which were to be assembled in the unit.[2] According to Bittle and others, Harder claimed to have used the word as early as 1935, but did not use it again until 1947.[3]

From this point on, the term "automation" began to be accepted and used in the professional literature of manufacturing. For example, as early as 1948, the *American Machinist* described the activities of the Ford Motor Company Automation Department.[4]

In 1952, John Diebold wrote *Automation, the Advent of the Automatic Factory*. The purpose of the book was to promote a better understanding of the automation phenomena, and to suggest ways in which business and industry could more effectively use this new system. In his book he also defined automation as "a new word denoting both automatic operation and the process of making things automatic."[5] Diebold later defined automation as "a means of analyzing, organizing, and controlling our produc-

[1] *Webster's New World Dictionary College Edition*, (Cleveland: The World Publishing Company, 1968), p. 100.

[2] Ford Motor Company, *The Evolution of Mass Production* (Dearborn, Michigan: The Ford Motor Company, 1956), p. 50.

[3] Lester R. Bittle, *et al.*, *Practical Automation: Methods for Increasing Plant Productivity* (New York: McGraw-Hill Book Company, 1957), p. v.

[4] Rupert LeGrand, "Ford Handles By Automation," *American Machinist*, XCII (October 21, 1948), pp. 107-122.

[5] John Diebold, *Automation, The Advent of the Automatic Factory* (New York: D. Van Nostrand Company, Inc., 1952), p. v.

tion processes to achieve optimum use of all our productive resources — mechanical and material as well as human."[6]

Einzig, an economist, offered a broader definition. He called automation a technological method that tends to reduce current production costs in terms of man hours per unit output and cited the following example:

> From the technological point of view the adaption of electric screw drivers, for instance, is not automation, because though power driven they are used by human hands. But their economic effects of the saving of man-hours through their adaption is substantially the same as if the power screw drivers were machine handled.[7]

Up to this point, most of the definitions and descriptions of automation applied more to industry than to other areas. But automation is more than an industrial application; it is used in banks and other business enterprises. The computers and data processing machines used by these concerns, certainly must be considered a form of automation. James Carey, a union leader, expressed this point of view when he testified before a Senate Subcommittee in the following manner:

> When I speak of automation, I am referring to the use of mechanical and electronic devices, rather than human workers, to regulate and control the operation of the machines.
>
> Automation is a new technology, arising from electronics and electrical engineering. It is not a new machine, or even a new industry. It is rather, a new and revolutionary technology that is applicable to almost all, if not all types of industrial and clerical operations. It makes possible the automatic office, as well as the automatic factory.[8]

Much written material has continued to be published in an attempt to describe, define, and discuss the nature of automation — these diverse publications have, to some extent, added to the confusion and misinterpretation of the meaning of automation. Bethel disclosed the fact that some people considered automation as a factory system operated and manned by robots and gigantic brains; whereas others merely considered it as a method of auto-

[6]John Diebold, *Automation and Technological Change, Hearings* before the Subcommittee on Economic Stabilization of the Joint Economic Report, Senate, 84th Congress, 1st session, October 14-28, 1955, p. 8.

[7]Paul Einzig, *The Economic Consequences of Automation* (New York: W. W. Norton, 1957), p. 17.

[8]James Carey, *Automation and Technological Change, Hearings* before the Subcommittee on Economic Stabilization of the Joint Economic Report, Senate, 84th Congress, 1st session, October 14-28, 1955, p. 220.

matic handling of materials and assembly systems.[9] For others, the concept of automation was not new; only the word itself was new. This opinion was expressed by M. L. Powers, Director of Business and Industrial Service at the University of Oklahoma, while delivering a speech at a meeting of the National Gasoline Association of America. For him automation was nothing more than a continuation of an evolution that had been going on for ages.[10]

Don G. Mitchell, while Chairman and President of the Sylvania Electric Products, Inc., offered the following opinion of automation while testifying before the Subcommittee on Economic Stabilization. "Automation is only a more recent term for mechanization which has been going on since the industrial revolution began."[11]

Thus one could continue to find divergent opinions as to the meaning of automation. There seemed, however, to be a trend in the direction of conceiving of automation as something broader than the mechanization image, as something that could involve philosophical and technological elements. Delmar S. Harder, the coiner of the word, wrote in the first edition of *Automation* that since automation was originally recognized and used in the Ford Motor Company, both the meaning of the word as well as the concept of automation as a manufacturing process had changed. It is now becoming necessary to take a new approach to the design and selection of production machinery. He stated that "our concept of automation has expanded from a simple definition involving automatic handling between operations to a concept which has engulfed planning for all our manufacturing processes."[12]

Peter F. Drucker also viewed automation as something more than mechanization:

> Mechanization is not, however, automation itself. It is only the result of automation and it is not essential to it. We have plenty of examples of effective mass production without a single conveyor belt; for instance the sorting of checks in a clearing house. We see samples of

[9]Lawrence L. Bethel, *Industrial Organization and Management* (New York: McGraw-Hill Book Company, 1956), p. 208.

[10]M. L. Powers, "Automation — What It Means," *Petroleum Refiner*, XXXV (January, 1956), p. 253.

[11]Don G. Mitchell, *Automation and Technological Change, Hearings* before the Subcommittee on Economic Stabilization of the Joint Economic Report, Senate, 84th Congress, 1st session, October 14-28, 1955, p. 176.

[12]Delmar S. Harder, "Automation: A Modern Industrial Development," *Automation* Magazine I (August, 1954), pp. 46-52.

automation without a single "automatic tool," let alone a single push button.[13]

Thus automation begins to loom as a concept embracing more than just industry's tools and machinery; it is a new way of organizing and managing an enterprise.

Walter Buckingham commented on automation as follows:

> Automation is the third phase in the development of technology that began with the industrial revolution of the eighteenth century. First came mechanization, which created the factory system and separated labor and management in production. Then, in the early twentieth, mass production brought the assembly line and other machinery so expensive that the ownership of industry had to be divorced from management and atomized into millions of separated shareholdings. Finally, since World War II, automation has added the elements of automatic control and decision making, turning the factory from a haphazard collection of machines to a single integrated unit and requiring production on an enormous scale. Mechanization was a technology based on forms and applications of power. Mass production was a technology based on principles of production organization. Automation is a technology based on communication and control.[14]

Thus the technology which we have today is the result of years of development. Automation in principle is not a radically new idea; it is rather a collection of ideas which have evolved through the centuries and developed as the need arose for faster and more efficient production methods. There had to be a need present in order to have the new method of production readily accepted. An example of an early process which did not gain immediate acceptance was the continuous flour process mill of Oliver Evans, as described by Roger Burlingame.[15]

In his account of the development of Evans' flour mill, Burlingame pointed out that the mill was one of the earlier, if not the first, example of producing a product continuously without benefit of human energy or attention. For its time, 1783, it was an ingenious array of horizontal and vertical conveyor belts which carried the raw materials from one level to another, utilizing the principles of gravity and energy from water power. Evans' method produced flour, therefore, from start to finish — without benefit of human energy or attention.

[13]Peter F. Drucker, *The Practice of Management* (New York: Harper & Brothers, 1954), p. 21.

[14]Walter Buckingham, *Automation* (New York: Harper & Brothers, 1961), p. 4.

[15]Roger Burlingame, *Machines That Built America* (New York: The New American Library, No Date), pp. 23-29.

Evans procured from the legislatures of Delaware and Pennsylvania the "monopoly rights" to produce the mill equipment. Even though he had the backing of these groups, he was, during the early years of development, unable to get acceptance of his automated mill by the farmers. Too often their remarks inferred that "what was good enough for their fathers was still good enough for them."

Years later, in 1816, when Joseph Evans, the brother of Oliver, was travelling through the mid-western part of this country as a salesman trying to sell mill equipment, he discovered to his amazement that there existed flour mills operating continuously without anyone in attendance. Evans' equipment was, therefore, being used without payment of monopoly right fees — a common practice in these early years of the patent system.[16]

2. *Automation Terminology.* Since automation is difficult to define in precise language, perhaps a description of its concepts and the design of the parts which make up its system would help clarify one's understanding of this term. Carl Dreher listed the underlying concepts of computers and other machinery which fall in the category of automated machinery as "communication, information, memory, programming, open-loop control, closed-loop control, and feedback."[17]

Communication refers to the system or means of making oneself understood through language, whether the language be in the form of symbols, such as numbers, or words. In the case of inanimate objects, it would take the form of operating switches to activate the current or energy used to run the device, whether man-controlled or automatic. Currently many machines for automation are operated by the use of tapes, both punched and magnetic.

Feedback is defined as a situation in which information about the output, at one stage of the process, is returned or "fed back" to an earlier stage so as to influence its action and cause the output either to change or to remain the same.

In order to have feedback in any control system operated by some physical mechanism, three conditions must be satisfied:

1. The required changes must be controllable by some physical means or regulating device.
2. The controlled quantity must be measurable and comparable with some standard.

[16] *Ibid.*

[17] Carl Dreher, *Automation: What It Is, How It Works, Who Can Use It* (New York: W. W. Norton, 1957), p. 20.

3. Both the measurement and the control or correction must be rapid enough for the job at hand.[18]

Samuel E. Rusinoff, of the Illinois Institute of Technology, described feedback as a process for detecting and measuring the output of information and for returning this information to the input. This information would be used for any corrections or adjustments necessary to restore the proper results or output. In order to make feedback a continuous process, a series of connections or systems would be required to relay the sequence of steps between the input and output of the system.[19]

This process introduces the term "closed-loop," a term which may be used to describe the above process when it becomes continuous. Input is transmitting information to output, which in turn relays its response to a regulating, or error-correcting device, which then sends this information back to input. When this "closed-loop" system is designed as a self-regulating device (without further attention by an attendant — unless output results need to be changed), it becomes an example of simplified automation.[20]

The home furnace is one of the commonest examples of feedback. Room temperature affects the control of the furnace, causing the furnace to go into operation to provide heat to maintain the room temperature at a certain level. A portion of the output (room temperature) has been fed back (through the thermostat) to an earlier stage (furnace fuel supply), and this action, in turn, has influenced the output (room temperature). This example of simple automation is made possible by one of the earlier and most completely automated processes: electricity. Electricity produced in power plants is an energy which cannot be stored in advance; it is made and delivered as needed, by the simple operation of flipping a switch or turning a dial. In the process energy travels from the switching device back through the wires, meters, transformers, substations, switchgear, generators, turbines and then back to the fuel sources which are used in generating the electricity.[21]

Servomechanisms is a term used in referring to a device used in a closed-loop system which is able to perform the dual function

[18]Dimitris N. Chorafas, *Factory Automation* (Washington, D. C.: Catholic University of America Press, 1958), p. 8.

[19]Samuel E. Rusinoff, *Automation in Practice* (Chicago: American Technical Society, 1957), p. 5.

[20]*Ibid.*, p. 8.

[21]Ralph J. Cordiner, *Automation and Technological Change, Hearings* before the Subcommittee on Economic Stabilization of the Joint Economic Report, Senate, 84th Congress, 1st session, October 14-28, 1955, pp. 5-6.

of controlling input and at the same time reporting the conditions at the output stage. Its function is to correct any deviations from a set point or required pattern of performance by making these changes at the input stage.[22]

These servomechanisms may be devices using electric, pneumatic, hydraulic (or any combination of these forms of) power or energy. Most of the new servomechanism devices today use electronic or electrical energy because of the speed of response and the precision required in modern automation equipment. In some of the more sophisticated devices, the servomechanisms are replacing man in the manufacturing process.

Another basic type of feedback control is the "open-loop." John Diebold described a simple example of an "open-loop" system which operates independently of the machine or device to which it is attached, and which could require the use of a human operator (in some systems) to make any necessary adjustments. The example used was that of the street lighting system which turned on the lights at a predetermined time and also turned them off at another predetermined time. This system would not be affected by darkness, as in the event of a mid-afternoon thunder storm. Diebold also stated that the open-loop system could contain two very important characteristics of automatic control systems: control at low energy levels and by remote control. These characteristics would, rather than incorporating more expensive and complicated devices, permit the use of simpler means of control.[23]

Programing is the phase of automation that prepares the direction for the operations which are to be performed by the device. Presently, this phase prepares information to be fed to the machine and punches this information on cards which are then fed to a computer in a sequence which will produce the desired output. The information fed to the machine is in the form of symbols and may be transferred to either magnetic or punched tape. The concept of programing is not new; Joseph M. Jacquard, of France, during the nineteenth century, developed a punched card system which automatically set the weaving looms to produce the pattern that was punched on these cards.[24]

Examples of programing which take place in the home include the setting of the thermostat which, in turn, controls room tempera-

[22]Rusinoff, *op. cit.*, p. 66.

[23]John Diebold, *The Advent of the Automatic Factory* (New York: D. Van Nostrand Company, Inc., 1952), pp. 11-13.

[24]D. S. Halacy, *Computers — The Machines We Think With* (New York: Dell Publishing Company, Inc., 1962), p. 39.

ture and the modern day washing machine which can be set to wash the clothes for a desired length of time and at a specific water temperature.

3. Automation Equipment. Today there are many classifications of automation equipment, some of which may be better classified as automatic rather than automated. Automated machines are designed for a single purpose and for specific industries. These machines do one thing, hour after hour, without requiring any adjustment or operator attention. Therefore, machines which, for example, place a cap on a bottle or produce a screw may be considered automated — since they do not require attention once they are programed and supplied with materials necessary for the job.

Other machines might be classified as automatic because although they perform mechanical work, they must at the same time be handled by an operator. Such tools as the automatic screw driver and the nut driver can be adjusted for certain job specifications but must be moved manually from one position to another by the operator. Such tools cannot, therefore, be programed.

In order to have high level automation it is necessary to have some means of supplying information to the machine in some form which makes the information "understandable" to the machine. Modern automation depends upon computers for this phase of its operation.

Buckingham classified computer controlled machinery used in factory automation into three types, namely:

> (1) automatic production machines such as milling machines and lathes; (2) automatic process control machines such as used in oil refineries and chemical plants; and (3) automatic materials handling equipment that transports finished or semi-finished products from one machine to another. All of these are operated by electronic computers, using magnetic tapes, punched cards or automatic sensing devices such as photoelectric cells which simulate human senses of seeing, hearing or feeling.[25]

Cybernetics

1. Definition of Cybernetics. Cybernetics has been defined in *The Basic Dictionary of Science* as "the science based on a comparison of the workings of the control system formed by the brain and nerves of man and the workings of the present day electric

[25]Buckingham, *op. cit.*, p. 27.

and other machines designed to do operations which were at one time looked on as needing a living brain."[26]

Dr. Wiener, the originator of the term, described cybernetics as "the theory of communication and control, wherever it may be found, whether in the machine or in the living being."[27]

In 1948, however, in his book on *Cybernetics*, Dr. Wiener had already pointed out the possibility of languages controlling machines by devices which would closely approximate the processes of the human brain.[28]

In 1954, Dr. Wiener clarified his earlier definition of cybernetics by explaining that when one person requests information from another, he actually imparts a message to that person. When the second person responds to the initial inquiry, he returns a related message which contains information primarily accessible to him but not to the original communicator. This technique of communication used in relaying messages of fact is also used in conveying messages of control (those given in the imperative mood). For if messages of control are to be effective, the communicator — in order to know if the command is understood and has been carried out — must be cognizant of any return message.[29]

Thus in his opinion, society could only be understood through a study of messages and communication facilities which were an integral part. Furthermore, the future development of these messages and communication facilities would have an increasing role for man and his society.[30]

As a result of Wiener's publication, James R. Bright, of Harvard University, maintained that many people assumed the following:

> (a) electronic controls were merely in their infancy; (b) these controls were about to make possible computation machinery that could be adopted to decision-making problems in war, business, and social areas; (c) as a result of these technological advances, the automatic factory was not only possible, it was an imminent reality and tomorrow's

[26]E. C. Graham, ed., *The Basic Dictionary of Science* (New York: The Macmillan Company, 1966), p. 102.

[27]Norbert Wiener, *Ex-Prodigy* (Cambridge, Mass.: M. I. T. Press), p. 8+. Simon and Schuster. Copyright 1953 by Norbert Wiener.

[28]Norbert Wiener, *Cybernetics* (Cambridge, Mass.: M. I. T. Press), copyright 1948 and 1961 by the Massachusettes Institute of Technology, p. 194.

[29]Norbert Wiener, *The Human Use of Human Beings* (Garden City, New York: Doubleday and Company, 1954), p. 16.

[30]*Ibid.*

certainty; (d) it would displace millions of people within 20 years — maybe sooner — and bring on violent depression.[31]

According to Bright, the fine line of distinction faded between automatic factory, automation, and cybernetics; they became interchangeable terms, suggesting a degree of automaticity and the control of some mental processes.[32]

2. *Historical Development.* According to Dr. Wiener the term "cybernetics" is itself derived from the Greek word "kubernetes," meaning "helmsman" or "steersman." From this same Greek word our word "governor" (a speed control mechanism) has also been derived. In his account of the historical development of cybernetics, he tells how he actually founded the science of cybernetics. Originally many of the ideas which he used in the development of cybernetics stemmed from the work of such scientists as Babbage, Gibbs, Leibnitz, and Maxwell.[33] He also stated that through his study of the Brownian motion theory and the theory of probability he was finally led to the study of forms of harmonic analysis. All of these concepts, coupled with his knowledge of engineering, eventually led him to found the discipline of cybernetics — "which is in essence a statistical approach to the theory of communication."[34]

The history of cybernetics can also be considered as a history of research in feedback, the control of a machine on the basis of its actual performance rather than its expected performance, the "How am I doing?" phase.

3. *Purpose.* The purpose of cybernetics is to develop not only a language and technique that will enable one to attack the problem of communication and control but also a method of storing ideas and techniques. Hopefully the development of such a language and method should alleviate some of the problems which confront business and management when they become so large that the problem of information and control necessitates the use of newer means of communication and control. It is here that cybernetics allows management to construct mathematical models that include all of the variables that may be present in complex problems, store this knowledge, and have it available for future use to solve similar problems which will arise in a growing technology.[35]

[31]James R. Bright, *Automation and Management* (Boston: Division of Research, Graduate School of Business Administration, Harvard University, 1958), p. 5.

[32]*Ibid.*, p. 26.

[33]Wiener, *Ex-Prodigy, op. cit.*, p. 8.

[34]*Ibid.*, pp. 274-275.

[35]Buckingham, *op. cit.*, pp. 53-54.

Unfortunately the term "cybernetics" shared the fate of so many other prodigies, for soon after its introduction in 1948, newsmen began to use, misuse, and misinterpret it by referring to it not as a science, but rather as the product of a science. For while it is true that automation is an application of cybernetics and is affected by means of computing machines, cybernetics should not be considered as merely the theory of even the most complex of present day machines.[36]

Neither should cybernetics be considered as electronics, mathematics, neurology, nor as a theory peculiar to any of these disciplines. It has admittedly borrowed from these and other fields, but only with the expectation that solutions which it might discover will have some useful applications.

4. Five Major Areas of Cybernetics. In order to understand cybernetics to a fuller extent, it is well to understand its five components, namely: mathematics, communication theory, servosystems, computers, and finite automata.[37]

Mathematics is directly associated with cybernetics, for it is mathematics which gives cybernetics the precision so necessary to make it functional. Cybernetics has its roots in applied mathematics, especially in statistical mechanics, the general development of statistical thermodynamics, and gas laws. The development of abstract algebra and the theory of groups have also contributed to the theory of cybernetics.

Communication theory (or information theory) may be considered as a branch of modern mathematics dealing with the probability theory. This latter theory introduces the notion of an information source and a message which is transmitted by any number of possible means to a receiver who, in turn, picks up the message — whether it is from closed electronic circuits or from social systems where the flow of information regulates the operation of the system.[38]

Servosystems, another phase of cybernetics, is defined as "a closed loop control of a source of a power. It is usually an error-actuated control mechanism operating on the principle of negative feedback."[39] This negative feedback is the difference between a simple "power drive" and a "control system" — or a "servosystem."

[36]Alice Hilton, *Logic, Computing Machines and Automation* (Washington, D. C., Spartan Books, 1963), p. 4.

[37]F. H. George, *The Brain As A Computer* (Reading, Massachusetts: Addison-Wesley Publishing Company, Inc., 1962), p. 44.

[38]Sir Leon Bagrit, *The Age of Automation* (New York: The New American Library of World Literature, Inc., 1965), p. xvii.

[39]George, *op. cit.*, p. 41.

An elevator which requires a human operator to bring it to a desired floor by adjusting a speed control is a simple example of a power drive; the power is provided by the machine, but the element of guidance has to be furnished by a person. The automatic push-button elevator, on the other hand, is an example of the servosystem.[40]

Servosystems have three important attributes: stability, final accuracy, and speed of response. And "it is the existence of interrelationship between these characteristics which makes the design of servosystems a technology in its own right."[41]

Computers, during their early stages of development, were thought of as merely adding and subtracting machines. Later — probably because they had become capable of being driven by electronic rather than purely mechanical means—they were considered as having greater general application. Even today, however, many people still consider the computer as a deductive rather than an inductive system. It is this inductive use of the computer which makes it of value to cybernetics.[42]

The rise to prominence of cybernetics was due, in part, to World War II. A series of new problems, which had not previously been encountered, arose during the years of the war. There was, for example, the new problem of range-finding for anti-aircraft guns for high-speed aircraft warfare. The systems previously used involved human computers with manually controlled locators; this combination, however, proved to be wholly unsatisfactory and inadequate for range-finding for improved, high-speed aircraft warfare. The former process tracked and predicted the direction, velocity, and height of the enemy aircraft. Since the reaction of man proved inadequate for high-speed aircraft, it became necessary to seek other methods of range-finding. Computers capable of performing these functions were in existence at the time. They were soon found to be made capable of arriving at the mathematical solutions of range-finding more rapidly and accurately.[43]

The digital type computers are especially important to cybernetics. While these machines were originally designed to solve mathematical problems, they are today designed for a variety of purposes. The problem of range-finding mentioned above required a

[40]Reprinted by permission of the publisher, from D. A. Bell, *Intelligent Machines* (Waltham: Blaisdell Publishing Company, A Division of Ginn and Company, 1962), p. 24.

[41]*Ibid.*, p. 25.

[42]George, *op. cit.*, p. 17.

[43]*Ibid.*, p. 18.

simulation of another characteristically human type of activity, in the form of feedback. "Feedback is what differentiates the machines that we are primarily interested in from the popular docile machines, such as the motor car, the airplane, or even the most docile of them all, such as spoons, forks, and levers."[44]

Feedback involves some part of a machine's output which is initially isolated and is then fed back into the machine as a controlling part of its input. Perhaps one of the most common and familiar examples of feedback is the previously cited home furnace thermostat for controlling temperature.[45]

In so far as man must have knowledge of the results of his actions in order that he may continue to act rationally in his environment, he obviously operates on a gross feedback system. A man learning a new skill, for example, will be more likely to improve if he can see the results of his actions.[46]

Computers can be programed to learn and to perceive; it may even be reasonable to state that they can also be programed to think, since thinking and learning are closely related and are both necessary in problem solving. It is not beyond the realm of possibility that someday the processes inside of the human being and those within machines could be replicated to serve the same functions and produce similar results.[47] Wiener also claimed that if we could build a machine whose mechanical structure duplicated human physiology, we could then have a machine whose intellectual capacities would duplicate those of man.[48]

Some of these machines are already in the prototype stage and at this moment may be performing functions closely resembling those of man. One of these machines is labeled the "Cyberatron," an electronic information-processing system which does not have to be programed. It is not necessary to give the Cyberatron step-by-step input instruction as we normally have to give computers. The Cyberatron goes through the learning process much as a child does. After it learns the correct response to a certain stimulus, it will give this response automatically when confronted with the same condition again. The Cyberatron has already learned to distinguish between real and false target echoes in sonar operations for the military, and its performance compares favorably with those of human

[44]*Ibid.*

[45]*Ibid.*, p. 19.

[46]George H. Amber and Paul S. Amber, *Anatomy of Automation* (New Jersey: Prentice-Hall, Inc., ©, 1962), p. 203.

[47]George, *op. cit.*, p. 373.

[48]Wiener, *The Human Use of Human Beings*, *op. cit.*, p. 57.

operators. It is also expected to be able to evaluate data from electrocardiograms.[49]

A less sophisticated device, the "Perceptron," was designed by Dr. Frank Rosenblatt, and was used at Cornell University for an Air Force contract. Experiments were conducted to teach a computer to perceive, much as the human does. The human brain perceives in several stages and at such speeds that it appears to be a continuous process or an instantaneous act. The Perceptron was designed to function in much the same manner; it is capable of learning to recognize letters through a system composed of an array of 400 photoelectric cells, used as its eyes.[50]

Announcements of such machines as the Cyberatron and the Perceptron have not only caused many misconceptions among the general public but have also been responsible for disputes among scientists. Some scientists disagree with the idea that machines can be compared with the performance of the human nervous system. Even though there is controversy concerning these machines, scientists continue to seek ways of duplicating the performance of the human nervous system.[51]

It is believed that the whole development of machines which can "learn" and "think" is a vital product of the general theory of cybernetics — the first cousin of automation.[52]

Finite automation is the last and most important idea of general cybernetics. This concept requires careful attention, for it is an effective means of defining any system which is constructed from a finite number of parts.

The subjects treated by cybernetics, and of importance for automation, involve the theory of messages and control. For cybernetics unites information theory with control theory, thereby providing a mathematical basis for automation.[53]

If automation had not come when it did, Buckingham wrote that business firms would have suffered the same fate as did the Brontosaurus, whose body grew faster than his brain and nervous system. The Brontosaurus, with his little brain and ineffective nervous system, could be nibbled to death by small animals before he know what was happening to him. Fortunately, a whole new

[49]Thorsten Sellin, ed. "Automation," *The Annals of the American Academy of Political and Social Sciences*, 1962, CCCXL, p. 41.

[50]Halacy, *op. cit.*, pp. 127-129.

[51]*Ibid.*, p. 129.

[52]George, *op cit.*, p. 31.

[53]Amber, *op. cit.*, p. 192.

science of communication and control, cybernetics, has come to the aid of management.[54]

One of the lessons to be learned from cybernetics, as it particularly applies to automation, is that there is a general tendency for work being done by a machine to degrade and to deviate from the norm — a tendency which must be combatted. This natural tendency to deviate is called "entropy," a concept which makes up the main core of cybernetics. "Entropy originally referred to a mathematical factor which is the measure of unavailable heat in a thermodynamics system. Cybernetics uses entropy in the sense of being an index of the state of disorder in any system."[55]

Cybernetics explains that a natural tendency exists for all organized systems to continually lose more and more of their state of organization, to break down, to increase their "entropy." Eventually, all forms of organizations, such as men, machines, and society tend to become more random in behavior and less consistent in their actions until they meet death, breakdown, failure, collapse, or extinction.[56]

The less that an organized system (such as materials or information) is allowed to disorganize during a production process, the greater is the cybernetic efficiency. Presently, few concern themselves with cybernetic efficiency because the control and design engineers realize that refined design is expensive, and it must not be wasted. Its use must justify the expenditure involved.[57]

Applications

In 1954, the first commercial electronic computer (Univac I) was introduced to the American business and industrial scene. Since then the many uses and importance of this electronic marvel have, without doubt, exceeded the greatest expectations of its originators.[58] Since 1954, some 40,000 computers have been put into use throughout the nation. Their uses range from performing such diverse functions as preparing "junior's" report card to solving the complex mathematical problems for space scientists.[59]

Their many uses, as extensions of man's muscles and hands, have helped man in his furtive efforts to increase and improve the

[54]Buckingham, *op. cit.*, p. 53.

[55]Amber, *op. cit.*, p. 198.

[56]*Ibid.*

[57]Amber, *op cit.*, pp. 201-202.

[58]"Automation," *Reader's Digest 1967 Almanac and Yearbook* (Pleasantville, New York: The Reader's Digest Association, 1967), p. 427.

[59]"More Computers Used," *The Washington Post*, November 18, 1967, p. 16.

products of his imagination. They have also made possible man's achieving greater accuracy in the performance of machinery and other devices used in the industries and laboratories.

The list of uses for computers and computer-controlled equipment is continually growing. At present, these automated devices are commonly used to perform many functions: produce steel faster and better, control generating plants for power, control ships' engines from the bridge, forecast weather, route long distance calls, and check on plane reservations. State and national government agencies also commonly employ them for such purposes as income tax and payroll accounting.

New uses for computer-controlled devices are continually being reported. At a recent meeting of the American College of Cardiology in Washington, D. C., Dr. William H. Stewart urged members of this group to take advantage of the new developments in computer systems designed for their field. He said that "the main purpose of the computer in medicine is to free the physician from tedious, burdensome tasks so that more of his time is available for direct examination and treatment of the patient."[60] The computer-controlled device demonstrated at this meeting graphically recorded a speaker's heart activity, almost simultaneously before the eyes of the audience. To accomplish this, the electrical activity of the heart was relayed to a computer in downtown Washington, D. C., which returned a print-out of its reaction back to the hotel assembly room. Such results can provide the doctor with a rather complete history of the patient's heart condition.

One of the latest computer uses (still in the early stages of its development) is that of making a voice-controlled computer "teachable." Litton Industries' Mellonics Division, Sunnyvale, California, has developed — through voice commands — the first "teachable" system for the control of computers. The computer responds only to those voices which it recognizes. At the present time, the firm has delivered one such computer to a Federal intelligency agency. Within the next year and a half, however, the system will be available for non-classified applicants.

The attributes and operations of the system are described as follows:

> The SIDS (Speech Identification System) is programed so that "new" voices automatically can be learned by a computer, even over a telephone link or other communications medium. . . . Present operating vocabulary for the computer is about 30 words, and it can identify about

[60]Nate Haseltine, "Computers Are Hailed As Doctor's Time-Saver," *The Washington Post*, November 18, 1967, p. 20.

the same number of speakers, although there essentially is no limit to capacity. . . . Future systems should have a vocabulary of hundreds of words. However . . . most basic computers functions should be feasible with relatively few words. . . . Sounds spoken into a microphone or stored on magnetic tape are processed through a band pass filter system and analyzed by a power-spectral density processing technique that looks for speech clues — a pitch, power, frequency, intonation and others — at a sampling rate of 200 times per second.

Working in real time, the computer then searches a library of signal patterns and compares the spoken words — now converted into digital patterns — with this memory. When the input signals match a word in a computer's vocabulary, it responds accordingly. Meanwhile the system has also matched the speaker's unique vocal characteristics to the computer's memory. If the user wants to limit the access to authorized users, the system will not work unless the individual's voice is on file in the computer.[61]

Frank Druding, president of the company, claimed that in the future normal form of communication with computers will be the human voice. While the human voice does not possess the uniqueness of fingerprints, it can be used for positive identification — when used in combination with other things, such as symbols, codes, etc. One of the problems facing the present technology in voice identification is achieving the degree of accuracy which will be required. For it is difficult to obtain a high degree of accuracy (95% or better) of voice identification because of the day-to-day voice fluctuations (due to colds, hoarseness, and other factors). In order to eliminate these voice changes and achieve this high degree of accuracy, more costly research will be involved. Thus, all of the problems have not been solved, but company officials hope to have these under control within the next few months.[62]

The forecast of applications for the voice controlled computer will include not only military uses but civilian as well. One of the suggested non-military uses is as an identifier of credit card users. A customer's voice would be recorded on a magnetic tape and filed with each firm where he has an account. When the firm is called, the computer will be able to confirm the identity of the customer's voice. Once this identification is made, the business transaction may be completed.[63]

Predicting a checkless society, as one of the outcomes of computerized banking, was one of the prognostications at a recent

[61]Robert Lindsey, "Voice Controlled Computer is Teachable," *Aerospace Technology*, XXI (October 9, 1967), p. 52.

[62]*Ibid.*, pp. 52-53.

[63]*Ibid.*

meeting of the Washington, D. C. Chapter of the American Banking Institute. George W. T. Christman of the Data Division of the Chesapeake and Telephone Company described the means by which telephones will be used in the future in individuals' banking transactions:

I dial my bank's computer. . . . The computer answers and signifies by returning an audible tone. I enter my account number. The computer responds with my balance. I enter the account number for Pepco followed by the amount due. The computer responds with my new balance. I continue with the gas company, telephone company, Central Charge, etc.

That is all that I am required to do. No check to write, envelope to address or stamp to lick. . . . My statement at the end of the month will reflect these payments. We are also attempting the Post Office — It also has a problem.[64]

Postmaster General Lawrence F. O'Brien urged ideas for the innovation of more rapid devices which would assist in the processing of mail by the 1970's. O'Brien implied that ZIP codes, presorting, and human optical scanning will not be enough to handle the flow of mail — which in 1967 was eighty billion pieces and by 1987 is expected to reach one hundred and thirty nine billion. By 1971 ZIP coding and scanning concepts will be replaced by key-punch computers. The method which will then be used will operate as follows:

Letters would pass one at a time in front of the operator . . . who would route them down a certain chute with a push of a button.

This plan calls for a piece of invisible tape to be stuck to each envelope as it enters a post office. The tape would be coded in computer language, and the letter could be sorted the rest of its route by computer.[65]

The computer, since its introduction as a decision-making device, has helped to make automation what it is today. There is at the present time, however, one limitation. A computer has not yet been designed which will substitute for man's thinking ability, nor for his imagination. This present absence should not imply that such capacities as thought and imagination will not eventually be built into a computer — or a possible successor, whatever form this device might assume. Because we live in a time of innovations, modern man has ceased to be amazed or surprised in seeing what

[64]"Checkless Society Seen Far Distant," *The Washington Post*, November 15, 1967, p. 8.

[65]Robert Levey, "Machinery Sought to Put Zip in Mail," *The Washington Post*, November 4, 1967, p. 20.

he used to think impossible become, not only possible, but in many cases inevitable.

Effects

The effects of technological changes are seldom simple and clear cut; their ramifications reach all levels and aspects of our industrially oriented society, often without too much concern for the status quo and with little anticipation of future effects. The products of technology occasionally result in bringing about economic, political, social, and often moral problems. The societal leaders must, therefore, visualize these overall effects: their advantages and disadvantages as well as the degree of society's acceptance or rejection.

1. Industrial Implications. Dr. Elmer W. Engstrom, then Senior Executive Vice-President of Radio Corporation of America, offered the following four concepts of automation:

> 1. The movement to automation is a natural one under developing circumstances of our technology and the growing need to increase productivity. The factors which move industry into automation are so deep rooted and profound that this movement will continue even though the changes involved will create problems. There is a need for a clear understanding so as to minimize the growth problems as they appear.
>
> 2. The rate of the movement to automation and its effective use in industry and commerce will be determined by the economics of the enterprise as a whole and of its parts under the impact of automation.
>
> 3. To be effective and efficient, automation must be considered as a method of doing business — as a working arrangement of the whole business, where the enterprise must be treated as an integrated system.
>
> 4. Automation may make an industrial unit more flexible as to product manufactured but the economics of automation will require that the facility and the people who man it must be kept continuously engaged. This will mean a nearly continuous flow of goods requiring new merchandising procedures so as to absorb this flow of goods.[66]

Engstrom went on to present the following views concerning the broad meaning of automation, its evolution, as well as its present and future meaning for our industrial, commercial and everyday life. He substantiated the premise that the Industrial Revolution which started a long time ago still continues as an evolutionary process, bringing about changes in methods of pro-

[66]Elmer W. Engstrom, "Automation," (Address delivered at the Centennial Symposium on Modern Engineering, Philadelphia: University of Pennsylvania, November 11, 1955), pp. 15-16. (Published by the Department of Information, Radio Corporation of America, 1955).

duction through gradual replacement of various sources of energy — from that of human, to horse power, and then to machine power — in order to accomplish the complex and varied phases of a production task. He listed the aspects of a production process as follows:

1. The production of articles of manufacture including the related elements of raw materials, facilities and labor.
2. The transport of raw materials, partially manufactured articles, and completed articles through the marketing channels to the customer.
3. The marketing of the completed articles, reflecting the competitive situation and customer acceptance.
4. The financing, beginning with raw materials facilities, and labor, and ending with billing and collecting from the customer.[67]

He also inferred that with the introduction of automation into any production process, two or more steps would be included in the total process, for it is possible to control and to program each preceding (or any combination of) steps through the feedback feature of the system. That is to say, if any part of the system is in need of more raw material, this deficiency could be relayed to the control, which in turn would make the necessary correction. Through the electronic control system the automation process would continue the "Untouched By Human Hands" feature.[68]

2. *Safety Implications.* Supposedly one of the advantages of automation was that it would provide improvements in the safety conditions in industry. According to one source, this advantage has been evident, but not without some reservations. First, it will cut down hazards to which machine operators are exposed. Secondly, it will eliminate some injuries due to materials' handling. Third, it will bring a sharp increase in maintenance workers, who historically have a higher incidence of injuries than machine operators or manual workers. Finally, workers replaced by automation will seek employment in other activities which may be equally as hazardous as former occupations.[69]

Thus, in reducing accidents in one industrial activity, the potential for an increase in accidents in another is created. There is also the possible increase in accidents in off-the-job activities. For as the industrial worker has less to do with the actual manual operation of automated production, this increased production potential will eventually enable him to have shorter working hours.

[67] *Ibid.,* p. 4
[68] *Ibid.*
[69] "Automation Will Not Eliminate Accidents," *Safety Standards,* VIII (November-December, 1959), p. 5.

There will be more opportunity for his leisure time activities. And it is during these off-the-job periods that more and more accidents are occurring. The sportsman, the hobbiest, and the "do-it-yourself-happy-home-owner" do not always exercise the best knowledge or practice those safety precautions emphasized by his employer.

3. Educational Implications. Peter Drucker, a well-known management expert, offered the following ideas concerning the impact of automation and its effect on education:

> As far as the average citizen is concerned, automation's greatest impact will not be on production technologies and will not be on employment. The greatest impact will be on our intellectual and cultural life. Automation, after all, is first and foremost an idea. It is an idea which organizes other ideas, and its impact on ideas accounts for the far-reaching implications.[70]

The results of man's insights ultimately bring about changes, changes which often eliminate or reduce previous opportunities; but with the introduction of new changes come new opportunities demanding new skills and knowledge.

Drucker commented further on the effects of such an impact:

> A society in which automation has become a governing concept of production and distribution is, of necessity, an "educated society." It is a society in which knowledge rather than man's animal energy is the central resource.[71]

The society whose industrial facilities become highly automated needs more knowledge power than physical power. These conditions require a society to provide educational opportunities for those with the intellectual capacity to be offered advanced education. It is only within the last thirty years or so that knowledge, rather than brawn, has been considered an economic resource.

Drucker cited the example of a young mathematics student in England whose family was disappointed in his selection of mathematics as a vocation. During the period of 1930 and before, mathematics was not considered a desirable and salable skill. The only opportunities at that time were those of a poorly paid schoolmaster. During this period, opportunities for the educated person were confined to the standard professions of the time, such as "the law, the church, the army, medicine and the civil service."[72]

Today, due to the demand for talent by business, government, and industry, a person may select from a wide variety of employ-

[70]Peter F. Drucker, "Education in the New Technology," *Think,* XXVIII June, 1962), p. 3.

[71]*Ibid.*

[72]*Ibid.,* p. 4.

ment opportunities. Again, Drucker emphasized that the greatest employee increase is in the "knowledge employees" group, and these are not completely in the "boss" or "worker" category. Accountants, sales managers, operations researchers, and many others fall into the worker class, and not in management as such.[73]

In reference to this relationship between the changing technology and its educational implications, Drucker suggested that we may need a change in the very idea of "skill." For instead of a skill being thought of as what one has learned, it will have to be considered as one's capacity to learn, that is, the capacity to apply ideas regarding work to new tasks. Instead of an I. Q., Drucker suggested an S. Q., "a skill quotient that measures the ability of a man to transfer experience from one kind of material and one set of tools to new materials and new tools."[74]

William G. Mather also emphasized the necessity of flexibility in learning skills and pointed out some pitfalls in teaching just manipulative skills. Automation admittedly eliminates jobs. Usually the jobs that are the first to go are those which require low skills or are in the "operative" class (where machines are able to replace the human worker easily). As more and more of these situations occur, industry must prepare for increased in-the-plant-training for new positions and up-grading skills in order to maintain a reservoir of qualified personnel.[75]

As automation is beginning to affect people in all levels of society, our educational system must, therefore, develop new and more comprehensive programs in order to provide adequate education for all members of society.

Selected Bibliography

Amber, George H. and Amber, Paul S. *Anatomy of Automation.* Englewood Cliffs, New Jersey: Prentice-Hall, Inc., ©, 1962.

"Automation." *Reader's Digest 1967 Almanac and Yearbook.* Pleasantville, New York: The Reader's Digest Association, 1967.

"Automation Will Not Eliminate Accidents." *Safety Standards,* VIII (November-December, 1959), 5.

Bagrit, Sir Leon. *The Age of Automation.* New York: The New American Library of World Literature, Inc., 1965.

[73] *Ibid.*

[74] *Ibid.*, p. 5.

[75] William G. Mather, "When Men and Machines Work Together," *Automation, Education and Human Values,* ed. by William W. Brickman and Stanley Lehrer (New York: School and Society Books, Society for the Advancement of Education, Inc., 1966), pp. 40-41.

Bell, D. A. *Intelligent Machines.* New York: Blaisdell Publishing Company, 1962.

Bethel, Lawrence L. *Industrial Organization and Management.* New York: McGraw-Hill Book Company, 1956.

Bittle, Lester R., *et al. Practical Automation: Methods for Increasing Plant Productivity.* New York: McGraw-Hill Book Company, 1957.

Bright, James R. *Automation and Management.* Boston: Division of Research, Graduate School of Business Administration, Harvard University, 1958.

Buckingham, Walter. *Automation.* New York: Harper & Brothers, 1961.

Burlingame, Roger. *Machines That Built America.* New York: The New American Library of World Literature, Inc., No date.

Chorafas, Dimitris N. *Factory Automation.* Washington, D. C., Catholic University of America Press, 1958.

Diebold, John. *The Advent of the Automatic Factory.* New York: D. Van Nostrand Company, Inc., 1952.

Dreher, Carl. *Automation: What It Is, How It Works, Who Can Use It.* New York: W. W. Norton and Company, 1957.

Drucker, Peter F. *The Practice of Management.* New York: Harper & Brothers, 1954.

————————. "Education in the New Technology." *Think,* XXVIII (June, 1962), 3.

Einzig, Paul. *The Economic Consequences of Automation.* New York: W. W. Norton and Company, 1957.

Engstrom, Elmer W. "Automation." Address delivered at the Centennial Symposium of Modern Engineering, Philadelphia: University of Pennsylvania, 1955.

Ford Motor Company. *The Evolution of Mass Production.* Dearborn, Michigan: The Ford Motor Company, 1956.

George, F. H. *The Brain as a Computer.* Reading, Massachusetts: Addison-Wesley Publishing Company, Inc., 1962.

Graham, E. C., ed. *The Basic Dictionary of Science.* New York: The Macmillan Company, 1966.

Halacy, D. S. *Computers — The Machines We Think With.* New York: Dell Publishing Company, Inc., 1962.

Harder, Delmar S. "Automation: A Modern Industrial Development." *Automation,* I (August, 1954), 46-52.

Haseltine, Nate. "Computers Are Hailed As Doctor's Time-Savers," *The Washington Post,* November 18, 1967.

Hilton, Alice. *Logic, Computing Machines and Automation.* Washington, D. C.: Spartan Books, 1963.

LeGrand, Rupert. "Ford Handles by Automation." *American Machinist,* XCII (October 21, 1948), 107-122.

Levey, Robert. "Machinery Sought to Put Zip in Mail." *The Washington Post,* November 4, 1967.

Lindsey, Robert. "Voice Controlled Computer is Teachable." *Aerospace Technology,* XXI (October 9, 1967), 52.

Mather, William G. "When Men and Machines Work Together." *Automation, Education and Human Values.* Edited by William W. Brickman and Stanley Lehrer. New York: School and Society Books, Division of the Society for the Advancement of Education, Inc., 1966.

Powers, M. L. "Automation — What It Means." *Petroleum Refiner,* XXXV (January, 1956), 253.

Rusinoff, Samuel E. *Automation in Practice.* Chicago: American Technical Society, 1957.

Sellin, Thorsten, ed. "Automation." *The Annals of The American Academy of Political and Social Sciences,* 1962. Vol. CCCXL.

U. S. Congress. *Automation and Technological Change, Hearings* before the Subcommittee on Economic Stabilization of the Joint Economic Report, 84th Congress, 1st session, 1955.

The Washington Post. "Checkless Society Seen Far Distant," November 15, 1967.

————————. "More Computers Used," November 18, 1967.

Webster's New World Dictionary, College Edition. Cleveland: The World Publishing Company, 1957.

Wiener, Norbert. *Cybernetics.* Cambridge, Mass.: M. I. T. Press, 1948.

————————. *Ex-Prodigy.* Cambridge, Mass.: M. I. T. Press, 1953.

————————. *The Human Use of Human Beings.* Garden City, New York: Doubleday and Company, 1954.

Index

AFL — CIO Federation 178, 186
Absenteeism, 204
Acceptance, need for, 202
Accuracy, of measurements, 125
Affection, need for, 202
Aggregate income, 157
Agriculture —
  and factory system, 118
  and industrial revolution, 96
  nature of improvements, 97
  productivity and industrial revolution, 94
Analysis —
  of Della Vos, 18
  trade and job, 19
Animal husbandry, 97
Animals, domestication, 49
Apprenticeship, 66
Apprentices —
  in guild system, 78
  in industrial revolution, 101
Approval, need for, 202
Art —
  of craftsman, 76
  of early man, 50
  and work, 74
Artist, status of, 75
Assembly, in mass production, 127
Assembly work, dislikes in, 203
Attitudes —
  factors in work, 201
  of workers, 190, 201
Australopithecines, 33, 34
Authority —
  and control, 167
  and management, 162
  of managers, 164
Automation, 92, 189, 210
  definitions, 211
  effects of, 229
  as evolution, 213
  finite, 224
  of grain mill, 127
  implications for education, 231
  and production records, 210
  types of, 218
Automatism, of tools and machines, 115

Banking, computer in, 227
Bargaining —
  collective, 181
  role of union leader, 186
Behavior —
  patterns of man's, 38
  and symbols, 40
Belonging, need for, 176
Bone, for tools, 54
Boycott —
  secondary, 180
  as union power, 180
Brand name, role of, 139
Bureaucracy —
  causes of, 172
  industrial, 170
  reasons for, 171
Burial, early forms, 37
Business, responsibility of, 139

Capital —
  and industrial revolution, 95
  and interest, 156
Capital goods, 135, 154
Capitalistic economy, 82
  system, 80

Capitalism, 130-160
 American, 135
 defined, 132
 as economic system, 83
 evolution of, 136
 exploitive, 141
 and social responsibility, 141
 state, 148
Carpentry, origin of, 55
Carrington, 53
Caves, and early man, 36
Chancelade man, 37
Change, and economic systems, 138
Child labor, 100, 102
Children, protection of, 146
Choice, free, 132
Church, and technology, 74
Civilization, developed through technology, 72
Clock, importance in precision concept, 124
Closed-loop, 216
Closed shop, 180, 181
Coal, role in industrial revolution, 105
Collective bargaining, 181
 process of, 182
Collectivism, as economic system, 83
Colonization, 146
Combe Capelle man, 37
Commerce, development of, 63
Commercial economy, 82
Communications —
 and automation, 214, 215
 and cybernetics, 219
 and industrial revolution, 98, 110
Communication theory, and cybernetics, 221
Communism —
 and capitalism, 138
 as economic system, 83
Community, self-supporting, 61
Community projects, 139
Competition —
 and capitalism, 130, 133
 role of, 142
Computers —
 and automation, 212, 228
 concept, 217
 and cybernetics, 222
 learning of, 223
 types, 222
 uses and development, 225
 voice taught, 226
Concepts —
 organizational, 26
 roles in curriculum, 25
Consumer —
 requirements of, 16
 in society, 159
Consumer goods, 153, 154
Consumption —
 and income, 156
 in society, 43
Continuity, as element of mass production, 128
Contracts —
 and capitalism, 133
 freedom, of, 132
 and government, 146
Control —
 and automation, 214, 215
 and cybernation, 219
 as management function, 167
Conveyors —
 early use, 214
 and synchronization, 127
Corporation, development of, 90
Cow, domestication, 50
Craft guilds, 68, 77
Crafts —
 defined, 75
 and unions, 177
Craftsmanship, 75
Craftsmen —
 as class, 63
 status of, 42, 75
 in village economy, 77
Credit economy, system, 80
Cro-Magnon man, 37
Crusades, effects of, 63
Culture —
 evolution of early, 38
 function of, 39
 history of, 26
 nature of, 38, 39
 patterns of, 43

Curiosity, need to satisfy, 202
Custom work economy, 81
Cyberatron, 223
Cybernetics, 218

Data processing, and automation, 212
Demand, and supply, 153
Democracy, and business cycles, 158
Demonstration strike, 180
Depression, 149
  growth, 150
Digital computers, 222
Direction, as management function, 166
Discipline —
  as approach to industrial arts, 27
  and bureaucracy, 172
  and curriculum development, 25
  defined, 22, 23
  industry as, 28
  inter-, 28
  nature of academic, 22
  structure of, 26
Discrimination —
  and competition, 130
  and monopoly, 136
Distribution, systems of, 43
Dog, domestication, 49
Dues, union, 187

Economic stages, 81
Economic strike, 180
Economics, of industrial revolution, 96
Economic systems, 79
  of culture, 44
  elements of, 42
Economy, stages of usufacture, 62
Education —
  and automation, 211
  and child labor, 102
  as function of management, 167
  and government, 145
  and promotions, 193
Efficiency concept of, 190
Elections, union, 185
Employees —
  attitudes toward work, 194
  motivation of, 175
  freedoms of, 133
Employment, to Keynes, 148
Enclosure, as land practice, 94
Engineering —
  early status of, 73
  Roman, 74
England, before industrial revolution, 93
Enterprise, free, 132
Entrepreneur —
  and guilds, 119
  role of, 64
Entropy, 225
Environment —
  and life, 32
  man's improvement of his, 209
Eoliths, 53
Evolution, nature of, 32
Exchange, absence in family handicraft, 61
Exchange systems, economic, 81
Executive management, 164
Experimentation, and science, 120

Factory system, 72, 90, 93, 118, 123
  automatic, 220
  defined, 119
  establishment of, 70
  social impact of, 191
Family —
  form and function, 41
  usufacture unit, 62
Family economy, 82
  system, 79
Farming, evolution of, 48
Fascism, as economic system, 83
Feather-bedding, 193
Federations, unions, 187
Feedback, 215
  and cybernetics, 220
  importance of, 223
  negative, 221
Fertilization, 97
Finance, 230
Finite automation, 224
Fire —
  importance of, 45
  use by man, 36

Fishing, early methods, 47
Fixtures, 126
Flint —
  discovery of, 46
  shaping, 54
Food —
  and industrialization, 73
  man as gatherer, 45
  and societal growth, 51
Freedom —
  and capitalism, 130
  and industrial revolution, 95
  economic, 132
Free enterprise, 133
Free enterprise economy, 82
Free labor economy, system, 80

Gage blocks, 125
Genetics, 32
Geography, and industrial
    revolution, 95
Goals, of society, 43
Gold standard, 146
Government —
  and business cycles, 158
  and capitalism, 130, 133
  and depression, 150
  and industrial revolution, 99
  Keynesian role, 149
  and labor unions, 177
  regulation of industry, 101
  role of, 142, 144
  role in transportation, 145
  and socialism, 137
Governor, inventions, 108
Grimaldi man, 37
Grievances, 181
  procedure for, 182
Gross national product, 157
Groups —
  role in business organization, 169
  control by, 169
  man's need for, 176
  at work, 199
  of workers, 199
Guilds, 63
  as economic system, 84
  handicraft, 65
  role of, 77
Guild system, 67, 118
  factors in demise, 119

Handicraft —
  definitions, 59
  retail, 63
  stages of retail, 64
  as system, 84
  wholesale, 64 65
Handicraft system, 118
Hawthorne experiment, 140
Hawthorne study, 191
Heirarchy, of bureaucracy, 170
Homo erectus, 33
Homo habilis, 33, 35
Homo Neanderthalensis, 36
Homo sapien, 33, 35-36
Horn, for tools, 55
Horticulture, 52
Human relations, 139, 191
  and work, 198-200
Hunting —
  of early man, 35, 45
  methods of early man, 47
  of Neanderthal man, 37

Incentive pay, 198
Incomes —
  as base of economy, 152
  and capitalism, 133
  personal, 153
  and savings, 157
  and status, 198
  uses, 153
Independence, need for, 202
Industrial arts, functions of, 17
Industrial capitalism, 136
Industrialization, 90
  history of, 209
Industrial psychology, 195
Industrial revolution, 78, 89-113
  achievements of, 122
  causes, 95
  definition, 90
Industrial union, 178
Industry —
  functions, 16
  guild organization, 67
  as institution, 15

Industry (con't)
interdependence of, 96
and mass production, 128
nature of, 27
study of, 17
and unions, 178
Inheritance, in society, 44
Inspection functions, 168
Instruments, and machines, 114
Interest —
example of, 155
function of rate of, 157
as Keynes concept, 154
Interchangeability, and mass production, 126
International union, 186
Invention —
in industrial revolution, 96, 103, 110
result of need, 105
in textile industry, 108
Investing, by government, 152
Investment —
inducement to, 156
Keynesian role, 151
Iron, role in industrial revolution, 104
Ivory, for tools, 55

Java man, 35
Jigs, 126
Job —
automation as threat to, 210
as identity, 15
concepts of, 204
Job analysis, 162
Jobs, and automation, 232
Journeyman, in guild system, 78
Jurisdictional strike, 180

Keynesianism, 147
Knowledge —
and bureaucracy, 171
and industrial revolution, 99
need for, 232
role in curriculum, 25
structures of, 26

Labor —
and capitalism, 133
division in early workshop, 71
division in handicraft system, 67
division of, 42, 93, 143
early specialization, 52
family division of, 61
and government, 147
in guilds, 118
in industrial revolution, 95, 100, 102
status of, 75
strength of, 178
Labor systems, economic, 81
Labor unions —
development, 177-178
meet psychological needs, 176
See also Unions
Laissez-faire, 82, 101, 131, 142
Language, as symbol, 40
Learning, of culture, 40
Leisure, and automation, 211
Leisure time, 231
uses, 176
Life —
classification of forms, 33
evolution of, 32
origin of, 31
Life span, 32
Line organization, 168
Locals, of unions, 184, 186

Machinery —
and craftsmen, 76
use in agriculture, 97
Machines —
automatic, 117
and bureaucracy, 172
early definition, 116
development of, 210
in early workshops, 71
in industrial revolution, 92, 93
and inventions, 111
and labor skill, 192
and machine-tools, 118
parts of, 116
power for, 116
purposes, 116
replaced tools, 122
resistance to, 121
role in capitalism, 135
and tools, 114
and work interest, 196

Machine-tool, 117
  role in industrial revolution, 122
Man —
  evolution as producer, 28
  evolution of, 33
  features for survival, 38
  food of early, 44
  and mass production, 188
  needs of, 176, 202
  origin of, 31-38
  psychological needs of, 176
Management —
  automation as form of, 214
  in capitalism, 142
  and cybernetics, 220
  defined, 161
  definitions, 163
  functions of, 163
  government control of, 146
  of labor unions, 184
  levels of, 164
  middle, 165
  role of, 161-174
  of workers, 206
Manager —
  professional, 163
  status of, 162
Manor —
  as community, 61
  decline of, 85
  as economic system, 84
Manual Training Movement, 18-19
Manufacturing —
  in central workshop, 70
  evolution of systems, 83
  family, 60
  in industrial revolution, 108
  processes of, 189
Market —
  handicraft concept of, 63
  and laissez-faire, 143
  and prices, 139
  in wholsesale handicraft, 65
Marketing, 230
Markets —
  and factory system, 118
  and guilds, 119
  and industrial revolution, 95
Mass production, 90, 123,
  and automation, 214
  principles of, 124
  and worker, 188
Master —
  in guild system, 78
  as manager, 162
Master craftsman, 66
Materials, and industrial revolution, 95, 104
Mathematics —
  and cybernetics, 221
  and science, 120
Measurement —
  in feedback, 215
  in mass production, 124
  and standardization, 126
Mechanics, statistical, 221
Mechanization, and automation, 213
Medicine —
  computer in, 226
  and industrial revolution, 100
Medieval economy, 82
Memory, 215
Mercantile economy, 82
Mercantilism, and laissez-faire, 142
Merchant —
  evolution of, 65
  service of, 64
Merchant capitalism, 136
Merchant guild, 68
Metals, discovery of, 56
Methods —
  in curriculum, 25
  as direction function, 166
Middle management, 165
Migration, of early man, 47
Mining, and industrial revolution, 104
Minorities, and capitalism, 137
Missing link, 34
Mobility, of worker, 190
Monetary system, in society, 42
Money —
  and capitalism, 131, 133, 154
  and factory system, 119
  in Keynesian economics, 131, 148
  in usufacture stage, 84

Money economy, 85
  system, 80
Monopoly —
  and capitalism, 130
  and discrimination, 136
  guild as, 69, 119
  and industrial revolution, 98
  and laissez-faire, 142
  and patent, 215

National economy system, 79
National states, rise of, 85
National union, 186
Natural selection, 32
Neanderthal man, 36
Needs, of man, 202
Negotiations, unions in, 185
Noble, status of, 75

Objectives —
  and managers, 164
  manual training, 19
  as methods of direction, 166
  progressive education, 20
  setting by executive management, 165
  and workers, 195
Open-loop, 215-217
Opportunity, freedom of, 138
Optical scanning, 228
Organization —
  automation as form of, 214
  informal, 168
  of labor unions, 184
  management as, 163
  as management function, 165, 166, 167
  mass production as system, 123
  as union power, 180
Organization chart, 168
Owner, and manager, 161

Parts, production as concept of interchangeability, 126
Patent system, 215
Paternalism, 162
Peking man, 35
Perceptron, 224
Personnel function, 168
Philosophy, of work, 73
Physiological needs, 202
Picketing, as union power, 180
Pithecanthropus, 36
Planning, and bureaucracy, 172
Plantation, as community, 61
Plant husbandry, 97
Plants, domestication, 49
Plow, evolution of, 56
Plutocrat, 141
Policies, of unions, 185
Policy, and management, 164
Population, and industrial revolution, 95
Poverty —
  and production, 138
  and wealth, 150
Power —
  early sources, 121
  and factory system, 121
  and industrial revolution, 104, 106
  and machines, 114
  role in industrialization, 209
  sources of, 122
  union and management, 179
Precision, element in mass production, 124
Prestige, role of, 175
Prices —
  in capitalism, 130, 134, 135
  role of, 139, 145
  and unemployment, 158
Primate, man as, 33
Primitive economy, 82
Primogeniture, 44
Procedures, as direction function, 166
Production —
  in central workshop, 70
  early stages of development, 78
  goal of industry, 16
  in handicraft systems, 64
  in middle ages, 76
  ownership of means of, 137
  stages of, 230
  stages of manufacturing, 83
Production systems, 90
  economic, 81

Professions —
in industry, 173
and unions, 178
Profit —
and capitalism, 130
role of, 131
Programing, 217
Progressive Education Movement, 18, 19-22
Project method, 20, 21
Promotion, of labor force, 192
Property —
and capitalism, 130, 133
concept of, 43
and discrimination, 136
and return, 133
Proto-hominoid, 33
characteristics of, 33-34
Psychological needs, 176
Public, and labor unions, 177
Public relations, 139
Purchasing, 168

Quality control, 168

Recognition strike, 180
Religion —
early, 52
of early man, 50
Neanderthal man, 37
and science, 120
Rent, and capitalism, 133
Repetition, in work, 203
Respect, 202
Responsibility, of managers, 164
Revolution, and evolution, 91
Rice, early use, 51

Sabotage, as union power, 180
Safety, and automation, 230
Safety functions, 168
Safety needs, 202
Savings —
and income, 158
and investing, 152
and investment, 154
rate of, 156
Schools —
functions of, 22
in industrial revolution, 100
Science —
early development, 53
and early technology, 74
and factory system, 120
and industrial revolution, 99
revolution in, 120
use in production planning, 162
Scientific managment, 162, 190
Security —
as union function, 179
as union goal, 177
Security function, 168
Self-actualization needs, 202
Self-esteem, need for, 202
Self-regulation, 216
Self-sufficiency, economic, 61
Seniority, and union contracts, 183
Sensors, in cybernetics, 221
Servomechanism, 216
Servosystems, and cybernetics, 221
Sex, and division of labor, 42
Sexes, early roles of, 46
Shelter, evolution of man's, 50
Sinanthropus pekinensis, 36
Size, and bureaucracy, 171
Skills —
changing employee, 189
nature of, 232
and status, 191
with tools and machines, 115
Slave economy, system, 80
Slavery, and industrial revolution, 103
Slaves, and work, 73
Slow-downs, 193
Socialism —
and capitalism, 137
as economic system, 83
Social institutions, 15
Socialization, nature of, 39
Social needs, and work, 198
Social responsibility, 141
Social science, views society, 15
Society —
Cro-Magnon, 37
definition, 39
of early man, 50
early modern, 52

Society (con't)
economics of, 42
food-gathering, 45
individual in, 140
and individual welfare, 138
industrialization changes, 93
and industrial revolution, 89, 112
and managers, 163
needs of, 138
role of business in, 139
and work role, 196
Space age, 92
Specialization, and bureaucracy, 171
Staff organization, 168
Standardization, element in mass production, 125
Standards, concept of, 126
State capitalism, 148
Statesman, status of, 75
Status —
and job title, 197
role of, 176
of workers, 75, 191
Steam engine —
evolution of, 107
in industrial revolution, 98, 106
Stone —
polishing of, 55
for tools, 55
Strike —
forms of, 180
as union power, 180
Subject matter —
elements of, 23
and progressive education, 20
Success, need for, 202
Supply and demand, 130, 134
Symbols —
monetary, 42
use by man to learn, 40
Sympathetic strike, 180
Synchronization, as element of mass production, 127
Syntax, of discipline, 26, 27

Tariffs —
and laissez-faire, 144
uses of, 145
Teacher, in industry, 173
Technology —
based on industrial revolution, 89
effects of changes in, 229
handicraft, 60
and industrial revolution, 99, 104
interdependence, 104
and invention, 110
nature of, 27
as root of science, 53
and unions, 178
Textile production, and industrial revolution, 95
Theologian, status of, 75
Thermodynamics, statistical, 221
Thermostat, 216
Time-motion study, 190
Toolmaking, of man, 35
Tools —
defined, 114
early man, 36
evolution of, 50
and history, 72
and instruments, 114
and machines, 114
and man, 114
Neanderthal man, 37
social results of, 56
and survival of man, 53
Town economy, system, 79
Towns, growth of, 84
Trade —
and factory system, 118
and industrial revolution, 93, 99, 109, 122
and transportation, 98
world, 143
Trade economy, 82
system, 80
Trade union, 177
Transportation —
and industrial revolution, 98, 109
role of, 145
Truck economy, system, 80
Turnover, of workers, 204

Understanding, need for, 202
Unemployment —
causes, 154
and Keynes, 149

Unions —
 dues of, 187
 effects of, 183
 federations of, 187
 functions of, 179
 management of, 184
 and social needs, 199
 values of, 183
Union shop, 182
Urbanization, 15
Usufacture, 60, 83
 stages of, 62

Values —
 economic, 43
 of worker, 190, 201
Vernier principle, 125
Villages —
 growth of, 84
 growth and retail system, 63
 usufacture unit, 62
Village economy, 81
Villenage, 102

Wages —
 differentials in, 193
 goal of unions, 177, 182
 and job attitudes, 201
 role in capitalism, 140
 and unemployment, 158
 as union function, 179
Water power, in industry revolution, 106
Wealth, and poverty, 151
Weapons, evolution of, 46, 47
Welfare, and government, 146
Wildcat strike, 180
Work —
 assumptions about, 194
 attitudes toward, 190, 193, 205
 concepts of, 72, 200
 conditions of, 176
 disliked characteristics of, 203
 division of, 52
 and human beings, 140
 as identity, 15
 interaction of, 198
 interest in types of, 204
 managing to satisfy human needs, 206
 pleasure from, 205
 prestige of manual, 73
 progression in, 204
 psychology of, 195
 role of, 131, 175, 196
 and society, 42
 and status, 197
 for survival, 73
 of tools and machines, 115
 values of, 43
Worker —
 functions of, 189
 industrial, 188
 requirements of, 16
Workhouse, 103
Working conditions, during industrial revolution, 101
Workmanship, of guilds, 77
Workshop, central, 70, 78