PATENT, TRADEMARK AND COPYRIGHT JOURNAL OF RESEARCH AND EDUCATION VOLUME 4 1960

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VOLUME 4
1960
PAGES 1 TO 434

CONFERENCE ISSUE
1960
PAGES 1 TO 110

The Patent, Trademark, and Copyright Journal of Research and Education

VOLUME 4 SPRING 1960 NUMBER 1

TABLE OF CONTENTS

THE PATENT, TRADEMARK, AND COPYRIGHT JOURNAL OF RESEARCH AND EDUCATION is published by The Patent, Trademark, and Copyright Foundation of The George Washington University five times a year, quarterly in Spring, Summer, Fall and Winter with two issues during the Fall quarter; one of the two issues in the Fall quarter is a Conference Number. Second-class postage paid at Washington, D. C. To non-members, $3.50 per regular issue, Conference Number, $3.00 per copy. Printed by Judd & Detweiler, Inc., Washington, D. C.

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The Patent, Trademark, and Copyright Journal of Research and Education

VOLUME 4 SUMMER 1960 NUMBER 2

TABLE OF CONTENTS

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The Patent, Trademark, and Copyright Journal of Research and Education

VOLUME 4 FALL 1960 NUMBER 3

TABLE OF CONTENTS

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The Patent, Trademark, and Copyright Journal of Research and Education

VOLUME 4 WINTER 1960 NUMBER 4

TABLE OF CONTENTS

RESEARCH PROJECT REPORT

Federal Patent Policies in Contracts for Research and Development
Donald Stevenson Watson, Harold F. Bright, Arthur E. Burns

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FOREWORD

This report is a study conducted by The Patent, Trademark, and Copyright Foundation of The George Washington University pursuant to a contract with the General Services Administration. It was undertaken as a result of a research proposal submitted to the Interdepartmental Committee Study Group to Consider Government's Contract Patent Policy, established by the Administrator of General Services. Under the terms of the agreement, entered into by the Administrator of General Services and The George Washington University in December, 1959, the study was to be completed in approximately one year. Prior to this agreement, the feasibility of Foundation participation was explored in some detail by Executive Director Harris with the Interdepartmental Study Group. The purpose of the study is two-fold: (1) to provide a method for accumulating factual information and (2) within the limits of the time and funds available, to marshal such information, analyze and present it in a report which should be useful for policy decisions by the agencies concerned.

As is customary with the research projects of the Foundation, the Principal Investigator, Dr. Watson, the Associate Investigator, Dr. Bright, and the Consultant, Dr. Burns, had the benefit of the advice and consultation of the officers and research staff of the Foundation with respect to the questionnaires, procedures, and preparation of this report. Thus, the authors were enabled to derive full advantage of the multiple disciplines represented by Foundation personnel.

This project is the second undertaking conducted by the Foundation for a government agency. The project was construed as eligible for study by the Foundation as part of its program under Area VII—Governmental. Copies of this report have been transmitted to the General Services Administration. In conformity with the practice of the Foundation, the report on this project is published in the Foundation's *Journal*. Under the terms of the contract with the General Services Administration, the Government has complete right to publish, have published, or authorize publication of this study.

Oswald S. Colclough
Director
The Patent, Trademark, and Copyright Foundation and
Acting President
The George Washington University

L. James Harris
Executive Director
The Patent, Trademark and Copyright Foundation

PREFACE

This study of patent policies in government-financed research and development contracts has been conducted on a small scale. Our main purpose has been to describe the actual operation of federal patent policies, and to measure that operation against criteria of the public interest.

Our debts to others are large. Officials of the federal agencies mentioned in the study have been most helpful with advice and explanation. Business executives and patent attorneys have also given us the benefits of their knowledge and insight. Other members of the research staff of The Patent, Trademark, and Copyright Foundation offered many useful suggestions based on their experiences in patent research. The many business firms, research organizations, and universities that answered our rather complicated questionnaires provided us with most of the factual information that underlies the study. Above all, we are indebted to L. James Harris, Executive Director of the Foundation for his many helpful and stimulating suggestions. Executive Director Harris supervised the preparation of the legal appendix.

But we alone bear the responsibility for the method of the study, for its results, and for the errors that remain. Though the study is a joint product, primary responsibilities are borne as follows: For the design of the study and for Chapters 1, 2, 3, and 6—Watson; for Chapter 4—Watson and Bright; for Chapter 5—Burns; and for Chapter 7—Watson, Bright and Burns.

Donald Stevenson Watson
Harold F. Bright
Arthur E. Burns

December, 1960

LIST OF TABLES

Federal Patent Policies in Contracts for Research and Development

DONALD STEVENSON WATSON, Principal Investigator

HAROLD FREDERICK BRIGHT, Associate Investigator

ARTHUR EDWARD BURNS, Consultant

Dr. Watson and Dr. Burns are Professors of Economics and Dr. Bright is a Professor of Statistics at The George Washington University

A Study of the Professional Color Motion Picture Antitrust Decrees and Their Effects*

GEORGE E. FROST, Principal Investigator
S. CHESTERFIELD OPPENHEIM, Principal Consultant

SUMMARY

AN UNAIDED SINGLE SENSITIZED photographic medium is "color blind." That is, the image produced can be displayed only in some range of colors and as a single image. Where the range of colors approximates the visible spectrum, conventional black and white reproduction is obtained. Motion pictures in full color have generally required some method of making color separation images on emulsions responsive to three primary colors and of reconstituting the separations in their respective colors and in registration to give the illusion of a single picture in full color.

Color separation and image reconstitution can be accomplished directly by "additive" techniques. These methods are based on taking a motion picture frame for each color and thereafter projecting the positive prints in registration through appropriate filters onto the viewing screen.[1] This theoretically simple approach was the subject of much interest. Stubborn practical problems, however, prevented commercial application of "additive" techniques. As a result, until about 1935 the only commercially significant professional[2] color motion picture techniques were inherently unfaithful two-color processes used by Technicolor, Multicolor, and others.[3]

The Technicolor three-color process was perfected about 1935. From that time until at least 1945 this process was the only available source of quality professional color motion pictures. The process was based on the three-strip camera for live action photography and the imbibition process for print making. The camera exposed three motion picture films in unison. It was necessarily bulky, intricate, and

* The authors acknowledge the aid of Mr. and Mrs. Richard Kasperson and Mr. Neil Twomey in the preparation of this report on *Project 4a*, Effects of Certain Antitrust Decrees Involving Patents As a Major Factor.

[1] See, e.g., Edison patent 1,138,360, filed June 16, 1913.

[2] The term "professional" motion pictures is here used to designate shorts and features intended for theatre exhibition on paid admissions and using 35mm. or larger film size. Such motion pictures are here distinguished from amateur, scientific, and commercial motion pictures. Professional motion pictures usually differ from other motion pictures in (a) more exacting standards of quality (including color fidelity), (b) greater use of fades, laps, dissolves, and artistic effects generally, and (c) a larger number of prints.

[3] Technical Appendix, Parts 2 and 6.

expensive.[4] The imbibition process entailed printing of the three primary color images in sequence by dye transfer to the imbibition "blank" film. It required a high degree of skill, careful process control, and a heavy investment in equipment.[5] By concentrating on these difficult techniques until success was achieved, Technicolor provided full color professional motion picture services much sooner than they would otherwise have been available.

Despite the extensive technical development required for the Technicolor three-strip camera and the imbibition release print making process, the basic procedures and arrangements in each instance were old and well known. Technicolor has not, therefore, ever had basic patent rights to the camera and print making process it employed.

Technicolor was formed in 1915. Prior to development of the three-strip camera and the imbibition print making process, it explored a number of other techniques. In some instances it pursued approaches found impractical by others. These efforts had an important consequence in Troland Reissue patent 18,680. This patent was directed to what may be termed "monopack" color photography.[6] The patent issued after a Patent Office interference proceeding involving a number of patent applications, including an application by Mannes and Godowsky, to which Eastman had rights.[7] The subject matter of the interference was sufficiently broad to encompass Kodachrome, soon to be introduced by Eastman. After Troland (and hence Technicolor) won the interference, Eastman took license from Technicolor. The license included a complex provision, effective as to motion picture film of 35mm. size and larger, giving Technicolor a limited period during which it would be the exclusive processor of such film.[8]

From the date of the Troland license to December 1945, Eastman advised inquirers that Kodachrome was not commercially feasible for professional motion pictures and that the film would have to be processed by Technicolor. The license provisions as to Technicolor processing were cancelled in December 1945. The license as a whole terminated in 1948 when the Troland patent expired.

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[4] *Ibid.*, Part 4.

[5] *Ibid.*, Part 3.

[6] Full data on the patents here cited are given in the Bibliography (to appear in the Summer 1960 issue of this *Journal*). Unless otherwise indicated the term "monopack" is here used to designate multilayer film type color materials generally. Commercially important monopack films include Kodachrome, Ektachrome, Anscochrome, and the Eastman professional color motion picture camera, intermediate and release print films. The term "monopack" is sometimes used in more narrow senses, such as 35mm. color reversal film (e.g., Kodachrome). Paragraph 11(3) of the complaint filed in the case here studied (U.S. v. Technicolor, Inc., Technicolor Motion Picture Corp. and Eastman Kodak Co., No. 7507-M, Southern Dist. of Cal., 1947) defines the term "monopack" in the more narrow sense of reversal type film, such as Kodachrome. The term appears in this more narrow sense in the various court documents, although in most instances the distinction is not important. In the Eastman-Technicolor processing agreement of April 5, 1938, Exhibit C to the complaint, the term is not confined to reversal type film, although the only film processed under the agreement was Kodachrome, which is of the reversal type.

[7] Eastman Kodak Company is referred to herein as "Eastman." The company is referred to in many of the court documents as "Kodak."

[8] See page 7, *infra*.

Technicolor purchased essentially all of its film requirements from Eastman. Beginning about 1939, it engaged in developmental efforts with Eastman on the use of monopack camera film in lieu of the three-strip camera technique. Technicolor and Eastman also entered into contracts under which Technicolor agreed to purchase at least 50% of its negative and positive raw film from Eastman, provided that Eastman invested certain sums in imbibition process research.

The antitrust action here studied arose on government complaint filed in May 1947 against Technicolor and Eastman. Violations of the Sherman and Clayton Antitrust Acts were charged. As to the defendants jointly, the Troland patent license agreement and the imbibition process agreements were given primary emphasis. It was charged that through the license, Technicolor foreclosed Eastman competition in professional monopack film. As to the imbibition process agreements, the government contended that Technicolor had obtained the benefits of the Eastman research facilities and had foreclosed competitors from imbibition process developments in consideration of agreement to purchase film requirements from Eastman. Additional allegations of the complaint were directed to Technicolor alleged tying practices relating to the three-strip camera, the imbibition process services, film, and other items.

The antitrust action was concluded as to Eastman by consent decree entered in 1948. It was concluded as to Technicolor by a consent decree entered in 1950. Each consent decree required licensing of some patents royalty free and other patents on royalty basis, and in addition required that technical information be furnished to licensees. The Eastman decree required licensing of some 27 patents, either on a royalty-free basis or at a royalty rate not in excess of royalties paid by Eastman to others. The Technicolor decree was more stringent in that it required royalty-free licensing of some 92 patents constituting all or nearly all of the patents then owned by Technicolor. The Eastman decree did not require licensing of Hansen patent 2,449,966 or Vittum patent 2,428,054. These patents were destined to have considerable importance in connection with the major post-decree industry development, namely introduction to the Eastmancolor materials.[9]

It is concluded in the present report that none of the compulsory licensing decree provisions has had substantial effect on professional color motion picture industry, that the key industry development since the decrees (Eastmancolor) occurred without regard to the decrees, and that research and development in the industry has a much greater effect on market competition than the antitrust decree provisions.

The Eastmancolor materials were introduced in 1950. These materials included Eastman Color Negative Film, Eastman Color Print Film, and intermediate films. The color negative film was of the monopack type suitable for use in conventional motion picture cameras. It was similar to Kodacolor still camera film. The color

[9] The term "Eastmancolor" is here used to designate collectively the monopack color motion picture films introduced by Eastman in 1950. The full terms "Eastman Color Negative," "Eastman Color Intermediate," and "Eastman Color Print" are used by Eastman to identify the various films making up what is here referred to as the Eastmancolor materials. Motion pictures made with these materials are sometimes referred to as in "Eastmancolor."

print film was likewise of the monopack type and was intended primarily for printing from a monopack negative intermediate film, thus providing a relatively simple optical procedure. Eastman initially recommended that to preserve color fidelity in the usual four-step motion picture print-making procedure, at least one step should be made using color separations. By 1953 improvements in the color negative and intermediate films led to the recommendation of an all-monopack printing sequence without the use of color separations and the attendant expense and complexity.

Two main technical developments were used in the Eastmancolor materials. One was the colored coupler principle.[10] The other was improved methods of coating the film base with emulsions having the required uniformity of thickness. At least the colored coupler principle did not exist until shortly before the Eastmancolor materials were introduced. It was a significant contributing factor to the overall color quality attained. For this and other reasons it is not believed that Eastmancolor in the form offered could have been introduced at an earlier date, regardless of the antitrust decree. It is further concluded herein that the Eastman failure to promote professional motion picture monopack materials at an earlier date was consistent with good business judgment, taking into account the quality of the available materials, the Technicolor competition, and the existing Eastman market position. This conclusion finds support in the experience of Ansco. Beginning in 1945, this experienced film manufacturer introduced professional monopack materials, exerted every effort to promote the materials, and yet failed. The experience of du Pont provides some further support for this conclusion.

In considerable measure the government viewed Eastman as the victim of Technicolor demands based on the Troland patent rights, including demand that Eastman not offer a monopack film. It is obvious that Eastman preferred the license to litigation. The facts do not support a conclusion that Technicolor was in a position to coerce Eastman, or that it did so. Eastman was at all times entirely free to introduce a professional monopack film—the patent and license expired in 1948—and there is no reason to believe that the 1945 cancellation of the criticized provisions was less than genuine. Yet the Eastmancolor materials were not introduced until 1950, and then in a form subject to substantial later improvement. A more realistic appraisal of the Troland license is that Technicolor feared the inevitable monopack competition, it sought a head start in adapting itself to the new technique when it came, and Eastman agreed to the provisions because they did not limit its right to introduce the film or form a substantial impediment to the successful promotion of an otherwise acceptable film.

The body of this report concludes with a discussion of research and development in photographic industry generally and the effect of such activity on market competition. The conclusion is reached that research and development is a major influence on competitive marketing activity and that patent rights are an important stimulus to such research and development. It is also concluded that the industry, especially in the professional motion picture field, exhibits a definite tendency toward

[10] Technical Appendix, Part 5b.

concentration. New products based on research and development provide some balancing market force to this tendency, and a continuing threat to entrenched market positions. As the facts of the present study indicate, antitrust decrees are relatively ineffective on the industry as compared with the influence of new technical developments.

The Technical and Historical Appendix to the report traces the development of the important color motion picture techniques and the business concerns whose activities have been predicated upon these techniques. This appendix is available on request.

Part I

THE ANTITRUST PROCEEDINGS

THE ANTITRUST PROCEEDINGS HERE studied were instituted by complaint against Technicolor and Eastman filed on August 18, 1947.[1] The proceedings terminated in two consent judgments, one entered with respect to Eastman on November 26, 1948 and the other entered with respect to Technicolor on February 28, 1950.

The Complaint

The complaint was filed by the government under Section 4 of the Sherman Act and Section 15 of the Clayton Act. Violations of Sections 1 and 2 of the Sherman Act and Section 3 of the Clayton Act were alleged. Paragraph 13 of the Complaint charged monopolization by Technicolor of "professional color cinematography," namely (a) photographing, renting cameras, and supplying negative film, (b) processing the exposed film and (c) making and selling projection prints (release prints) for motion picture commercial exhibition. Paragraph 13 further alleged a combination and conspiracy between Technicolor and Eastman to restrain trade in and to monopolize "professional color cinematography."

With respect to the status of Technicolor, the complaint alleged:[2]

> Technicolor does over 90% of all the business in professional color cinematography in the United States. Since 1934 it has produced the positive film prints for all of the "Class A" feature length motion pictures and most of the short subjects and animated cartoons produced in color by the motion picture industry of the United States. Technicolor's net sales amounted to $11,614,779.66 in 1945, and it annually produces, sells, and ships more than 160 million linear feet of positive film prints of motion picture productions in color. Motion pictures filmed in color today represent from 15% to 20% of all feature length

[1] U.S. v. Technicolor, Inc., Technicolor Motion Picture Corp., and Eastman Kodak Co. No. 7507-M, Southern Dist. of Cal.

[2] *Ibid.*, para. 9.

pictures exhibited in theatres in the United States. Facilities for filming and processing motion pictures in color, however, have been and are insufficient to meet the demand.

Paragraph 12 further alleged:

> By June 25, 1934, Technicolor had acquired substantial control of professional color cinematography in the United States, and of the interstate and foreign commerce comprised in and incident to the business of professional color cinematography. For a period of several years prior to that date, Technicolor and Kodak, having respectively acquired various inventions, patents, and patent rights, relating to the "monopack" method of color cinematography, were engaged in independent efforts to develop and perfect said "monopack" method. At that time the manufacture and processing of "monopack" film for color cinematography had not yet been sufficiently perfected to enable either Technicolor or Kodak to exploit said "monopack" method commercially. The prospective development of the "monopack" method, if controlled by others than Technicolor, threatened Technicolor's control of professional color cinematography.

The complaint included extensive allegations with respect to a series of agreements between Technicolor and Eastman. Because of their importance to the cause of action alleged, these agreements require a somewhat detailed discussion here.

The first agreement set forth in the complaint was the "License Agreement" of June 25, 1934. With respect to this agreement the Government charged that "Technicolor was . . . protected against any potential competition based on the 'monopack' method." [3] It was further alleged that under this agreement "The field of commercial processing of wide 'monopack' film for motion picture purposes was allocated to Technicolor, and Kodak covenanted not to engage in the commercial processing of wide 'monopack' film . . ." [4]

The complaint also alleged that: [5]

> The covenant on the part of Kodak in the License Agreement of 1934 not to engage in the commercial processing of wide "monopack" film, nor to license others to process such film, nor to sell such film with the right for the customer to process it, was subject to automatic termination when any of certain specified events should occur. None of these events has occurred.
>
> By means of the License Agreement of 1934, the defendants intended to and did enable Technicolor to control and monopolize professional color cinematography. Technicolor was thereby protected against any potential competition based on the "monopack" method.

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[3] *Ibid.*, para. 16. For discussion of monopack type film, see Technical Appendix, Part 5b. Kodachrome is the most well-known type of monopack film. Eastmancolor film materials, introduced in 1950, are the most important such films used in 35mm. professional motion pictures.

Technicolor did not use monopack camera film until about 1939, when experiments started with Eastman. After the introduction of Eastmancolor, conventional cameras using the Eastmancolor monopack negative camera film (Eastman Color Negative Film) replaced the cumbersome Technicolor three-strip cameras.

The Technicolor imbibition release printing process involves the successive transfer of three dye images onto a mordanted blank film base. See Technical Appendix, Part 3. It is technically unlike monopack release printing, but is competitive with such printing.

[4] *Ibid.*, para. 14(c). "Wide" film was defined as not less than 35 millimeters in width and "narrow" film as less than 35 millimeters in width. Normal professional motion picture photography is on 35 millimeter film.

[5] *Ibid.*, para. 15 and 16.

The 1934 Agreement was elaborate and complicated. In an apparent effort to cover all the contingencies, the circumstances under which Eastman would not engage in processing monopack film were set forth in detail. The substance of the Agreement, insofar as it related to processing of 35mm. motion picture film, may be summarized as follows:

1. Eastman could market wide (e.g., 35mm.) film if it chose to do so.

2. At least six months before marketing such film, Eastman was to give Technicolor a demonstration of its best processing methods. Technicolor had a three month option period after such a demonstration within which to elect to equip a laboratory for the processing of wide film.[6] If Technicolor failed to make such election, the provisions as to processing by Technicolor would not become effective.

3. If Technicolor elected to set up processing facilities, Eastman could provide processing facilities up to 200,000 feet of film per week (about 10 million feet per year), such processing to be discontinued when Technicolor was ready to take over such processing.[7] Thereafter, for a period of time, Eastman was not to engage in processing or license others to do so.

4. The time would terminate (a) one year after Technicolor processed wide film to an average of four million feet per month for six consecutive months, (b) three years after Technicolor began processing such film, or (c) three years and nine months after Eastman had processed an average weekly output of fifty thousand feet for thirteen consecutive months.[8]

The longest period of exclusive processing that Technicolor could have—and the longest period Eastman would not be free to process—was three years under (b), above. This period would not necessarily be the first three years after Eastman marketed wide film. Eastman could, however, introduce a wide film with the assurance that if the film were reasonably successful the Technicolor processing rights would terminate within less than about four years from the date the film was introduced.

The Agreement also included extensive provisions to assure Technicolor of supplies of wide monopack film to Technicolor, if such film were introduced by Eastman.[9]

On December 20, 1945 the 1934 Agreement was cancelled as to the above provisions of Article 3. The government alleged that this took place "during the course and with knowledge of an investigation being conducted by the (government) of the violations of law herein alleged." [10] The government further alleged that "Kodak has since continued to refrain from the commercial processing of wide 'monopack' film, from licensing others to engage in such processing, and, with minor exceptions, from selling such film with the right to process to customers other than Technicolor." [11]

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[6] *Ibid.*, Exhibit A, article 3A. "Wide Film" was defined as 35mm. and wider.

[7] *Ibid.*, Exhibit A, article 3C.

[8] *Id.*

[9] *Ibid.*, Exhibit A, article 3B (requiring Eastman to sell to Technicolor at prices as favorable as those of other customers), article 3D (providing that Technicolor shall have the right to make wide film or have it made if Eastman should discontinue a wide film, once marketed), article 3E (providing that Technicolor shall have the right to make wide film or have it made if Eastman should not supply Technicolor orders).

[10] *Ibid.*, para. 18.

[11] *Id.*

The terms of the Agreement left Eastman free at all times to make and sell wide (e.g., 35mm.) monopack film if its economic interests dictated. It was not until 1950 that Eastman did market a wide monopack film (Eastmancolor). Processing of such film has been open to anyone seeking to do so.

The second agreement set forth in the government complaint [12] was the April 5, 1938 Agreement under which Technicolor was licensed to process 16 millimeter monopack film. The license was limited to film purchased from Eastman and used to make 16 millimeter reductions of wide (35mm.) motion picture film made by the Technicolor process. The third agreement set forth in the complaint [13] was the somewhat similar January 2, 1942 Agreement. Under this agreement Technicolor was licensed to process 16mm. monopack color film (a) purchased on the open market by Technicolor and exposed as part of an original commercial production of a wide film reproduced by the Technicolor process and (b) to make one copy of such film for cutting and editing purposes.

Finally, the complaint set forth the "Kodak-Technicolor Imbibition Agreement" of October 22, 1936.[14] Under this agreement Eastman agreed to undertake research on the imbibition process at least to the extent of $50,000 within the next five years. The agreement provided for a license from Technicolor to Eastman under the Technicolor patents and applications to the imbibition process if (a) Eastman had expended $150,000 in the research and (b) Technicolor had failed to purchase 50% of its requirements of negative and positive raw film from Eastman. Finally, Eastman granted to Technicolor an exclusive license for imbibition process purposes to patents and applications resulting from the research so long as Technicolor purchased from Eastman at least 50% of its requirements of negative and positive raw film from Eastman used in connection with the imbibition process. This agreement was cancelled on October 30, 1944. The government alleged that this cancellation was "during the course and with knowledge of the investigation leading up to the complaint." [15]

The complaint further alleged that from the time of the 1934 license agreement Technicolor purchased substantially all its requirements of film from Eastman.[16]

Finally, the complaint alleged that Technicolor required motion picture producers to accept tying clauses and restrictive provisions requiring them (a) to use Technicolor cameras exclusively for each production contracted to be photographed by the Technicolor method (b) to purchase all unexposed negative film for such production from Technicolor (c) to purchase all positive film prints of such production

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[12] *Ibid.*, para. 19.

[13] *Ibid.*, para. 20. The film to which the agreement was applied was Kodachrome.

[14] *Ibid.*, para. 22.

[15] *Ibid.*, para. 24. Eastman expended a total of $235,471.68 in research on the imbibition agreement. *Second Supp. to Agreed Statement of Facts*, para. K-249. A number of patents resulted from or were connected with the imbibition agreement. *Ibid.*, para. K-277. One patent covered the blank film supplied to Technicolor in 1948. *First Supp. to Agreed Statement of Facts*, para. 118.

[16] *Complaint*, para. 25.

from Technicolor and (d) to use Technicolor's processes for all the photographing of each such production.[17]

The government complaint concluded with a lengthy statement of the alleged effects of the practices and agreements. The following are typical and of present importance.[18]

> (d) Motion picture producers and others have been hindered, delayed, and prevented from establishing facilities of their own for color processing and from engaging on their own behalf in the business of professional color cinematography.
>
> * * * *
>
> (f) Film manufacturers have been deprived of a competitive market for the sale of film usable in professional color cinematography.
>
> * * * *
>
> (i) Technicolor has been enabled to maintain, and has maintained, a monopoly of professional color cinematography and the interstate and foreign commerce comprised in and incident to the business of professional color cinematography, to the exclusion of all potential competitors.

At the time the complaint was filed, the following appeared in the trade press:[19]

> Washington, Aug. 18.—The Justice Department disclosed here today that it had filed an antitrust suit charging Technicolor, Inc. . . . with monopolizing professional color cinematography and with having conspired with Eastman Kodak Company to restrain and monopolize the business in violation of the antitrust laws.
>
> A 'Popular' Trust Suit
>
> One film official, who asked not to be quoted by name, said that "This is one antitrust suit which will be popular with everybody in the industry but Technicolor."
>
> He pointed out that several motion picture companies had run into a stone wall trying to develop their own color film photography, and declared that "maybe color costs will come down now."
>
> A Department spokesman said that the suit against the Technicolor companies and Kodak was the result of a "long line of complaints" from many motion picture companies.

The Answers

In its answer filed on December 8, 1947, Eastman alleged that in addition to the Technicolor three-strip camera, successive exposure technique, and the use of monopack film there were various alternate methods of taking color motion pictures. It also alleged that in addition to the Technicolor imbibition process and

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[17] *Ibid.*, para. 26.

[18] *Ibid.*, para. 27.

[19] *Motion Picture Daily*, August 19, 1947, p. 1.

monopack film there were various alternate methods of printing release prints in color. The answer further alleged that "while additional color positives for projection may be produced from a monopack original, such additional positives, when printed on monopack film, are excessive in cost, and inferior to the standards of quality necessary for theatrical motion pictures." [20]

In an answer filed on January 8, 1948, Technicolor likewise alleged that there were many other color motion picture photography methods in addition to the successive exposure, three-strip, and monopack methods alleged in the complaint, as well as other motion picture release printing methods in addition to the imbibition and monopack methods. In similar fashion Technicolor alleged that "the manufacture and processing of monopack film had not been sufficiently perfected to enable Technicolor to use monopack film." [21]

Both answers admitted the agreements but denied violation of the antitrust laws.

The Consent Decrees

A consent decree with respect to Eastman Kodak Company was entered on November 24, 1948. By paragraph IV-A of this decree Kodak was required to grant royalty free licenses under 13 patents and by paragraph IV-B was required to grant licenses under 14 additional patents at royalties no greater than paid by it to others.[22] In addition, paragraph V of the decree required Kodak to grant reasonable royalty licenses "for processing, selling or distributing professional color motion-picture film" under any United States patents applied for or issued to Kodak within five years from the date of the judgment. The decree, paragraph VIII, requires Kodak to provide licensees with a written manual of Kodak's processing practices.

The decree as to Eastman included provisions requiring Eastman to make "professional" color film available without discrimination and forbidding various tying practices relating to the sale of such film, patent licensing, research, and other activities.[23] These prohibitions included an injunction against selling professional color motion picture film on condition that the person with whom Eastman dealt would have "professional color motion-picture film processed by any one or more specified persons." [24] This provision appears to have been regarded as forbidding the refusals to sell such film without inclusion of the processing charge. It was

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[20] *Eastman Answer*, para. 11.

[21] *Technicolor Answer*, para. 12.

[22] This number of patents should be compared with the total of 4041 patents owned by Eastman on December 31, 1955. See Federico, *Distribution of Patents Issued to Corporations*, Study No. 3., Subcommittee on Patents, U.S. Senate, 84th Cong., 2d Sess., p. 20. This figure represents all Eastman patents. Many Eastman patents do not relate to photography.

[23] *Eastman Decree*, para. X. "Professional color motion-picture film" under this decree was not limited as to size. The decree accordingly expressly covered 16mm. film.

[24] *Ibid.*, para. XF.

the forerunner of the 1954 consent decree, which more specifically prohibited such refusals as to still film and as to motion picture film less than 35 mm. in width used by the general public.[25]

Consent judgment with respect to Technicolor was entered on February 28, 1950. The judgment terminated the various contracts referred to in the complaint.[26] It also enjoined conditioning the availability of services and materials on the use of cameras, films, or release prints obtained from Technicolor.[27] The judgment included elaborate provisions relating to patent licenses and to disclosing technology to others.

Under paragraph IV-A of the consent judgment Technicolor was required to grant royalty-free licenses to all applicants under 92 patents listed in the decree. Only 20 of these patents, however, had more than ten years to run at the time of the decree. Paragraph IV-B required the grant of reasonable royalty licenses to all applicants on some 60 additional patents and patent applications, together with all patents issued to or acquired by Technicolor within the period ending November 28, 1953.[28] Since Technicolor owned approximately 101 live patents on December 31, 1955,[29] it is evident that the patents and applications covered by the judgment included all or nearly all the patents and applications owned by Technicolor at the time of the decree. In addition Technicolor is required by paragraph VII of the decree to provide technical information to licensees.

Immediately following entry of the Technicolor decree, the following appeared in the trade press:[30]

> Los Angeles, Feb. 28—Fred A. Weller, counsel and executive secretary of the Independent Theatre Owners of Southern California and Arizona, who in his former capacity as a member of the antitrust division of the Department of Justice investigated and prepared the government's action against Technicolor and Eastman Kodak issued today a four page release to the press criticizing the government for accepting decrees without imposing penalties.

The following statement from the Department of Justice was reported in the press at the time of the Technicolor decree:[31]

> Washington, March 2—U.S. Attorney General J. Howard McGrath and the antitrust chief Herbert A. Bergson today hailed the recent Technicolor consent decree.
>
> McGrath pointed out that many factors contribute to the production of a color motion picture—the film, cameras, photography, processing of negatives and film prints, and "his judg-

[25] *Final Judgment,* U.S. v. Eastman Kodak Co., No. 6450, W.D.N.Y., December 21, 1954, especially para. VA.

[26] *Technicolor Decree,* para. VIII.

[27] *Ibid.,* para. IX.

[28] This date was the cut-off date for compulsory licensing of new applications and patents under the Eastman decree.

[29] Federico, *op. cit.,* p. 29.

[30] *Motion Picture Daily,* March 1, 1950, p. 1. On the Friday preceding entry of the Eastman decree, George J. Schaefer, Board Chairman of Keller-Dorian Colorfilm Corp., telegraphed the court protesting the entry of the decree. At the time, Keller-Dorian had a law suit pending against Eastman and Technicolor. See Technical Appendix, Part 5a. *Motion Picture Daily,* Nov. 23, 1948, p. 4.

[31] *Motion Picture Daily,* March 3, 1950, p. 7.

ment confirms the general position of the government that each of these products and services should be made available on the basis of free competition without restrictive agreements or illegal tie-ins."

Bergson said the government's case was aimed at preventing restrictive technical and commercial arrangements from blocking technological advances in color films. "By making Technicolor's patents and know-how available," he declared, "by opening up the Technicolor three-strip camera to independent manufacture and use, and by removing tie-in provisions from Technicolor's arrangements with motion picture producers, we have solved this problem and put an end to the technological restraint in this case."

Another contemporaneous report touched on the attitude of Cinecolor, and read:[32]

Hollywood, March 2—In response to press inquiries regarding the effect Technicolor consent decrees might have on Cinecolor, the latter company issued a release stating: As previously reported, Cinecolor will be ready in June to use Ansco color and the new Eastman color films as photographic media in conjunction with the new Cinecolor three-color process. The consent decree of Technicolor will not alter these plans. It does, however, open up another avenue which can also be used in connection with the Cinecolor three-color method.

Technicolor issued the following statement with respect to the decree:[33]

The decree does not terminate any contracts between Technicolor and its customers. . . .

The decree purports to terminate certain contracts between Technicolor and Eastman Kodak Company. Actually, we have not operated under any of those contracts for several years.

Under the decree, Technicolor will grant licenses under its patents. The decree sets forth a list of patents under which Technicolor will grant to each applicant a non-exclusive license without royalty and without know-how, and it sets forth another list of patents under which it will grant a non-exclusive license on a reasonable royalty with know-how. The applicant must apply for the license in good faith and must accept the ruling of the Court as to the amount of royalty in the event that Technicolor and the applicant cannot agree as to what is a reasonable royalty.

In the event that such a royalty-paying license has been entered into, Technicolor will give know-how to the licensee in the form of a manual or equivalent statement stating the methods and technical information known to and used by Technicolor in its commercial practice of manufacturing motion picture prints in color at the date of the entry of the consent decree which is relevant to the practice of such licensed patents. Technicolor has long been willing to license its patents.

Technicolor is extremely proud of its history as a pioneer in the use of color in motion pictures. The name "Technicolor" has always stood for the highest quality and will continue to do so. Nothing in the decree permits the use of the name "Technicolor" without the permission of Technicolor. It is through continuation of its policy of expenditure for research, of constant further development of its apparatus and procedure, of improvement of its services, and fair prices that Technicolor expects to maintain an outstanding position in the field of color motion pictures.

Technicolor has agreed to the entry of this decree because it believes it affords a practical basis for a settlement of its difficulties with the Government and to avoid the time and expense of a long protracted trial. . . .

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[32] *Id.*

[33] Statement of Dr. Kalmus, Feb. 27, 1950, printed in *1949 Annual Report*, pp. 5-7. Unless otherwise indicated, annual reports here referred to are the Technicolor Annual Reports.

Part II

DEVELOPMENTS SINCE THE ANTITRUST DECREES

AT THE TIME OF THE TECHNICOLOR consent decree in 1950, the industry concensus was that other concerns would not set up imbibition facilities because of the large investment required. In the words of a contemporaneous report:[1]

> Little Change—Actually Hollywood isn't stirred up much by the latest development in the case. Even with Technicolor's storehouse of knowledge available for the asking, no major studio—in these days of strict economy—is willing to lay out at least $2-million for a pilot-plant duplication of the Technicolor process.
>
> There is an added deterrent as well in the new color films and color-film processes that have hit Hollywood recently. . . . Particularly noteworthy are the Eastman and duPont offer in so-called negative-positive types of film that can be shot in regular black-and-white cameras and require relatively simple processing afterwards. Then there's Cinecolor, an older contender in the field, that expects to offer its new 3-color film at about 5¢ a foot for release prints as against Technicolor's charge of slightly more than 6¢ per foot.
>
> Fair Prospects—Nevertheless Hollywood expects that Technicolor will roll merrily along for some years yet. The company says that it can bring down the price of its finished prints as low as 4½¢ per foot to meet the competition, and it has expanded plant capacity until it can process 320 million feet a year.

These predictions have proven correct as to competition in imbibition film processing. In 1953 Technicolor did license DeLuxe Laboratories to build imbibition processing facilities in New York. This license, however, was only partially under the decree and contemplated many aspects of a joint venture rather than a wholly competitive enterprise. Indeed, Pathé Laboratories filed suit based in part on antitrust law violation contentions as to the license.[2] DeLuxe ultimately decided not to install imbibition printing facilities and has not operated under the license. Technicolor has remained the only source of imbibition prints for the professional industry.

In other respects, however, sweeping changes have taken place in the field of professional color cinematography. At the time of the 1948 decree against Eastman there were definite indications that practical monopack professional color photography would soon be developed. Ansco color, for example, is reported to have been used to the extent of 24 million feet in 1947 and 1948,[3] and in 1949 M-G-M filmed at least one feature film in Ansco color.[4] The monopack film destined to enjoy the major demand was Eastmancolor, introduced in 1950 and

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[1] *Business Week,* March 11, 1950, p. 25. In 1944 a single imbibition transfer machine, with tax, cost Technicolor almost $100,000. Technicolor Motion Picture Co. v. Westover, 202 F.2d 224 (9th Cir. 1953). In 1953, the Technicolor balance sheet showed land, buildings, machinery and equipment, after depreciation, at over $6 million. On August 1, 1953, Technicolor reduced its "base price" to 4.98 cents per foot from the earlier figure of 5.44 cents. *1954 Film Daily Year Book,* p. 141.

[2] Pathé Laboratories, Inc. v. Technicolor, Inc., *et al,* Civil 94-152 S.D.N.Y., 1954.

[3] *Film Daily Year Book, 1948,* p. 111.

[4] *Film Daily Year Book, 1949,* p. 91.

in common use by 1952. This film provided negative-positive type color camera and release print technique of good quality and incorporated the flexibility necessary for practical utilization by the professional industry.

Eastmancolor camera and release print materials are suitable for processing by comparatively small independent processors and by the processing laboratories of the major studios. However, the Technicolor imbibition process has continued to enjoy advantages when a considerable number of release prints are to be made. Technicolor has continued to make a substantial proportion of the total release prints. Eastmancolor negative film, however, provides practical color camera technique without the complex inflexible and expensive Technicolor three-strip camera. Eastman color negative film is now used on essentially all motion pictures for which Technicolor imbibition release prints are made. The Technicolor three-strip camera is practically obsolete.

The advent of practical monopack professional color technique has had a more severe effect on Cinecolor. In its peak year, 1949, Cinecolor processed about 115 million feet of film using its two color process. In 1951 Cinecolor introduced a new three color process called Supercinecolor. In 1954, however, both the Cinecolor and Supercinecolor processes were discontinued.[5]

In the years immediately following the 1950 Technicolor consent decree, the motion picture industry went through another important technical change. This was the trend to Cinerama, Cinemascope, and other schemes designed to provide three-dimensional effects.[6] These films imposed additional performance requirements on Technicolor, which were met after some developmental effort. Technicolor is currently emphasizing wide film techniques and especially its "Technirama" system.[7]

The following more detailed discussion of events is divided into two parts. The first part relates to Technicolor because this company is of particular interest in assessing the effects of the decrees. Secondly, Eastman is discussed.

Technicolor

THE TECHNICOLOR BUSINESS ACTIVITY may be divided for present purposes into (a) professional color film processing, three-strip camera services, and other services to the professional motion picture industry, and (b) other activity. An indication of the overall trends in the Technicolor business is found in Table I, showing net sales, net income, and the quantity of film processed. As indicated in the table, the Technicolor net sales volume and net income have varied in accordance with the volume of film processed. Net sales and net income increased until about 1953, but since 1953 the trend has been downward. 1958 processing volume, net sales, and net profit were approximately 50%, 70%, and 16%, respectively, of the peak figures of 1953.

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[5] For a discussion of Cinecolor and its processing techniques, see Technical Appendix, Part. 6.

[6] See, e.g., Rose, *American Cinematographer Handbook* (1956), pp. 304-19. See also, *Technicolor Annual Report, 1953,* pp. 15-19, and *1953 Film Daily Year Book,* pp. 144-61.

[7] *1956 Annual Report,* p. 13.

TABLE I

TECHNICOLOR SALES AND NET PROFIT, 1932-58

Year	Net Sales (Millions of dollars)	Net Profit (Millions of dollars, before taxes)	Positive Prints Shipped (Millions of feet)
1932	0.50	(0.24)	6
1937	3.13	0.47	41
1939	5.11	0.91	70
1946	13.06	0.46	165
1948	20.02	2.98	265
1950	23.45	4.25	312
1952	33.02	6.34	461
1953	37.70	7.43	561
1954	34.65	4.90	530
1955	32.42	4.11	489
1956	29.45	2.69	388
1957	24.67	0.24	276
1958	26.78	1.18	272

Source: Technicolor Annual Reports
( ) indicates loss

The present study is particularly directed to an evaluation of the effects of the Technicolor and Eastman consent decree provisions directed to compulsory patent licensing. One possible effect of such provisions is that of stifling research activity by Technicolor. Throughout its history, Technicolor management has emphasized research activity and the value of the anticipated patent rights. At least in the case of the Troland patent Technicolor did receive substantial patent license royalties.[8]

Since the antitrust decree, Technicolor reports to stockholders and announcements to the trade and public have continued to emphasize research. It is not possible, however, to draw significant conclusions as to the dollar volume of research in the years since the decree. Financial statements of the company, however, have included only figures with respect to the capitalized research expenditures, and since 1949 these have been only in terms of the balance sheet figure for research, development, patents, and good will, and the charge for amortization. These figures are rendered even less revealing by the large write-offs that have occurred in some years. To the extent that these figures reflect relative total research expenditures, they indicate that there has been some decrease since the antitrust decree. Thus, the balance sheet account for capitalized patent and research increased by an annual average of about $97,000 between 1944 and 1947, by about $50,000 between 1947 and 1950, and by about $42,000 between 1954 and 1957.[9] Assuming the proportion of research expenditures capitalized

[8] Technical Appendix, Part 5b.

[9] The above figures are computed by taking one-third of the increase in capitalized patent and research cost for each of the three year periods indicated. In the 1954-1957 period the figures also include the item of "good will" and to this extent are inflated. However, since it is customary to charge advertising as an expense, it is not likely that the "good will" item appreciably influences the figures. More likely reasons why the figures might not truly reflect the annual level of research expenditures are the possibility of write-offs in the periods compared and the possibility of changing proportions of actual research and development expense capitalized.

to all research has not changed significantly, these data indicate that Technicolor research expenditures have been diminishing, with the greatest decrease prior to the 1950 antitrust decree.

It has been reported that Technicolor appropriated "upwards of $500,000" for research in 1950, a "substantial" part of which was for the Geer television tube.[10] This was about two per cent of the sales volume in that year.

On January 30, 1956 Technicolor released the following "Message to Our Customers": [11]

> One—For nearly forty years Technicolor has served the motion picture industry as its largest and most dependable source of color;
>
> Two—It is the aim and determination of Technicolor to continue to serve the motion picture industry for at least another forty years;
>
> Three—To that end Technicolor has appropriated $1,200,000 for research and development expenditures *during the current year;*
>
> Four—Technicolor has installed laboratory equipment to serve producers employing various dimensions and types of negative from which Technicolor can service the distributor with *almost any size and type of print.* Technicolor is anxious to consider further installations to meet any requirement of the motion picture industry;
>
> Five—Besides serving the motion picture industry for its present needs the future motion picture in color is Technicolor's business. To this end the $1,200,000 appropriation is directed.

The Technicolor annual reports do not indicate whether the above sum was actually spent on research, nor are there any available data on the accounting methods used to determine research expense. Company net income for calendar 1956 was $1,226,149 and the capital account for research, development, and good will was increased by $81,782 in that year. Expenses, including depreciation, charged to sales in 1956 were $27,853,071, about $1.5 million under the corresponding 1955 figure. Total company net sales for 1956 were about $30 million, making the advertised research budget of $1.2 million about 4% of sales volume. This figure is in keeping with research expenditures of industry generally.

When all available information is weighed, it appears that there is no basis to conclude that Technicolor research expenditures have been significantly effected by the decree. Management statements to stockholders and the public continue to emphasize research as in the past. Available financial data are inconclusive because so many elements are reflected. The reported "upwards of $500,000" budget for 1950 and the advertised $1.2 million 1956 budget give no more than a suggestion as to the order of magnitude of total research expenditures. Capitalized research expenditures involve possible variations in the proportion of research capitalized. To this extent the figures are meaningful, they reflect trends apparently unrelated to the antitrust decree.

Current trends in Technicolor processing volume and net sales unquestionably exert a strong influence on the research expenditures of the company. In 1950

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[10] *Motion Picture Daily,* March 8, 1950, p. 6.

[11] *1955 Annual Report,* p. 14.

the company had a $4 million profit before taxes, $23 million in sales, and shipped 312 millions of feet of film. All three figures had progressively increased in the years preceding 1950 and continued to do so until 1953. At the present writing, profits, sales, and film processing volume have been generally decreasing for six years. (See Table I). In addition, a major line of company activity is now in the field of consumer film processing, where research is a less important factor than in professional color film processing. With these sweeping changes in the business, it is most doubtful that the trend in Technicolor research expenditures, even if known, would be a significant measure of the effects of the compulsory licensing decree provisions. Rather, the conclusion appears inescapable that the radical changes in business conditions have necessarily had a great deal more influence upon Technicolor research activity than the compulsory licensing decree provisions.

Another and more significant measure of the effects of the Technicolor compulsory licensing decree provisions is the extent competitors have taken license. This is especially true with respect to the three-strip camera and the imbibition print-making process. The only license known to have been granted pursuant to the 1950 consent decree is that to DeLuxe Laboratories, Inc. With respect to this license, the *1953 Technicolor Annual Report* states:[12]

> DeLuxe Laboratories, Inc. of New York City, have for many years operated one of the larger black and white motion picture laboratories which is affiliated with and controlled by 20th Century-Fox Film Corporation. Officers of 20th Century-Fox and of the DeLuxe Corporation have from time to time expressed an interest in making dye transfer imbibition prints under license and engineering agreements with your company. Protracted negotiations between them and the officers of your company have culminated in long term agreements entered into on November 24, 1953, under the terms of which DeLuxe agrees to build a laboratory in or near New York City to process Technicolor dye transfer (imbibition) release and answer prints.
>
> These agreements in addition to patent license and royalty provisions include engineering and consulting service by Technicolor, supervision of quality of product by Technicolor, reciprocal arrangements with Technicolor, Limited, London, and any other future Technicolor affiliates or licensees abroad.
>
> These agreements mean that the public in addition to the famous "Color by Technicolor" trademark will see another symbol of highest quality—"Color by Technicolor-DeLuxe."

While the subject matter of the DeLuxe license appears to have been primarily within the compulsory licensing decree provisions, it should be noted that the agreement was of broader scope than the decree required. Specifically, the agreement contemplated continued engineering and consulting services, access to Technicolor improvements not included in the decree, the use of the trademark Technicolor, and other additional matters. It should further be noted that 20th Century-Fox—the DeLuxe parent corporation—has been and still is a substantial purchaser of Technicolor imbibition release prints. Significantly, Technicolor reported the possible income from the DeLuxe license as "on the positive side" with respect to its future profit potential in 1953.[13]

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[12] P. 21.

[13] *1953 Annual Report*, p. 26.

At the time the license was negotiated DeLuxe had a very small capacity for color processing.[14] The license was apparently negotiated on the theory that the capacity would be increased to include substantial color release print capacity. One course of action was thought to be the installation of imbibition release printing facilities. However, when the final decision was made, DeLuxe ultimately installed equipment for release printing on Eastmancolor positive. The entire license thus proved to be a nullity. It is a rather dramatic indication that Technicolor's continued status as the sole source of imbibition prints rests on the fact of its existing equipment and investment and not on an exclusive technology.

The DeLuxe license had a somewhat curious result in the complaint filed by Pathé Laboratories, Inc. against Technicolor on July 7, 1954.[15] The second cause of action alleged by Pathé was based on the Sherman Act. Pathé alleged that the DeLuxe license was part of a conspiracy in which:[16]

> Technicolor Motion Picture Corporation now controls the operation and profits of DeLuxe Laboratories, Inc. and has effectively eliminated its largest competitor in the motion picture laboratory business and has created a monopoly in said business. Said agreements provide for the licensing of DeLuxe Laboratories, Inc. by Technicolor Motion Picture Corporation to use the patented technicolor process in the processing of dye transfer (imbibition) release and answer prints. These agreements in addition to patent license and royalty provisions include engineering and consulting service by Technicolor Motion Picture Corporation, supervision of quality of product by Technicolor Motion Picture Corporation, reciprocal arrangements with Technicolor, Limited, London, and any other future Technicolor affiliates or licensees abroad. Upon information and belief, the royalties provided for in said agreements to be paid to Technicolor Motion Picture Corporation have been fixed at such a high rate that in effect substantially all profits realized by DeLuxe Laboratories, Inc. will be paid to Technicolor Motion Picture Corporation as royalties which, in effect, has resulted in the purchase by Technicolor Motion Picture Corporation of DeLuxe Laboratories, Inc., its hitherto largest competitor, under the guise of a license agreement.

The Pathé complaint further sought damages and cancellation of the Technicolor trademark on the ground that "Color by Technicolor" was being used to designate films made on monopack film (and not by the imbibition process). On December 20, 1955 the Pathé suit was dismissed on motion of Pathé. Pathé was required to pay the Technicolor attorney expenses.[17]

Technicolor is affiliated with Technicolor, Limited of Great Britain.[18] The British concern makes imbibition release prints and provides motion picture film processing services. In many instances Technicolor, Limited is supplied with the color separation matrices from Technicolor for the purpose of making imbibition release prints. In 1954 a similar affiliate, Societe Technicolor, was organized in

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[14] DeLuxe is reported to have increased its color capacity ninefold in 1954 from its "very small" prior capacity. *1955 Film Daily Year Book*, p. 157.

[15] Pathé Laboratories, Inc. v. Technicolor, Inc., *et al*, Civil 94-162, S.D.N.Y., 1954.

[16] *Complaint*, Pathé Laboratories, Inc. v. Technicolor, *et al*, para. 20.

[17] *1955 Technicolor Annual Report*, p. 20.

[18] Technicolor, Ltd. was organized in 1935. The company had an initial capitalization of $1,500,000 and was owned equally by Technicolor and by British interests. *1936 Film Daily Year Book*, p. 57.

France. Operations began in 1955.[19] A third affiliate, Technicolor Italiana was organized in 1955 in Italy.[20] These are the only imbibition release print making facilities that have been set up by anyone outside the United States.

Technicolor, Limited has been successful. In 1946 it sold about 47 million feet of release prints. It reached a peak year of 209 million feet in 1955—over 40% of the volume of Technicolor itself in that year. The volume declined in the 1956-1958 period to 142 million feet in the latter year. Technicolor, Limited is now processing over 50% of the footage processed by Technicolor. By way of contrast, the French affiliate never has been profitable. In July 1958 Technicolor announced that the French processing plant would be closed. The French plant had a capacity of 70 million feet per year. The failure of the French associate appears to be the result of operating difficulties and lack of processing volume. Losses sustained by the French affiliate have been estimated at about $750,000.[21]

Film Processing

The peak year for release print Technicolor color film processing was 1953 when over 560 millions of feet of prints were processed by the imbibition process. Since that date, volume has fallen to less than half of this figure. (See Table I, page 15).

The declining volume of release print processing by Technicolor is largely due to two causes. One is the use of black and white pictures in lieu of color. The other is a decreasing share of the total color feature release print making. As to the first, it is reported that:[22]

> The approximate number of feature length black and white photoplays that were started in Hollywood during the years 1954, 1955 and 1956 were respectively 85, 110, and 180; i.e., the number of black and white pictures was more than twice as great during 1956 as it was during 1954. The approximate total number of pictures, black and white and color, during the years 1954, 1955 and 1956 was respectively 230, 250 and 275; i.e., the percentage of the total in black and white has increased during these years respectively as follows: 37%, 44% and 65%.

Table II, below, compares the approximate number of black and white and color professional motion pictures for the 1954-1958 period. It indicates that, while there is some recent trend toward an increased proportion of color motion pictures, the number of color features has continued to decrease.

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[19] *1955 Annual Report*, p. 24.

[20] *Id.*

[21] *Wall Street Journal*, July 11, 1958. Technicolor has reported that the French plant is being held intact for future operations if conditions warrant. *1958 Annual Report*, p. 17.

[22] *1956 Annual Report*, p. 2.

TABLE II

COLOR VS. BLACK AND WHITE PROFESSIONAL PICTURES, 1954-8

YEAR	TOTAL FEATURES	FEATURES IN BLACK AND WHITE	FEATURES IN COLOR	PERCENTAGE OF FEATURES IN COLOR
1954	230	85	145	73%
1955	250	110	140	56%
1956	275	180	95	35%
1957	290	200*	90*	31%
1958	200	124*	76*	38%

Source: 1954–1956, Adapted from data, *1956 Annual Report*, p. 2.
* indicates estimated

The changing proportion of color features to black and white shown in Table II indicates that the alternative of black and white is now—as in the past—an important form of competition to Technicolor. This obstacle was faced by Technicolor throughout the long period of process development. The data of Table II also indicate the margin of choice between color from sources other than Technicolor and black and white remains small. Essentially all of the color processing other than by Technicolor is conducted with Eastmancolor monopack materials. In the form introduced in 1950 these materials were far superior to the similar product Eastman could have offered at an earlier date. Since 1950 these materials have been additionally improved. The fact that these vastly improved materials still provide only a limited margin of preference over black and white strongly suggests that the pre-1950 product would have had very limited success. Doubtless the declining market for professional motion pictures, and the incident pressure on budgets, accounts in large measure for the present tendency toward black and white. These data nevertheless indicate that Eastman had a sound business basis for not promoting the color monopack films that it could have introduced prior to about 1950.

The second form of competition faced by Technicolor in its processing activities is that of alternative color processing, notably monopack print films. At the present writing, such films are almost entirely made on Eastman Color Print Film by the various independent film processors. Table III, below, compares the trend in Technicolor processing volume with the number of color features produced in the 1954-1958 period. As indicated, the Technicolor processing business has generally kept pace with the trend in the number of color features in this period.

At the time of the antitrust complaint (1947), Technicolor was processing essentially all professional motion pictures in full color. The increases in Technicolor processing volume in the 1950-1953 period (Table I), indicate that at least initially the films processed in Eastmancolor materials (introduced in 1950) were largely films that would otherwise have been in black and white. The trend since 1954 (Table III) seems as much attributable to the reduced total number of features as to substantially shifting proportions of the market as between Technicolor and other processors.

TABLE III

TECHNICOLOR PROCESSING VOLUME VS. TOTAL COLOR FEATURES, 1954-8

Year	Total Color Features		Technicolor Processing			
			Processing Volume		Number of Features	
	No.	Pct. of 1954	Million Ft.	Pct. of 1954	No.	Pct. of 1954
1954	145	100	530	100	88	100
1955	140	97	489	94	73	83
1956	95	66	388	73	53	60
1957	90•	62•	276	52	44	50
1958	76•	52•	272	51	a	—

Source: Number of color features, Table II.
Processing volume, *1958 Annual Report*, p. 9.
Number of features processed, "commitments" reported in *1954–1957 Technicolor Annual Reports.*

a No figure available comparable with 1954–1957 figures. The *1958 Annual Report*, p. 7, states that 66 features were "produced" in that year. Since the trend in processing volume in terms of feet of film continued downward in 1958, it appears that Technicolor must have processed a considerable number of additional features having small numbers of prints each.

• indicates estimated.

The competition of Technicolor and other color processors is fundamentally one between reliance on monopack print stock and use (at least for large quantity production) of the imbibition process.[23] The following excerpt from the Technicolor *1957 Annual Report* states the position of the Technicolor management on this point:[24]

> There has been some discussion about the relative merits of these two processes and whether in the long run the imbibition process will survive the oncoming of color positive. Your Company employs both processes as we believe each has advantages for certain purposes. We think the imbibition process has decided advantages where a large number of prints are required as in the distribution of pictures for the motion picture industry. For certain uses where relatively fewer prints are required we think an advantage lies with the color positive process. If the time should come when your officers and technical staff believed that the color positive process, all things considered, was likely to become a more advantageous process for the motion picture industry in general, then your Company would no doubt gradually increase its capacity for the manufacture of color positive prints.
>
> But as it stands today your officers and technical staff hold the opinion that we can best serve our customers of the motion picture industry for the large number of prints required for each picture by continuing to employ the Technicolor imbibition process for most of our prints. In our opinion, which we believe is supported by most of the industry, the actual color rendering of Technicolor imbibition prints is superior to that of color positive prints.
>
> In the Technicolor imbibition process the negative goes through a printer (where in any process it is subjected to possible damage from scratching, dirt and the like) only once in the manufacture of a considerable number of prints, say 50. This is achieved by the use of a matrix. However, in the color positive process the negative (or a dupe) goes through the printer each time a print is manufactured. In the manufacture of release prints for foreign countries it is practically impossible to ship the negative to such foreign countries in order to make the foreign prints for prompt release because the negative is required for domestic

[23] Technicolor has made prints on Eastmancolor print film. This was done, for example, for "The Robe," an early CinemaScope feature. *1953 Annual Report*, p. 17. The bulk of Technicolor release prints are made by the imbibition process.

[24] Pages 4 and 5.

> printing in the United States. Consequently for the manufacture of prints for foreign distribution by the color positive process a dupe negative is made here from the original negative and shipped abroad which results in a very considerable deterioration of quality. This deterioration is very apparent when compared with foreign prints by imbibition. Technicolor can have foreign prints made in any one of its foreign affiliates without the employment of such dupes by making the usual matrices in Hollywood such as are made for the production of the domestic prints and shipping those to the foreign affiliates.

The economics of the imbibition process vis à vis monopack print film is reflected in a comparison of the prices per foot. In 1953 the Technicolor "base price" [25] was 4.98 cents per foot. At that time the base price of prints made on positive Eastman or Ansco color print stock cost between 6¼ and 6½ cents per foot.[26] Since the Technicolor "base price" applies only after set-up costs are divided among a considerable number of prints, this economic advantage becomes effective only where the print volume is sufficiently large. However, as indicated above, this economic limit is reached with many professional motion pictures.

The most recent statement of the Technicolor management on the relationship between the imbibition and monopack (color positive) process is as follows: [27]

> Your Company's dye transfer or imbibition process has completed another year in competition with other laboratories employing color positive process for making prints. Your management feels its imbibition process is more than holding its own both with respect to quality of product, character of service, cost and price. However your management has in mind the possibilities of further change in the nature of the motion picture business, of further diminution in size of orders and of a possible unfavorable situation in the relative cost of raw materials and labor and aims to more than offset them with technical improvements, increased efficiency of operation and new fields of activity. Meanwhile your Company is operating with both the imbibition and the color positive process.

The availability of the Eastmancolor negative-positive monopack materials made it possible for motion picture producers to dispense with the cumbersome Technicolor three-strip camera. In order to prevent loss of processing business because of the disadvantages of the three-strip camera, Technicolor was forced to adapt the imbibition process to release print production from the Eastman Color Negative Film.

Unlike the three-strip camera which provides black and white color separation negatives direct, the color negative contains the three color separations on a single backing. To obtain the color separations, black and white film must be exposed to the color negative under light of proper color. Upon the introduction of Eastmancolor, Technicolor pursued a research program directed to the perfection of processes for making the requisite black and white color separation negatives. It was not until the *1957 Annual Report* that Technicolor reported that it had overcome the "lack of definition, excessive graininess or the presence of dirt (imper-

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[25] The "base price" applies to single orders in excess of a specified quantity. In the case of feature films processed by the Technicolor imbibition process the quantity is 250 prints. On smaller orders the price per foot per print is higher, reflecting the increased set-up costs.

[26] *1953 Annual Report*, p. 25.

[27] *1958 Annual Report*, p. 3.

fections)" encountered "during the long period of transition from Technicolor special three-component negative to currently employed color negative." [28]

In the full text of the *Annual Report:* [29]

> During the past year or so we have made improvements in the processing of the negative and at almost every point in the process of manufacture of Technicolor prints. As now made these are superior in color rendering and no longer suffer from lack of definition, excessive graininess or the presence of dirt (imperfections) as they did during the long period of transition from Technicolor special three-component negative to currently employed color negative. We are now beginning to reap the reward of all this in expressed customer satisfaction and through the introduction of the new and important Technicolor product, Technirama. Your management and directors feel optimistic about the long range future of your Company's imbibition process.

This developmental effort by Technicolor appears to have been essential to the survival of the imbibition process. If the imbibition process were permanently incapable of providing high quality prints from monopack color negative and meeting wide screen quality requirements, it appears likely that the Technicolor release print processing business would have been largely superseded by the independent processors and studio laboratories. Since this developmental work took place after the February 28, 1950 Technicolor consent decree—and patents resulting from it would not be likely to issue prior to November 28, 1953—Technicolor has been free to utilize the patent rights obtained from this work in the normal fashion.[30]

While Technicolor has pursued a policy of obtaining available patent rights on release print processing, it is doubtful that such rights ever have formed the key to application of the imbibition technique to monopack processing. They certainly do not do so now. Rather, the achievement of quality imbibition printing from monopack positive appears to be the result of development not reflected in patents

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[28] Page 5.

[29] *Id.*

[30] A number of patents relating to the imbibition process have issued to Technicolor since the November 28, 1953 cut-off date. These include Pohl 2,676,116, filed October 17, 1950, issued April 20, 1954 (treatment of gelatin of imbibition blanks); Lofquist 2,679,800, filed May 16, 1952, issued June 1, 1954 (pressure roller mechanism for printing); Warme 2,681,618, filed Oct. 24, 1952, issued June 22, 1954 (same); Lofquist 2,767,649, filed Feb. 15, 1952, issued Oct. 23, 1956 (application of sodium sulfate to film blank before imbibition printing to improve dye transfer adjacent "hills"); Delangre 2,821,455, filed August 17, 1954, issued Jan. 28, 1956 (metal chelate dispersed in gelatin of blank as a mordant—particularly suitable for "Cinemascope" or other wide-screen inbibition prints); Peasgood 2,821,773, filed Nov. 22, 1955, issued Feb. 4, 1958 (machine for inserting sprocket hole pins in belt used to align matrix and blank for imbibition printing); Francis 2,821,774, filed Nov. 22, 1955, issued Feb. 4, 1958 (same); Goldberg 2,837,430, filed July 12, 1955, issued June 3, 1958 (soluble thiosulphate used in the developer to prevent etching matrix film entirely through in the highlights—said to be especially suitable for prints for wide screen projection); Delangre 2,842,049, filed Sept. 22, 1954, issued July 8, 1958 (acid salt of deacetylated chitin added to gelatin before coating support to make matrix blank). Some of these patents, such as Francis 2,821,774 and Goldberg 2,837,430, may be used for motion picture film printing generally.

and the use of techniques for which alternatives are available. A 1949 popular article on Technicolor states: [31]

> . . . know-how is more important than patents in the color business. He (Dr. Kalmus) contends that he could give all his secrets to rivals and still not fear them as competitors, because by the time they had the equipment setup and the know-how teams to use it, Technicolor would be offering something else still better.

A measure of the relative importance of patent rights on imbibition processing is found in the following statement of fact agreed to by the government and by Technicolor: [32]

> The imbibition process of color photography is generally quite old and there are no basic patents covering the film used in it. Kodak supplies to Technicolor for this process negative film, matrix, stock and materials on which dye images are printed by imbibition transfer. Of these materials, the only one patented by Kodak is the blue-sensitive negative material which has a red filter overcoating. The specific structure which Kodak sells to Technicolor is covered by Carroll and Chechak U.S. Patent No. 2,294,893, granted September 8, 1942 to Kodak. Technicolor U.S. Patent No. 2,044,864 covers matrix stock and is the only patent owned by Technicolor on the film supplied to Technicolor by Kodak for imbibition purposes.

Additional research effort has been placed by Technicolor on the general improvement of the imbibition process. One problem arises from the tendency of the dye to migrate or wander in the lateral direction of the release print blank. This problem was accented by the need for increased sharpness in the prints for some of the wide screen projection systems. On this problem, the Company reports: [33]

> One of the big problems in the imbibition printing process has always been the control of the spread or wandering of dye during the transfer from the matrices to the release print blank. Such control is of even greater importance now, with the advent of the larger theatre screens requiring greater magnification in the theatre projector.
>
> The problem is to preserve the sharpness of the images which exist in the matrix by having dye and a blank of such characteristics that there will be a very little diffusion of the dye during its transfer or imbibition. This is accomplished partly through the introduction of chemicals called mordants in the blank.
>
> These dye mordants are sometimes incorporated in the raw stock emulsion by the blank manufacturer and sometimes they are added during the Technicolor processing and sometimes both. As a result a significant improvement in sharpness or visibility has been obtained. This whole procedure and the resulting release print are being thoroughly tested under practical manufacturing conditions and by distribution of prints to the theatres. We are greatly encouraged by the progress thus far. But further commercial tests will be made before we announce the general adoption of these new materials and processes. Also the raw stock manufacturers will need time to produce the quantities we shall require.

Again, the patents touching on these developments are outside the scope of the compulsory licensing provisions of the 1950 Technicolor consent decree.

A third area of motion picture developmental effort by Technicolor is in connection with increased area motion picture films. The concern here is with both

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[31] *Saturday Evening Post*, Oct. 22, 1949, p. 133.

[32] *First Supp. to Agreed Statement of Facts*, para. 118.

[33] *1954 Annual Report*, p. 19.

perfection of film exposure techniques and adapting imbibition printing to the manufacture of release prints. Activity in increased area films began at least by 1953. One such technique of particular importance to Technicolor is that of using standard 35mm. negative film stock with the frames extending longitudinally rather than transverse to the length of the film. By 1956 Technicolor had adopted the trademark Technirama for its processes for making prints of this type, as well as other large area prints.[34]

The Technirama technique is based on the use of monopack negative film. The imbibition method can, however, be used for release print manufacture where the number of prints so requires.[35] Some 24 feature pictures were filmed in Technirama in 1958.[36]

One of the advantages of the large screen technique is that of increasing the illusion of three dimensions in motion picture projection. In January 1954 Technicolor entered into a patent license agreement with Polaroid Corporation for another 3-D technique using special Polaroid raw film stock called Vectograph.[37] The agreement contemplated that research and development would make possible imbibition printing on the Vectograph stock. The prints were to be used with the Polaroid three-dimensional projection system using individual eyeglasses with cross-polarized lenses.[38] No commercial use of the Vectograph process has been reported. The license remains in effect and there is some feeling that the process may be used in the future.[39]

Three-Strip Camera

The antitrust complaint alleged that Technicolor required customers to use its three-strip camera exclusively for motion pictures to be release printed by Technicolor.[40] The decree prohibited such requirements.[41] The effects of this decree provision, however, generally coincided with the availability of practical monopack color photography through the Eastmancolor negative and positive film. When the Eastman film proved practical, Technicolor was faced with the problem of

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[34] *1953 Annual Report*, p. 19.

[35] Some of the patents listed in note 30, *supra*, are specifically directed to the making of imbibition prints for wide-screen projection. These include patents 2,821,455 and 2,837,420.

[36] *1958 Annual Report*, p. 3.

[37] *1953 Annual Report*, pp. 18-19.

[38] On the Polaroid system see Marks v. Polaroid Corp., 237 F.2d 428 (1st Cir. 1956), where the court upheld the Polaroid patents and sustained the legality of the restrictions under which the viewers were sold.

[39] The most recent reference to Polaroid appears at page 16 of the Technicolor *1957 Annual Report*.

[40] *Complaint*, para. 26(a).

[41] *Technicolor Decree*, para. IX. It is interesting to note that in paragraph X(B) the decree requires Technicolor to have at least two three-strip cameras available for rental, but specifically permits Technicolor to require the lessee to engage a Technicolor camera technician to accompany the camera. Throughout the period here studied there has been no occasion for this provision to have any effect.

preserving its investment and market position in the imbibition process itself. It seems certain that Technicolor could not have effectively required the use of the three-strip cameras without driving a greater proportion of the color business to the use of monopack release prints. With respect to the effect of the Eastmancolor negative and positive process film it has been stated that: [42]

> In 1953 a new method of photography was introduced to the motion picture industry, employing single strip color negative, which largely superseded the use of Technicolor three-strip cameras.

Technicolor is now completely converted to the use of monopack camera film. Technicolor had used such film in experiments with Eastman beginning at least by 1939.[43] It was announced in 1952 that Technicolor had begun the installation of equipment to process Ansco and Eastmancolor film.[44] At least as late as 1953, however, Technicolor was increasing its three-strip camera facilities.[45]

The emphasis upon wide screen film techniques has tended to accelerate the trend away from the three-strip camera. While the three-strip camera can be adapted to wide screen photography, the complexity of the three-strip camera—added to the changes required for any of the practical wide screen techniques—makes the overall system rather impractical. Thus when Technicolor had adapted its imbibition printing process to negatives with the frames longitudinal rather than transverse of the film, it could not supply cameras.[46] Three-strip cameras have, however, been converted to some extent to the use of larger area negative systems using monopack camera film.[47]

Up to at least 1953, Technicolor nevertheless filed a number of patent applications directed to the improvement of the image-splitting dichroic reflector that forms an important part of the three-strip camera.[48] These applications reflect

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[42] Rose, *American Cinematographer Hand Book* (9th Ed. 1956), p. 59.

[43] The first sales from Eastman to Technicolor took place in 1939. From that date through at least 1948 Technicolor and Eastman engaged in experiments in the use of monopack camera film. Total film sales in 35mm. motion picture film from Eastman to Technicolor in that period exceeded $500,000, the peak year being 1945 when sales totalled about $134,000. *First Supp. Agreed Statement of Facts*, para. 125. Monopack camera film was used in the Warner Brothers feature "The Younger Brothers," released in 1948. *First Supp. Agreed Statement of Facts*, Schedule C. It was also used in "Son of Lassie," released in 1944. *1945 Film Daily Year Book*, p. 69. The first feature released with any portion filmed with monopack film was "The Forest Rangers" released by Paramount in 1942, where the forest fire scenes were taken in monopack.

[44] *1953 Film Daily Year Book*, p. 167.

[45] *Id.*

[46] *1953 Annual Report*, p. 20.

[47] *1954 Annual Report*, p. 18.

[48] A number of patents relating to the dichroic reflector have been issued to Technicolor since November 29, 1953. These patents include Kelly 2,723,821, filed Feb. 15, 1952, issued Nov. 15, 1955 (universal mounting for dichroic reflector—disclosed for use in three-strip camera or for color television); Rock 2,737,076, filed June 12, 1952, issued March 6, 1956 (method of making prism including dichroic reflector); Kelly 2,740,317, filed Aug. 13, 1951, issued April 3, 1956 (dichroic reflector coating for prisms—disclosed for use in three-strip camera or for color television); Kelly 2,749,792, filed Feb. 1, 1952, issued June 12, 1956 (same); Dearing 2,809,570, filed April 7, 1953, issued Oct. 15, 1957 (dichroic reflector with specific illustrations showing use in three-strip camera and in television).

a continuing research effort in this field at least through 1953. This activity was motivated at least in considerable measure, however, by the application of the reflector in color television cameras—a field where it performs a major function in the non-sequential type of color television transmission systems.[49]

Other Technicolor Activity

Since the close of the war, Technicolor has pursued a number of lines of research and has engaged in a number of fields of business activity in an effort to broaden its field of business activity. The attitude of the company in this respect is indicated by the following passage from the *1955 Annual Report:* [50]

> Your company's intense interest in diversification continues active along two lines: (1) The establishment of businesses which your officers and directors consider [to] have important growth possibilities to be operated initially as divisions of Technicolor Motion Picture Corporation and financed with your company's funds; and (2) through assimilation by purchase or merger of one or more businesses in which Technicolor has confidence of satisfactory profits. In both of these lines your company's interest would be in businesses toward the growth of which Technicolor research, engineering and administrative departments can play an important part.

The diversification efforts of the company have been in three major directions, namely, color television, graphic arts, and amateur film processing. The color television efforts have been of a research character not reaching the stage of commercial exploitation; the graphic arts effort entailed initial research which was followed by an unsuccessful effort to commercialize the company services in this field; and the amateur film processing activity has involved relatively little research and at the present time appears on the way to be a profitable business venture.

Television

Color television involves many techniques in common with color photography. Practical color photographic techniques recognize and utilize the black and white silver halide process, repeated for each of the color separations. In color television the time-varying signal representing the image is black and white in character and utilizes separate signal components for each of the color separations. Because of these underlying technical similarities, the field of color television is one in which a substantial part of the Technicolor experience and scientific work has application. It is not surprising, therefore, that Technicolor has engaged in significant research effort in this direction.

One aspect of color television relates directly to Technicolor's main business interest. This is the making of color prints suitable for color television use and

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[49] The non-sequential type of color television transmission is based on the simultaneous transmission of information as to the three color aspects of each image area. This type of system is now standard for commercial television transmission.

[50] Page 14. See also *1954 Annual Report*, p. 14.

their projection. Technicolor has reported substantial research and experimental activity in this field.[51]

One aspect of the Technicolor activity in television relates to the color television camera. Here the similarity between a color television camera and the Technicolor three-strip camera is substantial. Each dissects the color image into three color separation components and projects them on separate image-receiving surfaces. Apparently in an effort to attain maximum color television application of new three-strip camera developments, essentially all of the recent patents issued to Technicolor personnel in this field have specifically illustrated the utilization of the techniques involved in color television cameras.[52] In addition, Technicolor has obtained a number of patents to inventions concerned primarily with color television, including camera mechanisms,[53] receiver circuits,[54] television camera tube constructions,[55] color television transmission systems,[56] and color television reproduction schemes.[57]

The Geer image display tube is an early illustration of the color television activity of Technicolor. In March 1950, the announcement was made that:[58]

> Technicolor is appropriating upwards of $500,000 for the work of its research department, of which a substantial part will be applied to the professional and commercial application of the Geer tube.

In the following *Annual Report,* Technicolor stated:[59]

> . . . It has not been [the practice of Technicolor] to buy patents from the outside world but [it] has relied upon its own technical staff including a growing research department.
>
> Your company's first important departure from that practice was made early in March [1950] when it purchased the patent rights to the color television tube invented by Professor C. Willard Geer, Professor of Physics at the University of Southern California. This color television tube consists essentially of a single television tube in which three electronic beams are directed upon a specially formed phosphor bearing screen so as to present a separate surface to each beam. There are three such separate surfaces, and on the face of each such surface is a different phosphor material which when activated by each of the electron beams, yields an appropriate color, red, green or blue. The combination of the three colors would give a television in natural color which is viewed on the surface of the television tube. For color television these colors would correspond with the three fundamental additive colors employed in color photography.
>
> One of the great advantages of the Geer device is that it may provide a means for converting existing black and white television sets to receive color television broadcasts in a way which will avoid obsolescence.

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[51] *1953 Annual Report,* p. 22; *1954 Annual Report,* pp. 11 and 14. Technicolor, apparently as a consequence of its 1958 purchase of Warner Bros. Laboratory, has done some television film processing for Warner Bros. *1958 Annual Report,* p. 2.

[52] E.g., Kelly 2,723,821, filed Feb. 15, 1952, Col. 1, line 19; Dearing, *et al* 2,809,570, filed Apr. 7, 1953, Figure 12.

[53] Kelly patent 2,703,506, filed March 30, 1951.

[54] Brady patent 2,710,347, filed June 3, 1952.

[55] Evans patent 2,758,235, filed June 22, 1953.

[56] Mann patent 2,776,335, filed Nov. 22, 1952.

[57] Pohl patent 2,829,194, filed March 31, 1953.

[58] *Motion Picture Daily,* March 8, 1950, p. 6.

[59] *1949 Annual Report,* pp. 12-13.

> Your company has appropriated substantial sums for research on the Geer tube which will be conducted in part in your company's research laboratories in Hollywood and in part through contract with Standard Research Institute of Stanford University under the supervision of your company's engineers.
>
> Satisfactory arrangements have been made with Radio Corporation of America with respect to this matter.

Continued work on the Geer tube was reported in 1950, with indication that by June 1951 the first "practical appraisal of the prospect for the Technicolor color tube" would be made.[60] In the *1951 Annual Report,* however, it was stated that the work on the tube "has not turned out successfully" and that "it is likely that your company will elect to discontinue further work on this particular project." [61] There has been no reported activity on the project since 1951.

The Geer television tube project is a clear example of diversification of Technicolor into a field where larger and more experienced concerns were actively engaged in intensive research. Since about 1950 a number of business concerns interested in color television have sought to develop an effective way to display television images in color. The problem is similar in principle to that in color photography. Like color photography, the technique involves the creation and superpositioning of three color separation images. R.C.A. has been notable in its emphasis upon the "shadow mask" type tube. General Electric, Philco, and other concerns have also undertaken research programs to solve the problem. Technicolor has sought to obtain a practical solution to this image display problem through the development of the Geer tube, which operated in a manner unlike the other devices under development. Geer's work on the tube can be traced to activity dating back to 1944.[62] A number of patents assigned to Technicolor relate to various aspects of the tube.[63] At the present writing, however, there is no known application of the tube and the principal color television tube in use is the competing R.C.A. shadow mask type.

Another line of research effort by Technicolor is closely allied with the television. This effort has been with respect to recording pictures on magnetic tape and reproducing them from such tape. Technicolor expressed interest in this subject in 1953 [64] and in 1954 reported expansion of efforts.[65] The company reported, however, that the prospects of this technique appeared to be far in the future. At the present writing there appears to be no immediate prospect of any commercial application of this idea.

Technicolor is currently emphasizing its "TV Bandwidth Reduction System." [66]

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[60] *1950 Annual Report,* p. 14.

[61] *1951 Annual Report,* p. 16.

[62] Geer patent 2,480,848, filed July 11, 1944.

[63] Geer patent 2,629,838, filed August 4, 1949; Howse patent 2,682,478, filed Sept. 11, 1950; Lynch patent 2,745,005, filed October 31, 1952.

[64] *1953 Annual Report,* p. 23.

[65] *1954 Annual Report,* p. 14. See also, *1955 Annual Report,* p. 19.

[66] *Wall Street Journal,* October 28, 1958, p. 4; *Business Week,* April 5, 1958, p. 146. The system appears to be that generally shown in the Pohl patent, *supra* note 57.

Technicolor announced in 1958 that through the use of the system a television signal could be accommodated within the same bandwidth as 250 conventional telephone communication channels, or about one-fourth of the spectrum required by currently used television transmission methods. If the system proves successful, it will have numerous practical applications for long distance television transmission, both military and commercial. The company reports:[67]

> Your management has no plans for the Company to manufacture the computers which comprise the heart of this new system. Instead, we are seeking to cooperate with electronics manufacturers and with government agencies toward application of the development to future communications needs. Important interests from the above fields have sent representatives to your Company's research laboratory to witness demonstrations over the system now in experimental operation there.

The TV Bandwidth Reduction System bears only a remote technical relationship to color reproduction technology. It is applicable both to monochrome and color television. The problems associated with the system are communication problems of the type previously and currently under intensive study by Bell Laboratories, R. C. A., and the radio industry generally. The TV Bandwidth Reduction System accordingly represents a definite departure from the fields of previous Technicolor research interest. It also takes Technicolor into a field where it has no prior business experience and into competition with concerns that have long been faced with the technical and commercial problems involved.

No figures are available with respect to the dollar investment of Technicolor in its television development work. Based upon review of the patents issued on the work, the general costs of experimentation in this field, and similar items, it is estimated that the dollar expenditures to date have probably exceeded a quarter of a million dollars and probably do not exceed a million dollars. The projects appear to have been entirely speculative from the start, with the objective of obtaining a foothold in the television industry. To date they have been unsuccessful in reaching this end.

Graphic Arts

Technicolor entered the graphic arts industry in 1956.[68] Here again, many of the problems are similar to those of color photography in that three color separation images must be obtained and superimposed to produce the final full color reproduction. A research and development group had been set up by Technicolor to work in this field in March 1956. Commercial services were

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[67] *1958 Annual Report*, p. 22.

[68] On Technicolor activity in graphic arts see *1955 Annual Report*, pp. 15-16; *1956 Annual Report*, p. 18; and *1957 Annual Report*, pp. 9-10. In a prospectus filed with the Securities and Exchange Commission on April 23, 1959, Dynacolor Corporation of Brockport, New York, estimated that it was processing from 20 to 25% of all Kodachrome film. Dynacolor stated that Eastman was processing about 60% of the total, and that seven other processors shared the remaining 15 to 20%. The same prospectus includes figures indicating that the Dynacolor sales volume for 1958 was in the neighborhood of $5 millions, essentially entirely in Kodachrome processing. These figures indicate a total Kodachrome processing of dollar volume of about $20 millions and a Technicolor share of something less than $4 millions. This is a comparatively small sum in relation to the Technicolor total sales volume ($26.78 millions in 1958).

commenced in July 1956. In the *1957 Annual Report* the Technicolor management indicated that in the technical and production areas the operations had proceeded satisfactorily. Sales, however, were reported as disappointing. By late 1957 the sales prospects were considered so unfavorable that the graphic arts operation was discontinued.

Amateur Film Processing

Technicolor entered the amateur color film processing field in 1956.[69] Operations were commenced in the Hollywood plant of the company in June of that year, processing Kodachrome film. In August of the same year Technicolor acquired the assets of Pavelle Color, Incorporated, which was in the business of amateur film processing and maintained a plant in New York for this purpose.[70] The company reported a total volume in amateur film processing in excess of $1,000,000 in the last five months of 1956,[71] and that in 1957 the Hollywood plant capacity was insufficient to meet the demand. Nevertheless, New York operations were still unprofitable in 1958. California operations reported an "operating profit" of $224,000 before taxes in 1958.[72] In considerable measure it appears that Technicolor will benefit in the amateur color processing field from its reputation in the professional motion picture field.

The entry of Technicolor into the amateur color film processing field is especially significant because it is related to the antitrust consent decree entered against Eastman in December 1954.[73] Prior to this decree, Eastman had sold Kodachrome and other color film with the processing charge included as part of the purchase price. Eastman did all such processing itself. This decree required Eastman to sell film without processing charges, to license and otherwise aid other business concerns in entering the amateur processing field, and after six years to divest itself of so much of its facilities as are in excess of 50% of the then domestic capacity for processing Eastman color film.[74]

Although the matter has not been the subject of detailed inquiry in the present study, it appears most unlikely that Technicolor would have entered the amateur processing business in the absence of the 1954 Eastman decree.

The experience of Technicolor since the 1950 consent decree is discussed in relation to the industry as a whole in the concluding chapter of this report. It is accordingly sufficient to note here that Technicolor has continued to receive most of its income from the manufacture of imbibition release prints and that, while the company has made a smaller proportion of the total color release prints, the imbibition process continues to offer substantial advantages over other processes

[69] *1955 Annual Report*, pp. 16-17.

[70] *1956 Annual Report*, p. 16.

[71] *Ibid.*, p. 17.

[72] *1958 Annual Report*, pp. 11 and 13. Technicolor reports that the Burbank facilities purchased in 1958 from Warner Bros. will be used for amateur film processing. *Ibid.*, p. 12.

[73] U.S. v. Eastman Kodak Co., C.A. 6450, W.D.N.Y., 1954.

[74] *Ibid.*, para. V and XII.

when large numbers of release prints are required. Technicolor has continued its research efforts with respect to this process. At least in the case of accommodating the process to the Eastmancolor film and wide screen projection, Technicolor undertook substantial research for reasons clearly unconnected with possible patent protection or any requirement for patent licensing. In other respects, both in relation to technical developments in the motion picture field and in its diversification efforts to fields such as color television, Technicolor appears to have looked to the normal benefits of patent protection as a justification for its research expenditures. The compulsory licensing provisions of the consent decree do not appear to have substantially altered the Technicolor efforts in any of these directions.

The only patent license that appears to have been directly related to the compulsory licensing decree provisions is that granted to DeLuxe Laboratories. This company proposed to use the imbibition process in New York. This license, however, went beyond the strict requirements of the compulsory licensing provisions. It provided for continued engineering and consulting service by Technicolor. DeLuxe finally decided not to install imbibition release printing facilities.

Late in 1959 it was announced that Dr. Kalmus, executive head of Technicolor for the 45 years of its existence, was retiring. Mr. John R. Clark, Jr. became president and general manager on January 1, 1960. A contemporaneous press report stated: [75]

> In accepting the office of chief executive here yesterday Mr. Clark said that increased emphasis must be placed on research and development programs to improve present manufacturing techniques. This will also be done to broaden the company's future base of operations not only in the photographic field but also in other areas including audio and visual communication, and selected activities in the electronics field.

The press quoted Mr. Clark, as follows: [76]

> "One of the company's most important assets," Mr. Clark said, "is its name—Technicolor. This name is seen by over 150,000,000 people each week in the motion picture theatre(s) of the world and in increasing numbers each year in the consumer products field through the company's amateur color film processing activities. . . ."

Present indications are that Technicolor management policy will continue as in recent years, although the above suggests that as to the matters here considered, the Technicolor management policy will not undergo any immediate change.

Another possible source of future Technicolor policy changes is a change in corporate control. Indication of an impending proxy fight was recently carried in press indications of a demand by Patrick J. Frawley, Jr. and others to name nine of the twelve Technicolor directors. It has been reported that Mr. Frawley's plans for Technicolor: [77]

> . . . . include getting the concern into the film manufacturing field . . . "We feel we should make another [Eastman] Kodak out of the company," Mr. Frawley commented. Mr. Frawley was subsequently elected to the Technicolor Board of Directors. He later denied reports of a possible merger between Eversharp, Inc., of which he is president, and Technicolor. *Wall Street Journal*, March 23, 1960, p. 17.

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[75] *New York Times*, December 19, 1959, p. 33.

[76] *Id.*

[77] *Wall Street Journal*, December 15, 1959, p. 24.

Whatever may be in store for Technicolor, it is believed clear that technological changes (notably Eastmancolor) have had a far greater influence on the company than the provisions of the 1950 antitrust decree, that the earnings of the company remain primarily in the color film processing field, that the company has undertaken definite efforts to diversify, and that its diversification efforts in many respects have been predicated upon research and development activity of a kind not affected in any respect by the decree provisions.

Eastman Kodak Company

The principal emphasis in the government antitrust complaint was directed to the market position and activity of Technicolor. Eastman was treated as having a secondary and submissive role in the acts complained of. Some aspects of the complaint, such as Technicolor's alleged tying practices, did not involve Eastman at all. The decree entered in 1948 against Eastman likewise reflected the secondary role of Eastman. It required compulsory licensing of only a minute proportion of the Eastman patents, for example, as compared with the compulsory licensing of essentially all of the Technicolor patents required by the Technicolor decree.

In addition to the less stringent character of the decree entered against Eastman, the professional motion picture business of Eastman is a relatively small proportion of the total Eastman photographic sales volume. In recent years it has been in the neighborhood of 10% of all Eastman volume. A decree approximately limited to the professional motion picture business was therefore likely to have substantially less influence on Eastman than on Technicolor, even assuming all other aspects are the same.

Another analytical consideration suggests that the decree as to Eastman was not likely to have major effects. The company has an exceedingly strong market position in photographic materials. This is particularly true in the field of color film and supplies. In substantial measure, the research activity of Eastman in this field is directed to maintenance of its existing market position and assuring that competitors do not foreclose new product opportunities. Patent rights resulting from Eastman research are—in general—"defensive" patents directed to maintaining access to new product and process opportunities. They are not generally looked upon as ways to foreclose competitors. This aspect of the Eastman patent rights is reflected in the general listing of Eastman patents as available for licensing[1] and in the absence of patent litigation brought by Eastman to enforce patent rights.

[1] See e.g., the listing of patents appearing at volume 671 *Patent Office Official Gazette,* page 14 (which includes Vittum 2,428,054 which is important to Eastmancolor type film but was not specifically required to be licensed by the decree). The attitude of a competitor toward patent rights relating to photographic products is reflected in the Dynacolor Corporation prospectus filed with the Securities and Exchange Commission on April 23, 1959. With respect to a number of new products (including a film similar to Kodachrome), the prospectus states that patent licenses will not be required, but that "should any such licenses be required, in the opinion of the Company such licenses will be available at a reasonable royalty."

To be sure, antitrust considerations dictate the Eastman policy of listing patents for licensing. Also, the decree here under study is unquestionably a case example to Eastman management of the need for steps to minimize such challenge. The fact nevertheless remains that for analytical reasons it would be surprising to find that the decree as such actually did significantly alter the Eastman activity.

Conclusions may also be drawn from the specific patents listed in the decree. Again the indication is that the effect of the compulsory licensing provisions as to Eastman would be mild.[2] Under paragraph IV of the decree, Eastman was required to grant royalty free licenses as to 13 patents. Five of these patents expired within three years. Because of the time limitations inherent in litigation, the practical opportunity to obtain injunctive relief against a competitor using these patents was very remote. Of the remaining eight patents, three are directed to Kodachrome type processing where the couplers are incorporated in the processing solutions,[3] and the remaining five patents are directed to duplitized film,[4] particular developers and couplers for which alternatives are available,[5] a specific type of sound track for which alternatives are available,[6] reversal film processing [7] and to stripping film of a type that might be used for imbibition printing.[8]

The monopack films that have actually been used for professional motion pictures —Ansco color and Eastmancolor—do not use Kodachrome techniques, duplitized films, reversal processing, or stripping film. It accordingly appears that insofar as any of the 13 patents listed in paragraph IV of the decree as to Eastman have actually been used in the professional motion picture film industry, such use has either been under circumstances wherein Eastman could not obtain practical patent relief, or elective in character and open to practical alternatives.

The Eastman judgment, paragraph IVB, lists 14 patents under which Eastman could charge royalties not in excess of its own royalty payments. Four of these

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[2] The patents listed in the Eastman decree appear to have been selected in part from the information supplied to the government by Eastman. On November 18, 1948, a few days before the decree, Eastman wrote the Department of Justice that:

1. Eastman Kodak Company represents that it has the right to grant licensees, as required, under patents listed in section IV of the consent judgment. *Eastman Kodak Company further represents that these patents include all unexpired patents which it is using or has used in its commercial practice of processing professional color motion picture film for professional color cinematography, as defined in the judgment.* [Emphasis added].
2. Included among the patents listed in section IVB of the consent judgment are patents relating to the processing of lenticulated film. Eastman Kodak Company has engaged in research work on lenticulated film but its work on this film has not reached the point where the company considers that lenticulated film is satisfactory for commercial use in professional color cinematography, and Eastman Kodak Company has never used these patents relating to the processing of lenticulated film in its commercial practice of processing professional color motion-picture film. Eastman Kodak Company represents that these processing patents are not dependent upon any manufacturing patents relating to lenticulated film which have been issued to Eastman Kodak Company.

[3] 2,019,718; 2,271,238; and 2,362,598. The Eastman decree was modified on January 31, 1949 to permit royalty charges on patent 2,019,718 to the extent Eastman was required to pay royalties.

[4] 2,059,884.

[5] 2,108,602.

[6] 2,258,976.

[7] 2,295,013.

[8] 2,417,060.

expired within three years of the decree, and thus could not practically have been the subject of injunction. Of the other ten patents, nine relate to lenticular film,[9] and the other relates to processing film of the Kodachrome type.[10] As matters have developed, lenticular film has not been used to any significant extent in professional color motor pictures, [11] nor has Kodachrome type film. Again, the nature of the patents is such that the compulsory licensing provisions of the decree could not be expected to have substantial effects.

Some of the patents listed in the decree as to Eastman, such as Mannes, *et al* patent 1,980,941, and 1,997,493 were important Kodachrome processing patents. As to these, it appears that the government acted on the assumption (consistent with the complaint) that the Kodachrome technique would prove important to monopack professional motion picture film. Subsequent events have disproved this assumption and have made this aspect of the decree unimportant. Other patents, such as Seymour 1,897,866, were listed in the Technicolor-Eastman imbibition agreement. As this agreement was an emphasized part of the antitrust complaint, listing of these patents is consistent with the government theory. The importance of imbibition patents is, however, quite limited because Technicolor has continued to be the only imbibition release print maker. The nine decree patents to lenticular film and the five decree patents to duplitized film are likewise not important. Neither lenticular film nor duplitized film was ever involved in agreements between Eastman and Technicolor. They were apparently included in the decree because of some display of interest by third parties in them, interest that has since disappeared when the Eastmancolor materials became available.[12]

A further measure of the likely effects of the decree as to Eastman can be obtained by considering the patents the decree does not cover. The only Eastman patent that covered the imbibition release print stock sold to Technicolor was Carroll and Chechak patent 2,294,893.[13] This patent covers an elective alternative rather than any key ingredient of the release print stock. It is accordingly of limited importance. In any event, it is not listed in the compulsory licensing

[9] 1,997,325, 2,008,989, 2,039,691, 2,047,282, 2,058,409, 2,095,826, 2,143,762, 2,191,038, and 2,382,604.

[10] 1,997,493. This patent, which expired on April 9, 1952, includes broad claims to the overall Kodachrome process.

[11] Lenticular film has been given some emphasis in connection with the color film reproduction of television program materials. At the present writing, however, monopack film is primarily used for this purpose. Question could well arise as to the application of Section IV of the Eastman decree to television use of the lenticular film patents on the ground that these are not "professional color cinematography" as that expression is used in Section IV and defined in Section IID. On the use of lenticular film in television see *Elements in Color in Professional Motion Pictures,* Society of Motion Picture and Television Engineers (hereafter SMPTE), (1957), p. 93.

[12] As late as 1951, for example, 20th Century-Fox was reported to be engaged in lenticulated film development efforts. *1951 Film Daily Year Book,* p. 121. Eastman was collaborating with 20th Century-Fox in this work, which began at least by 1942 and was in progress at the time of the Eastman decree. Between 1931 and 1937, Eastman cooperated with Paramount in a more extensive program to develop a satisfactory lenticular film process. This effort involved about $140,000 of research expense to Eastman. See *Second Supplement to Agreed Statement of Facts,* para. K250 a and b.

[13] *Supplemental Joint Statement of Facts,* para. 118.

provisions of the decree as to Eastman and is not covered by the terms of this decree respecting future patents. But if there were any patent rights of significance in connection with the purchase of imbibition print stock by Technicolor exclusively from Eastman, it would appear that this patent would cover such rights.

Of equal significance, the two principal Eastman patents to the colored coupler film development are Vittum patent 2,428,054 and Hanson 2,449,966. The colored coupler principle, as discussed in the Technical Appendix to this report,[14] is an important aspect of the Eastmancolor camera and intermediate monopack films. It is fair to state that either of these patents is more important to the developments that have since taken place in the industry than any of the patents listed in paragraph IV of the Eastman decree. As both patents are offered for license by Eastman in any event, this gap in the scope of the decree is of little practical importance. It does, however, point up the spread between the emphasis of the decree and the subsequent events in the industry.

The introduction of Eastmancolor materials in 1950 was the most important technical development in the color motion picture industry after the Eastman and Technicolor decrees. The technical background of these materials is discussed in the Technical Appendix to this report and is not repeated here.[15] The business considerations behind the introduction of Eastmancolor are discussed in the conclusions to this report.[16] It is sufficient at this point to note that at least one important technical development incorporated in Eastmancolor materials—the colored coupler development—was not available until about 1949, and that when the Eastmancolor materials were offered and proved successful, the entire character of the professional color motion picture processing and film supply industry changed. From the standpoint of Eastman, these materials made possible the sales of color film for many motion pictures that otherwise would have used the less expensive black and white materials.

As is discussed above with respect to the Technicolor release print sales volume, the trend toward black and white pictures and the reduced overall motion picture production volume are considered responsible for the declining Technicolor dollar volume. In contrast, the Eastmancolor materials offered in 1950 opened a new color film sales volume in which Technicolor did not participate. The Eastman dollar volume of motion picture film sales has accordingly tended to resist the declines reflected in the Technicolor figure and in the industry generally. The following comparison of the Eastman dollar volume and the Technicolor processing volume over the 1941-1958 period brings out the point.[17]

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[14] Technical Appendix, Part 5b.

[15] *Id.*

[16] Analysis and Conclusions, Part 3a.

[17] Table IV is taken from the Eastman and Technicolor annual reports. The dollar volume figure is computed from the percentage of Eastman dollar volume listed as "professional motion picture film," a category that appears to be broader than the sales of 35mm. film for theatrical exhibition use. However, the additional types of film listed do not appear to loom large in the total. For example, Eastman sold about 2.1 billions of feet of 35mm. film to the professional motion picture industry in 1948. (Schedule A, *First Supplement to Agreed Statement of Facts*). The table indicates that the Eastman "professional motion picture film" dollar volume in that year

TABLE IV

EASTMAN VS. TECHNICOLOR VOLUME, 1941-48

	Eastman		Technicolor	
Year	Dollars (Millions)	Ratio to 1948	Millions of Feet Processed	Ratio to 1948
1941	16	0.4	97	0.4
1947	32	0.8	222	0.8
1948	39	1.0	265	1.0
1949	36	0.9	267	1.0
1950	41	1.0	312	1.2
1951	49	1.3	393	1.5
1952	52	1.3	461	1.7
1953	57	1.5	561	2.1
1954	70	1.8	530	2.0
1955	85	2.2	489	1.8
1956	62	1.6	388	1.5
1957	80	2.0	276	1.0
1958	75	1.9	272	1.0

No dollar figures reflecting the intensity of Eastman research effort after 1948 are available. Every indication, however, is that the consent decree has had no significant influence on such expenditures. In the specific field of professional monopack color film, Eastman undertook substantial developmental effort prior to offering the Eastmancolor materials in 1950. That effort was followed up by a series of improvements that made possible an all-monopack professional photography and printing method in 1957.[18] All of this work appears to have been motivated primarily by a desire to maintain market position and to upgrade dollar volume of Eastman professional motion picture film sales. The prospect of patent rights has had a secondary role.

The present study is not directed to detailed consideration of the effects of the Eastman decree as to film processing. It seems clear that in the professional motion picture film field (35mm. and larger), the processing provisions of the decree have been of slight importance. The early experiments of Eastman and Technicolor, beginning in 1939, used film similar to Kodachrome. This fact, together with the extensive 35mm. still film use of Kodachrome, certainly suggested in 1948 that Kodachrome type films might well attain importance in the professional industry. As matters have turned out, the 35mm. films used since

was about $39 million. The resultant figure of about 1.8 cents per linear foot of film indicates that the figures of the table fairly measure the Eastman 35mm. professional motion picture dollar sales volume. The Technicolor footage figures represent release print processing volume. They are believed to be a fair indication of the Technicolor processing volume of all forms of film, including camera film.

[18] See Bello, *et al*, "A New Color Intermediate Positive-Intermediate Negative System for Color Motion-Picture Photography," 66 *Jl. SMPTE* 205 (1957). The most recent professional motion picture film introduced by Eastman is its No. 5250 camera film, introduced in the spring of 1959. This film features an exposure index of 50, tungsten, as compared with the index of 25 for the prior type 5248 film.

the decree have been of the incorporated coupler type, and all of the current Eastman professional motion picture color materials are of this type. This fact has reduced the Kodachrome processing policy to little, if any, importance to the professional industry.

The consistent Eastman policy on incorporated coupler films has been to encourage processing by independent laboratories and users. For example, in the case of the color film sizes most frequently used for professional still photography, Eastman supplied Kodachrome film prior to about 1948. As in the case of other Kodachrome processing, the film was processed by Eastman. When Ektachrome (the related incorporated coupler type film) became available about 1948, Eastman encouraged the photographers and independent processors to undertake the processing. Later, Kodachrome in many sizes was withdrawn from the market, leaving the field to Ektachrome and later to other incorporated coupler negative-positive materials.[19] The policies followed by Eastman in this and other instances indicate that the company would not have sought to process the Eastmancolor materials in any event, and that the processing aspects of the 1950 decree have accordingly not had substantial effect on the industry.

While the 1948 decree does not appear to have had substantial direct effect on 35mm. professional motion pictures, it has been of significance in connection with 16mm. Kodachrome motion picture film processing. It is accordingly desirable to trace briefly the effects of the decree on such processing.

Kodachrome processing requires not only that the usual developing chemicals be applied to the film, but in addition demands that the color-forming couplers be introduced into the three layers of the film selectively to produce images of the appropriate colors.[20] The process is most exacting and complex. It is much more difficult than black-and-white film processing or the processing of incorporated coupler type color films. When Kodachrome was introduced in 1935, no film processing facilities were available. High quality processing was essential to success with the film. It is not believed that Eastman then had any alternative but to process the film itself. The policy of selling the film with processing included followed as a matter of business convenience.

By 1948, when the Eastman decree here studied was entered, Kodachrome processing had been improved, experience with the film had been accumulated by the industry generally, and the film was the most widely used color for 16mm. motion pictures. Eastman continued to include the processing charge in the film price, giving little if any incentive for independent processing, and (with unimportant exceptions) was the sole processor of the film.

The provisions of the 1948 decree were not limited to 35mm. and larger motion picture film. Following the decree, Eastman sold 16mm. Kodachrome without including the processing charge. In view of the above history and the heavy commitment of Eastman in processing facilities, it seems clear that the decree had a very substantial effect in bringing about these changes.

At the present writing, Kodachrome (both still and motion picture) is sold

[19] Technical Appendix, Part 5b.
[20] *Id.*

by Eastman without processing charge. Independent laboratories, including Technicolor, process the film on an unrestricted basis for amateur and commercial customers. The 1954 Kodachrome processing decree [21]—covering amateur still and motion picture Kodachrome—is the most significant and specific antitrust decree in this field. The 1948 decree is nevertheless of considerable importance, especially as the forerunner to the 1954 decree. Specifically, the 1948 decree defined "professional color cinematography" in a manner including 16mm. Kodachrome for commercial use, thereby giving rise to steps by independent Kodachrome processors toward undertaking such processing. It is believed that the most important hurdle to independent Kodachrome processing was the policy of selling film with the processing charge included. Once this practice ended, the decree provisions as to processing manuals [22] certainly facilitated the efforts of the independent processors, and (at least to the extent of the patents subject to the 1948 decree) the compulsory patent licensing provisions gave the independent processors assurance that patent problems would not arise.

In summary, the compulsory patent licensing provisions of the 1948 decree as to Eastman have had little direct effect in the professional motion picture field. They do not appear even to cover the Vittum and Hanson patents that appear to be the most important patents to the Eastmancolor negative and intermediate monopack films. Outside the professional motion picture field, the decree provisions have been important as a first step in bringing about Kodachrome film processing by others than Eastman.

(*Part III of this report will be published in the Summer Issue of the* Journal)

[21] *Final Judgment,* U.S. v. Eastman Kodak Co., No. 6450, W.D.N.Y.
[22] *Eastman Decree,* para. VIII.

Prologue to a Study of Patent and Other Factors in the Machine Tool Industry*

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SUMMARY

THIS PAPER PROVIDES SOME OF THE BACKGROUND material compiled for a questionnaire study of the role of patents and other factors in the development and the innovation process of the machine tool industry. The machine tool industry occupies a crucial position in modern industrial economies because of its relation to capital formation. It plays a strategic role in the twin processes of economic growth and fluctuations. Although the basic patents in the machine tool industry have long since expired, patents on control and transmission elements and other components of the machines are nevertheless important.

Purpose of Study

OUR STUDY IS INTENDED TO THROW some light on the role of patents and other factors in the internal and external motivations for change in the technology of the machine tool industry. Clearly, these two kinds of motivation are conceptually and empirically separable. Does the patent system affect one more than the other? And, what is the influence of firm size, competitive conditions, nature of product, and export markets? These questions are starting points for our study, the main results of which will be derived from a survey of firms in the machine tool industry (and certain related industries). The survey will seek information from responding firms as to the role of patents and other factors in the development and the innovation process of the machine tool industry. In this paper, we present some of the information gathered from secondary sources, in preparation for the questionnaire phase of the project. The questionnaire will attempt to ascertain the role of owned and licensed patents in the origin, development, and current operation of the responding firms.

Patents in the Machine Tool Industry

There are virtually no published materials which examine the role of the patent

* This paper was prepared by Dr. Murray Brown and Dr. Nathan Rosenberg, Assistant Professors of Economics at the Wharton School of Finance and Commerce, University of Pennsylvania. This is an interim report of one of several studies conducted as part of *Project 3a*, Role of Patents in the Creation and Growth of Small Industrial Units, under the general direction of Dr. Irving H. Siegel, Principal Consultant.

system in the machine tool industry, although this role has clearly been a significant one. All the basic machine tools had been developed by the turn of the present century, but the industry has continued to experience significant change in the past 60 years. Innovations have made it possible to cut metals with increasing speeds, closer tolerances, and greater automaticity. The introduction of metals of greater durability, culminating in the general utilization of tungsten-carbide cutting tools, brought with it the redesign of machine tools for sturdier construction and operation at higher feeds and speeds. More recently, strides have been taken toward automatic control of operation sequences and the incorporation of electronic control systems. Another important trend is the increasing integration of formerly discrete machining operations.

In essence, there are only six basic machine-tool processes: grinding, planing, drilling, milling, turning, and metal forming. The origin of some of these goes back to antiquity; for example, the potter's wheel is the ultimate source of the lathe. The invention of the screw-cutting lathe was delayed until 1800; John Wilkinson had already invented in 1775 the machine that made it possible to bore cylinders for the steam engine, which in turn helped to increase the efficiency of metal cutting tools. By 1875 the planer, the milling machine, and the drill press had been invented. These dates make it clear that the basic patents on the major types of machines have long expired.

It has been suggested in interviews and correspondence that patents today apply mostly to machine tool components, such as tool holding devices or hydraulic and electrical circuits, and that none of these patents is basic enough to constitute a significant monopoly. This view is confirmed to some extent by an authority on the industry, W. H. Brown, who comments that the great majority of patents protect only the control and transmission elements of the machines. Accordingly, machine tool designers appear to have been free to devise other methods of performing the same operation.[1] Some patents nevertheless have been of "major importance"—e.g., the Gleason Gear Works patent for bevel gear machinery and the Cincinnati Milling Company's patent for the centerless grinder.[2] The first contributed to the eminence of Gleason as a manufacturer of bevel gear machinery in the U. S., and the second patent did the same for Cincinnati Milling in the grinding product class until it expired in 1938.

The distribution of patents between large and small firms in the machine tool industry is a significant statistic. Quantitative data on patents frequently tell us little, since so many ancillary processes are patentable, but they do illuminate certain aspects of the innovation process. It seems plausible to relate the number of patents held by a firm to its size, its research expenditures, its growth, etc., and for this purpose the distribution of patents is invaluable. As a first step toward constructing such a distribution, we offer Table I, which shows selected firms having over 75 patents in the industry.

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[1] Brown, "Innovation in the Machine Tool Industry," unpublished Ph.D. thesis, Yale University, 1952, p. 96.

[2] Brown, *ibid.*, p. 97.

TABLE I

NUMBER OF PATENTS ISSUED TO SELECTED FIRMS IN THE MACHINE TOOL INDUSTRY
1939–55

Norton Co.	515
Cincinnati Milling Machine Co.	274
Niles-Bement-Pond Co.	215
Ex-Cell-O Corp.	189
LeBlond Machine Tool Co.	175
Warner & Swasey Co.	123
Kearney & Trecker Co.	107
Landis Tool Co.	105
New Britain Machine Co.	105
Fellows Gear Shaper Co.	92
Bryant Chucking Grinder Co.	91
Brown & Sharpe	75

Source: *Distribution of Patents Issued to Corporations (1939–55)*. Study of the Subcommittee on Patents, Trademarks, and Copyrights of the Committee on the Judiciary, United States, Senate 84th Congress, 2d Session, Pursuant to S. Res. 167, Study No. 3, Washington, 1957.

Characteristics of the Machine Tool Industry

The machine tool industry is unique from the viewpoint of technology. It produces machine tools which it uses for the production of other machine tools—i.e., the industry reproduces itself. It produces machine tools for use by other industries in turning out consumer and investment goods. Everything fabricated of metal is, by ancestry, either a first or second generation offspring of the machine tool industry.

Although the production of machine tools for use in other industries is more important quantitatively, the reproduction function of the industry is especially significant for economic growth.[3] This reproduction characteristic motivates the machine tool industry to improve technology for producing its own tools, i.e., it has an internal motivation for technological change. Also, there are external technical specifications imposed upon the industry by its customers which encourage technological change. Since all industrial establishments engaged in the production of machinery and consumer durable goods use machine tools, these externally imposed changes permeate the entire structure of the modern economy.

Examples of technological changes in machine tools associated with the external developments are (1) the demand for guns even prior to the Civil War, (2) the demand for bicycles in the 1890's which stimulated production of handscrew and other machines, (3) the rise of the automobile industry, and (4) the rise of the aircraft industry. Examples of technological changes in machine tools arising within the industry itself will be noted in the section on history.

Recently, another aspect of machine tool technology has received attention in the press.[4] It has been argued that the industry has been delinquent in adapting mass production techniques for machine tools, in contrast with practice in the Soviet Union. Consequently, the U.S.S.R. apparently can supply tools to under-indus-

[3] See A. Lowe, "Structural Analysis of Real Capital Formation," in *Capital Formation and Economic Growth* (National Bureau of Economic Research, 1956).

[4] *New York Times*, November 26, 1959.

trialized areas at advantageous prices and thus expand its political influence. Furthermore, it is argued that the mass production of industrial equipment at low prices may allow the more rapid replacement of older machine tools and thereby increase efficiency. It is the latter aspect of the argument that is interesting for the present study, for it points up the role of technological change in the machine tool industry in terms of an objective economic phenomenon: the replacement of machine tools. Although the press did not mention the following point, it too is relevant to this argument: Competition in the machine tool-using industries may tend to limit the mass production of standardized machine tools,[5] for competition often forces firms into making frequent design changes, which in turn require specialized tools.

There is considerable doubt, however, as to the validity of the above argument. It is not clear that the criterion for the replacement of machine tools should only be technological change, as suggested above. At least as relevant is the economics of replacement: Does the reduction in costs attributable to the new machine compensate for the replacement of a tool which is still physically productive? Another pertinent question is whether mass produced or standardized machine tools provide the technology that is optimal for economic growth. Could the customized machine tools produced in the U.S. perhaps satisfy this need better? We shall consider such problems in the second phase of the study.

Perhaps the most important underlying characteristics of the machine tool industry which is pertinent to the study of the factors influencing the origin, growth, and innovational processes of the industry is the structure of its demand—the distribution of its total sales among other industries.

This pattern affects technological cross-fertilization. Even the competition among firms in the industries comprising the markets for machine tools may influence innovation in the tool industry. Furthermore, if the structure of demand is changing with respect to secular and cyclical changes in business activity, opportunities may be provided for systematic innovation in the machine tool industry. Another pertinent fact is that machine tools are vital for producing armaments. The government is, in fact, an owner of machine tools on a massive scale.[6]

To delimit our study area, we shall focus on the Standard Industrial Classification number 3541, which is defined as:

> Establishments primarily engaged in manufacturing power driven machine tools that shape metal by grinding or progressively cutting away chips. Important products of this industry include forging, broaching, drilling, gear cutting and finishing, grinding, milling and planing machines; lathes, shapers, and slotters; honing and lapping, polishing and buffing, sawing and cutting off; contour-sawing and filing, tapping, threading and rifling machines, and replacement and repair parts for machine tools. The rebuilding of machine tools is included in this industry.

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[5] The small size of the capital coefficient in machine tools bears out the contention that machine tools are not mass-produced. For 1939 the capital coefficient was .501. W. Leontief, *et al, Studies in the Structure of the American Economy* (Oxford, 1952), p. 220.

[6] In 1955 the U. S. Government owned about 400,000 machine tools which were conservatively valued at $2,000,000,000. It is not without interest that one of the key proposals in the post World War II plans for the "demilitarization" of Germany was the imposition of severe restrictions upon her output of machine tools.

The machine tool industry, so defined, is heavily concentrated in the East North Central section of the U. S. In 1954, 24% of the employment in the industry was in Ohio and 54% in the states of Ohio, Indiana, Illinois, Michigan, and Wisconsin. Approximately 33% of the industry's employment was in the New England states, and over 9% in the Middle Atlantic states of New York, New Jersey, and Pennsylvania. Table II presents a detailed distribution of the establishments and employees in the machine tool industry by location for 1954.

TABLE II

NUMBER OF ESTABLISHMENTS AND EMPLOYEES IN MACHINE TOOL INDUSTRY BY REGIONS

1954

LOCATION	ESTABLISHMENTS*	EMPLOYEES
INDUSTRY TOTAL	639	80,959
East North Central	326	43,736
West North Central	27	1,197
New England	105	27,099
Middle Atlantic	109	7,656
West	62	764
South	10	505

Source: Bureau of Census, U. S. Department of Commerce.

* Definition of "Establishments" includes individually located plants of each company.

Although there are many different machine tools performing numerous functions, the structure of a machine tool has certain fixed characteristics. There is the feed mechanism which provides the tool with a flow of materials; there are controls which guide the input during the cutting; and there are the cutting elements. This invariant structure may be one of the essential reasons for the type of innovation that has occurred in machine tools.

The extreme durability of the industry's chief products is related to many special problems such as the high degree of cyclical instability that are characteristic of the industry. The useful working life of a machine tool (especially the more general-purpose types) may be 20 or 30 years, but changes in final products and productivity-increasing innovations typically induce replacement at far shorter time intervals. Nevertheless, in a recent year it was estimated that more than one-half of the machine tools in use in the U.S. were more than 10 years old, and one-fifth of all machine tools were at least 20 years old.

According to the Bureau of the Census, the machine tool industry in 1954 consisted of 627 companies which operated 639 plants. The value of shipments by the industry in that year exceeded $1.1 billion and the number of employees was 80,959. As may be seen from a distribution of these workers according to the size of establishment, the industry consists of a large number of very small firms.

Entry into the industry is relatively easy, at least as far as financial requirements are concerned. This is reflected in the growth in the number of machine tool firms to accommodate the rapid expansion in machine tool demand after the Korean outbreak in 1950. Between 1947 and 1954 the number of machine tool companies doubled, rising from 312 companies in 1947 to 627 in 1954.

TABLE III

ESTABLISHMENTS IN MACHINE TOOL INDUSTRY LISTED BY EMPLOYMENT SIZE, 1954

(*Value figure in thousands of dollars*)

Number Employees, Establishments, and Value Added by Manufacture	Total, All Establishments	Establishments with average of			
		1–9 Employees	10–19 Employees	20–49 Employees	50–99 Employees
Number of Establishments	639	296	77	89	54
Number of Employees	80,959	1,082	1,110	3,005	3,726
Value Added by Manufacture	788,219	8,847	8,007	23,300	32,486
	100–249 Employees	250–499 Employees	500–999 Employees	1,000–2,400 Employees	2,500 and over Employees
Number Establishments	57	34	11	17	4
Number Employees	10,001	12,438	7,932	26,147	15,515
Value Added by Manufacture	98,980	126,471	86,858	262,886	140,381

Source: Bureau of Census, U. S. Department of Commerce.

The smallness of the typical machine tool firm is closely connected with another very important feature of the industry. This is the highly specialized nature of the bulk of its final products. The output of the industry consists of a very wide assortment of tools, many of which are individually designed and custom-built to specifications established by the final user, or, alternatively, on a small job-lot basis. Not only are there well over 400 distinct types of machine tools, but each is in turn available in a variety of different sizes and with a wide array of special attachments and accessories. Individual machine tool plants typically produce a single or, at most, a few, types for the highly specialized uses of their industrial customers. Thus, the machine tool industry is composed of a large number of firms whose final products, metal-cutting instruments, possess a certain technical common denominator but may otherwise bear little economic resemblance to each other. In a recent year only three companies manufactured turret lathes with a bar capacity of 3½ inches or larger; only four companies produced vertical boring mills with tables of at least 60 inches in diameter; and only five made large horizontal boring machines.

Table IV shows the growth of the machine tool industry over two decades, 1937-57. From the low starting point (a depression year) shipments more than doubled during this period. The peak years occurred earlier, however, in 1952-53, during the Korean conflict. The industry is well known for the variability of its output according to general business conditions and defense requirements.

In the postwar period, between 20 to 30% of the tool output has been exported. The principal importing countries have been the United Kingdom, Canada, France, Argentina, Brazil, and Mexico. Our own imports are small, amounting to approximately 1% of domestic production.

TABLE IV

VALUE OF SHIPMENTS BY MACHINE TOOL INDUSTRY

YEAR	VALUE OF SHIPMENTS ($1,000)	PER CENT OF 1947
1957	$1,209,071	245
1956	1,270,470	257
1955	1,007,752	204
1954	1,146,932	232
1953	1,541,374	312
1952	1,566,024	317
1951	953,124	193
1950	486,662	99
1949	395,035	80
1947	493,853	100
1939	221,267	45
1937	202,739	41

Source: Bureau of Census, U. S. Department of Commerce.

Lathes and grinding machines constitute the largest component of machine tool exports. These product classes are among those for which the "concentration ratios" published by the Senate Committee on the Judiciary are the lowest. (See Table V). Apparently, the more "competitive" sector of the industry is also the sector most strongly oriented toward foreign trade.

TABLE V

CONCENTRATION RATIOS IN THE MACHINE TOOL INDUSTRY

SIC CODE	PRODUCT CLASS AND PRODUCT CLASS-GROUP	VALUE OF SHIPMENTS ($000's)	CONCENTRATION RATIO: % OF VALUE OF SHIPMENTS ACCOUNTED FOR BY: 4 LARGEST COS.	8 LARGEST COS.	20 LARGEST COS.
3541	Machine tools	1,000,152	18	27	49
35411	Boring machines	114,443	51	73	92
35412	Drilling machines	86,066	36	56	87
35413	Gear cutting and finishing machines	48,111	69	90	99
35414	Grinding and polishing machines	154,396	43	59	79
35415	Lathes, except woodworking	206,886	38	63	89
35416	Milling machines	121,494	65	77	92
35417	Other machine tools, except home workshop	239,011	21	34	53
35418	Machine tools, primarily for home workshop	9,283	40	59	85
35419	Rebuilt machine tools	15,012	32	49	75
35410	Machine tools not specified by kind	5,450	—	—	—

Source: *Concentration in American Industry*, Report of the Subcommittee on Antitrust and Monopoly to the Committee on the Judiciary. U. S. Senate U.S.G.P.O., Washington, 1957, p. 57.

History of Industry

The emergence of a recognizable machine tool industry in our country was historically coincident with the growth of mass production methods of industrial manufacturing. Indeed, its very development helped encourage adoption of such methods.

Its earliest growth was intimately connected with the advance of metallurgy and the utilization of steam as a general source of industrial motive power.

Most of the basic machine tools were developed in the last quarter of the eighteenth and the first half of the nineteenth century. The start of the modern machine tool industry may be related to the development of the steam engine itself. James Watt's brilliant conception of the separate condenser long proved impractical because of his inability to secure for his engine a cylinder bored to a sufficient degree of accuracy. At one time he actually operated a cylinder containing an error of ⅜ inch in its diameter. The incredible improvisations, by modern standards, to which he resorted are indicated in the following quotation:

> The close fitting of the piston in the cylinder, which did not so greatly matter in the Newcomen engine, was essential to the proper working of Watt's. For want of an accurate boring-machine, the cylinder of his first engine was made of tin and hammered to shape against a hard-wood block; the gaps between piston and cylinder were sealed as far as possible with felt, paper, oiled rags, and the like.[7]

The precision required by Watt was eventually achieved only with the assistance of John Wilkinson's boring machine which finally supplied cylinders of the required degree of accuracy and, in so doing, immediately rendered the steam engine a commercially practicable proposition. Wilkinson's boring machine may justly be regarded as the beginning of the modern machine tool industry.

The machine tool industry developed at an extraordinary speed in the first half of the nineteenth century. The pioneers in England, including such men as John Wilkinson, Joseph Bramah, Samuel Bentham, Henry Maudsley, James Nasmyth, and Joseph Whitworth, directed their energies primarily toward the production of the general purpose machine tools. They concentrated their efforts upon creating machinery to accommodate the growing demands of the steam engine, mining equipment, railroads, naval machinery and equipment, etc.

In America the machine tool industry achieved its first significant growth in the production of firearms, built with standardized and interchangeable parts by Eli Whitney, Simeon North, and later on, Samuel Colt.[8] So successful were these efforts that, by 1853, a British Royal Commission, which included Whitworth and Nasmyth, visited the U. S. to study the manufacture of small-arms. Almost immediately "The American System" (as manufacture with interchangeable parts was then called) was adopted in Britain, and American machinery was even being exported to England for use in British armories.

Although the earliest development of machine tools in the U. S. was centered upon the introduction of the principle of interchangeability in the production of firearms, its major achievements came in the extension and application of the interchangeable system to the production of other products which were themselves de-

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[7] K. R. Gilbert, "Machine Tools," in *A History of Technology,* Charles Singer, *et al* (eds.), IV, 421.

[8] It is one of the minor ironies of history that Eli Whitney turned to the development of a system for the manufacture of firearms on an interchangeable basis because of his failure to derive a substantial income from his cotton gin, which failure was in turn due to the difficulties and frustrations which he encountered in attempting to enforce his patent rights! Joseph Wickham Roe, *English and American Tool Builders,* pp. 131-132.

veloped in the second half of the nineteenth century. The machine tool industry grew in importance with the attempt to achieve large quantity production of machines which were composed of separate metal components requiring accurate fitting, i.e., sewing machines, typewriters, bicycles, agricultural machinery, automobiles, and electrical equipment. In all these and many other cases, mass production and commercial success were dependent upon the introduction of an appropriate battery of machine tools which were geared to the specific needs of the new product.

Technological change in the machine tool industry continued at a very rapid rate between 1850 and 1900. In addition to the introduction of significant new devices such as the turret lathe, multiple-spindle drilling machines, automatic lathes, automatic gear cutters, grinding machines, and a vast proliferation of special purpose tools, the introduction of superior cutting tool materials such as mushet steel and high speed steel, and the electrification of machine tools, exerted a diffused effect in increasing productivity and flexibility throughout the entire industry.

The machine tool industry began to approximate its present form in the second half of the nineteenth century. Throughout this period an increasing amount of attention was devoted to the construction of special-purpose machine tools. Individual firms increasingly specialized in the production of one or, at best, a very limited family of tools. In spite of the increasing predominance of the corporate form of organization, the machine tool industry long remained a stronghold of the individual proprietorship and family-owned firm. Although financial requirements for the establishment of a machine tool firm remained small by comparison with the rest of industry and never constituted a serious obstacle to entry, business success in the production of machine tools was heavily dependent upon the possession of highly specialized skills and technical abilities, both on the managerial and labor force levels. New machine tool firms were frequently organized by young men after having served extensive apprenticeships and having acquired their familiarity with the exacting requirements and technology of the industry in well-established firms.[9]

[9] See the various "genealogies" of individual firms in Roe, *op. cit.*

Patents and Other Factors Affecting Executive Decisions*

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SUMMARY

THE PROJECT ON THE ROLE OF PATENTS in executive decisions is directed toward discovering some of the ways in which firms' behavior is affected by the patent system. Particular emphasis is given to the relations between decisions concerning research and the patent system. A small sample of firms has been selected for intensive study.

Executive decisions and the acquisition of patents are regarded in the context of the many factors that enter into firms' competitive strategies, and it is expected that some interesting variations will be found concerning the impact of the patent system on different kinds of industries and companies.

Because the system is of such long standing and is embedded deeply in many business policies and attitudes, it is not easy to identify its specific effect on decisions made by the business community. The broad problems with which the present project deal are, first, determining the kinds of decisions in which the patent system may play a part, and then attempting to isolate whatever effects the system might have on those decisions. This interim report describes the nature of the project, identifies some of the problems which are involved, and offers some tentative findings.

THE FOUNDATION BECAME INTERESTED in the relations between the patent system and executive decisions as a result of the work of an earlier project on "The Value of the Patent System in the United States" carried out under the direction of Dr. Jesse W. Markham.[1] That project examined a variety of methods by which an evaluation of the patent system might be made. The following statement appears in that study:

> It should be made clear at the outset that the value of the patent system cannot be quantitatively measured in the relatively precise manner in which such economic variables as the national income and its various components are measured. The system embraces a host of components such as expectations of financial reward and scientific fame, the urge to create, and changes in the stock of scientific knowledge. Some of these are by definition of a qualitative nature. . .[2]

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* This research interim report on *Project 8a,* The Role of Patents in Executive Decisions, was prepared by Mr. Strong.

[1] *PTC J. Res. & Ed.,* 1, No. 1, (June 1957), pp. 20-56.

[2] *Ibid.,* p. 20.

The present project accepts the validity of this statement and makes no attempt to measure quantitatively the impact of the patent system on executive decisions.

Rather, this study takes as a guide one of the conclusions of the earlier project which was stated as follows:

> Since the basic decision-making unit in a free enterprise economy is the firm, it follows that the most promising approaches to the value of the patent system should seek to estimate its impact on firms' behavior. It has been argued elsewhere in this study that the system probably affects firms in different ways and in different degrees. If this is so, better understanding of the *modus operandi* of the system in a wide variety of cases is required before its fruits can be reliably identified. Hence an intensive study of a well-selected sample of firms . . . would be invaluable.[3]

Thus, the present study seeks to estimate, for a small sample of firms, the impact of the patent system on firms' behavior, as exhibited by the decisions of responsible executives. Of course, a great many types of executive decisions are of such a nature that patent considerations are never involved. But decisions concerning research, new product development, and diversification may frequently take into account the patent system,[4] and it is the purpose of this study to examine the various ways in which these kinds of decisions are affected under differing conditions.

The method of research that has been adopted is to select for intensive study four to six large corporations from each of the broad industrial categories of mechanical equipment, electrical equipment, and chemical manufacturing. The object is not to try to obtain a statistically valid random sample or even a representative cross-section of manufacturing industry, but rather to select a diverse group of firms with the expectation that it will exhibit a wide variety of policies, attitudes, and experiences in relation to the patent system. The success of this procedure was demonstrated to some degree by the fact that two interviewees from different companies expressed the opinion that their firms were poor choices for the purposes of this study since they had patent policies that were not representative of American industry in general. One of the executives felt that in spite of the fact that many patents were taken out regularly by his company, research was carried on as an essential part of the business and would be just as essential even in the absence of a patent system; and the other executive felt that his firm was unusual because the company depended on the royalties from patent licensing for an important part of its income, and, except for its present military contracts, could not exist without patents.

For each of the firms chosen for investigation, all available published sources are searched for information about the firm's activities and the changes in those activities over the past several years. A considerable amount of information can be found in annual reports, financial directories and manuals, applications to stock

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[3] *Ibid.*, p. 53.

[4] One type of executive decision which normally would not be associated with the patent system deals with the geographical location of a firm's subsidiaries. However, in the case of one firm, an important factor in the location of its subsidiaries was the variations in the degree of leniency with which different Circuit Courts customarily treated cases concerning the validity of patents.

exchanges for the listing of new stock or bond issues, prospectuses, stockbrokers' reports, trade journals, newspapers, and the popular business periodicals. These sources at least provide a good indication of a firm's involvement with the patent system; for example, if a company has diversified its products over a period of years but has not engaged in any mergers and has not spent much money on research, one logical point for further study would be to investigate the extent to which the firm has bought or licensed patents from others. In addition to examining the published sources of information, interviews are held with officers of the firms being studied; and in some cases, permission can be obtained to see records concerning intra-company recommendations on actions involving patents. Specific information that comes from the companies themselves is especially valuable because, while much has been written concerning the factors that *should* enter into business decisions, there is very little published information concerning the factors that actually *have* entered into decisions.

Decisions Concerning Research

Although this study is concerned with the relation of the patent system to many kinds of business decisions, the kind of business activity that is of principal interest is research (two other major areas, decisions concerning taxes and antitrust involvements, are dealt with in other Foundation projects). The patent system is designed to stimulate economic progress through invention, innovation, and disclosure; and industrial research often serves the same end of economic progress through development of new and better products and processes, and the promotion of greater efficiency and customer satisfaction. Consequently, a good starting point in the present discussion of the effect of the patent system on executive decisions is an examination of decisions that relate to research and development. Then will follow a discussion of the kinds of decisions involving the acquisition of patents.

All large manufacturing firms carry on some research if research is defined to include engineering and design improvements as well as "basic" research which does not strive for such immediate results. If, in addition, research is conceived to include both the kind of activity that leads to invention and the kind that leads to innovation, the more common reasons for carrying on research may be listed as follows:[5] [5a]

1. To invent or develop new materials, products, or processes.
2. To improve the quality of existing materials or products.
3. To standardize products or processes.

[5] This list is adapted from Lincoln T. Work, "The Philosophy and Economics of an Industrial Research Program," in Conference on Industrial Research, *Costs, Budgeting, and Economics of Industrial Research* (New York: King's Crown Press, 1951), pp. 5-6.

[5a] It should be noted that some of the reasons for carrying on research may become operative only when firms can foresee that their research accomplishments are likely to be protected by patents.

4. To develop new uses for existing materials, products, or processes.
5. To reduce the costs of production through better engineering.
6. To devise ways of helping customers make better use of a product, including the distribution of technical information.

It will be noted that these reasons are not all mutually exclusive; for example, in order to improve the quality of a product it also may be necessary to redesign the corresponding manufacturing process.

Too few companies have been investigated up to this point to indicate any consistent pattern, either for the companies in a single industry or the sample as a whole. However, all of the reasons except Number 3 had some importance attributed to them by two or more companies. It is probable that, as the study progresses, reasons in addition to those listed may turn out to have significance.

A fact that does appear clearly is that, while most companies consider one or more of the same reasons for carrying on research to be important, there are sharp differences in the emphasis which they give to the various reasons. A firm in the machinery industry stressed the importance of continuous quality improvement and the adaptation of its machines to appeal to a wider market. A firm in the electrical equipment industry devotes much of its research effort to developing new products and to providing assistance to the licensees of its patents. A firm in the chemical industry emphasized new product development. (The question of *why* a firm has one or more of these reasons for carrying on research is beyond the scope of this project, but, in general, the answer may be found for any one company in some combination of the characteristics of firms and industries which are discussed in a later section of this report.) What is important for present purposes is the extent to which research decisions are related to decisions concerning the acquisition of patents.

Decisions Concerning the Acquisition of Patents

The factors that lead companies to acquire patents are as numerous as those inducing them to carry on research. The more common reasons for acquiring exclusive property rights in an invention may be listed as follows:[6]

1. To obtain greater freedom in pricing and production policies than would be possible without a patent monopoly.
2. To protect new products during the period while manufacturing methods are being perfected and markets are being developed.[5a]
3. To prevent other firms from engrossing a field of technology, i.e., technological excellence could well be futile without patent protection.
4. To avoid the risk of being unable to obtain patent licenses from outsiders.
5. To obtain bargaining power in cross-licensing negotiations.

[6] This list is adapted from Frederic M. Scherer, and others, *Patents and the Corporation, a Report on Industrial Technology Under Changing Public Policy* (2nd ed., Boston: 1959), pp. 47-49.

6. To obtain royalty income from the licensing of patents.
7. To gain prestige for the company by proving technological leadership with patents.
8. To raise the morale of research personnel by allowing patents to be issued in their names.

As in the case of the reasons for research, some of the reasons for acquiring patents overlap one another; for example, patents may serve the purpose of preventing competitors from engrossing a field of technology and at the same time provide bargaining power in negotiating cross-licensing agreements with those same competitors.

It is still too early to predict what, if any, pattern will finally emerge as far as different types of companies are concerned—each of the reasons has been granted at least some importance by one or more companies, but there have been no outstanding favorites. The range of emphasis is illustrated by the variation between a petroleum company that considers patents valuable in cross-licensing bargains to an electrical equipment company that has experienced so little difficulty in obtaining licenses from others that it considers the obtaining of bargaining power to be of negligible importance as a reason for acquiring patents.[7]

When the reasons for carrying on research are compared with the reasons for acquiring patents, it is seen that in some cases these reasons are unrelated, i.e., a company may take out patents for the sake of its employees' morale, but certainly would not undertake research merely to be able to take out patents for that purpose. Frequently, a patent may have been an accessory after the fact in contributing to the commercial success of the results of research, but it was not the moving force causing the research to be undertaken in the first place.

Methods of Competition

The methods of competition in everyday use in this country include those emphasizing price, quality, design, service, advertising, location, and technology or research. Obviously, some types of firms and industries because of their very natures cannot compete on the basis of research and technology. For example:

[7] A major difficulty in determining the degree of importance that companies ascribe to the various reasons arises because of the different ways in which executives describe their companies' policies. For example, one interviewee may say that his company's research decisions are made with little or no thought given to the possible patentability of the results of research, although in fact, patents are applied for wherever possible. Another executive may say that patents are very important and that much less research would be undertaken in the absence of a patent system. In fact, the two companies may have very similar research and patent policies—both may consider research very important and undertake it for the same reasons, and both take out patents on whatever develops from the research; the only difference is that one man chooses to emphasize the importance of research and the other the importance of patents. This points up the desirability of getting the opinions of more than one person in each firm and of checking verbal opinions against both written records and the actual behavior of the firm whenever possible.

> Some companies must rely on a favorable relation between costs of raw materials and the selling value of products. Good judgment with respect to inventories may control profits and there is little that can be done toward making more valuable products. . . . Other industries may make their return through economical manufacture. Standard bulk commodities, such as acids, cement, phosphates, are in this category. The sales margin is too close for much research.[8]

The methods of competition used by any one firm depend on a great many characteristics of the firm, such as the kind of industry in which the firm operates (expanding or stable), the type of product manufactured (importance of price, quality, design), the type of customer (consumer or producer), the number and strength of competitors, the nature of the production process, whether the firm is primarily a product or process company, the extent of public regulation of the industry, etc. The list could be extended almost indefinitely.

These are the factors that determine to a large extent the basic character of a firm and that strongly influence its business behavior. Depending on the character of a firm, patents may or may not be a major consideration in its behavior. However, even in those cases where patents may not be a strong causative factor in a firm's behavior, their influence may be felt in a less direct way. For example, new product additions to a company's line might be evaluated in terms of their potential markets, costs, contribution to balanced operation, expected profitability, etc., and if the products appear desirable on all these counts, patent considerations could determine whether any one product was actually adopted by a firm.

A more direct effect of the patent system may be to help *create* business firms in certain instances. This would be true in the cases of both the small, highly specialized firm, perhaps founded by a scientist with a few significant patents, and the few firms that derive the major part of their incomes from patent royalties. In addition, the patent holdings of one firm may induce a competitor to expend research effort to seek an alternative process or product. This effort to "invent around" the patents of others was mentioned by almost every executive interviewed.

The problem of the extent of causation in the impact of the patent system on executive decisions will be of major concern as the study progresses. It is desirable to establish as clearly as possible those cases where the patent system does have an influence on decisions and then attempt to determine when and how the system made its influence felt.

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[8] Work, *op. cit.*, pp. 7-8.

FORUM

Although the primary purpose of this *Journal* is to communicate the research work of the Foundation, it also serves as a vehicle for educational activities designed to exchange informed opinion and stimulate additional study. Comments from our readers are invited.

Our Patent System Works

A REPLY TO THE MELMAN REPORT

RICHARD F. CARR

FOREWORD

THIS STUDY, ENTITLED "OUR PATENT SYSTEM WORKS: A Reply to the Melman report," has been authorized by and prepared on behalf of the Patent Law Association of Los Angeles by one of its members, Richard F. Carr.

The appearance of the "Melman Report," a study written by Professor Seymour Melman for the Subcommittee on Patents, Trademarks and Copyrights, called attention to the need for a realistic assessment of the workings of the patent system premised upon a sound base. If Mr. Melman's report were to be accepted, the patent system had outlived its usefulness, and concepts held since the founding of our country were no longer sound.

It was decided that Professor Melman's report should be analyzed carefully and that independent data from a far broader base than the few large corporations and universities considered by Professor Melman should be collected and analyzed. A survey of many hundreds of large and small users of the patent system was made, and the collected data were analyzed. The Melman report was analyzed. The present paper is the result.

The conclusions and results of the present study are diametrically opposed to those of the Melman report.

Patent Law Association of Los Angeles,
RUSSELL M. OTIS, *President*
WM. DOUGLAS SELLERS, *Chairman,*
Legislative Committee

December 12, 1959

THE PATENT SYSTEM HAS BEEN in existence for many years, yet periodically is subjected to assessment and review. While most evaluations are commendatory, some have alleged that its imperfections outweigh the advantages normally ascribed to it. One such attack is found in a work by Professor Seymour Melman of Columbia University entitled "The Impact of the Patent System on Research." Professor Melman's document was prepared for the Subcommittee on Patents, Trademarks, and Copyrights of the Committee on the Judiciary of the United States Senate, 85th Congress, Second Session.

While the benefits attributed to the patent system have been well recognized and made the subject of numerous articles over a period of years, there is little in the way of statistical information to support such opinions. Accordingly, it was decided by the Patent Law Association of Los Angeles to conduct a survey to determine the actual effects that have been realized from the operation of the patent system.

The impact of the patent system is not particularly susceptible to analysis of a statistical nature because of the multiplicity of factors surrounding each new invention.[1] Nevertheless, it is possible to compile information to show what considerations may be given to patent matters when decisions concerning research and development are formulated. It may be determined how patents have motivated past actions or previous inactivity, as well as how other ramifications of the patent system have been felt.

In gathering such information, a questionnaire was prepared which was distributed by the members of the Patent Law Association of Los Angeles to their clients.[2] It was felt that in this manner a sampling could be made of those who are making use of the patent system and are familiar with its operation. More extensive inquiries of this type could be carried out, and information could be obtained from additional sources. The scope of the questions could be expanded. In other words, a more exhaustive survey is possible. However, the data obtained by the Patent Law Association are believed to present a fair showing of the thinking and experience of those whose decisions and actions in research and development have been affected by their contact with the patent system.

The Survey Results Summarized

In brief, the survey showed an overwhelming sentiment that increased secrecy regarding new ideas would be resorted to were it not for the patent laws. While those responding filed patent applications on most of their promising developments, a large proportion would protect more inventions in this manner if the

[1] "It is abundantly clear that the patent system's value is not susceptible of the relatively precise measurements to which we subject such economic variables as national income and its components. The system embraces not only the hope for financial reward, but also the desire for scientific fame, the urge to create increments to our accumulated stock of scientific knowledge, and many other economic, psychological, and sociological aspects." "The Value of the American Patent System: An Inquiry Into Possible Approaches to its Measurement" by Markham, Worley, and Brothers, *PTC J. Res. & Ed.* 1, No. 1, (June 1957), p. 20.

[2] A complete tabulation of the results may be found in Appendix A.

protection afforded by patents were strengthened. Anticipated patent protection had stimulated the developmental efforts of a substantial majority, while slightly over half would not conduct as much research if patents no longer existed. Patents had been influential in permitting 58% of those replying to become established in business, while for 61%, patents had led to company growth. Generally, similar figures were noted in the effect of patents in enabling expansion into new items of production, as well as causing an increase in research activity. Of those who had made efforts to design around patents held by others, superior products usually were obtained, and new fields of endeavor and further inventions generally were the result. About one-third of those responding indicated that they conducted basic research, and of these, 45% had increased their basic research because of patents, while a decrease had resulted for only 3%.

The Conclusions of the Melman Report

Before turning to the findings of the Patent Law Association Survey, the nature of the Melman Report and its conclusions should be noted. Professor Melman has based his results upon interviews held with the managers of four large industrial laboratories, as well as discussions with twenty additional men from university, industrial, and governmental laboratories. The engineers and scientists employed in the four industrial laboratories in question numbered about 7,700 and the laboratories operated on total budgets in the year 1955 amounting to around $260,000,000. From this experience, Professor Melman draws certain conclusions:

> The Patent system in the contemporary scene has not, as a rule, promoted conditions that facilitate research in science or the industrial arts.

states Professor Melman. He goes on to say:

> Henceforth, . . . the main impetus for the promotion of science and the useful arts will come not from the Patent system, but from forces and factors that lie outside that system.

In brief, Professor Melman is of the opinion that the patent system is outmoded, and its influence, if any, is to hinder scientific progress.

The Inadequate Basis for Professor Melman's Opinions

Certain conspicuous matters surrounding Professor Melman's paper cast considerable doubt at the outset upon the authenticity of any of his findings. His report is founded upon a highly restricted, totally inadequate, inquiry. Medium-sized businesses, small businesses, and individuals, all were ignored in his search for background information. Indeed, consultation with personnel of only four large industrial laboratories could hardly be regarded as an accurate sampling of opinion associated with laboratories of that character.[8] Also, Professor Melman

[8] According to the National Association of Manufacturers, there are today 285,000 manufacturing companies in the United States.

limited his interviews to laboratory managers, engineers, and scientists. He failed to consult those in managerial positions whose feelings regarding research, and the influence of the patent position of the company on such research, might well be somewhat different.

Professor Melman also believes that if a strong patent picture is of any importance, this will be particularly true for such large organizations as those to which his inquiry was confined, while having much less influence on smaller firms. Hence the limited field of investigation by Professor Melman. Actually, however, while patent matters may be of considerable significance to these sizable concerns, patents are of enormously more importance to individuals and businesses of small or medium size. The larger corporations have well-established positions in the market, possess mammoth distribution networks, expend vast sums on advertising, and may have a diversified line of products—some of which are in a stable period of development, unchanging significantly from year to year. Generally, too, they have considerable amounts of capital at their disposal for weathering changing economic climates. All of these factors tend to promote the welfare of a company regardless of its ownership of patents. Patents, therefore, may well be relegated to a secondary position for some industrial giants of this nature.

For the smaller operation, however, none of these stabilizing influences may be present. Limited in economic resources and areas of distribution, the very existence of the company may well depend on its patent situation. The assurance of an exclusive right to manufacture and sell an improved product can compensate for the many assets of the larger competitors of a struggling young business.[4] For these reasons, the patent system generally operates at its peak efficiency with regard to individuals and businesses less sizable than the economic colossus which receives Professor Melman's attention. In ignoring the viewpoint of all but these large manufacturers, Professor Melman likewise closed his eyes to the basic function of the patent system.

Discussions with those connected with university laboratories and government laboratories likewise failed to reach the heart of the workings of the patent system. Such laboratories, having no connection with producers of goods, provide far less incentive to retain an exclusive position with regard to a patentable development. Also, the field of research may be somewhat different from those who have particular end items in mind for their developmental efforts. Basic research, that is, research carried out to advance the field of knowledge rather than to yield a specified result, necessarily will be of a more nebulous and theoretical nature than research having a more tangible goal. University laboratories, therefore, could be expected to have much less of a stake in the patent system than that of individuals and industrial concerns.

Patents and Group Research

One matter which received a great deal of attention by Professor Melman in finding no present justification for the patent system is the current tendency to-

[4] This is borne out by the results of the Patent Law Association Survey, Appendix A, question 5, and discussed *infra*.

ward group activity in the course of research. Professor Melman contends that at the close of the eighteenth century, when our national patent laws were first formulated, the patent system was devised in the contemplation of an individual or "lone wolf" type of inventor. At the present time, however, laboratories large and small customarily have many individuals working together who all participate in achieving the end result. According to Professor Melman, no such group effort was anticipated for the operation of the patent system which, therefore, was not devised to cope with the modern research system. As research now is carried out, Professor Melman contends, it becomes impossible to determine who is the inventor of a development because large numbers may have had a part in its perfection.

In selecting the close of the eighteenth century as the time when our present patent system was formed, Professor Melman seems unaware that the patent system has a considerably earlier genesis, dating from the Statute of Monopolies in Great Britain in 1623, and even before. Also, patents have been the subject of legislative enactment continually to the present decade.

While colonial patent grants considerably antedated the formation of the Republic, our first national patent law was passed in 1790, providing for an examining board made up of the Secretary of State, the Secretary of War, and the Attorney General who were authorized to issue patents for worthy developments. This law was supplanted in 1793 by a new statute under which patents were issued without any examination for novelty or utility. The Patent Office, with its system of examination under the auspices of a commissioner, was created by the third patent law in 1836. Later, Congress passed the Patent Act of 1870, generally revising the patent laws. Numerous enactments involving patents were made after that date, and our present patent statute was passed in 1952. It cannot be said, therefore, that our patent laws reflect only the thinking prevalent in the eighteenth century. Rather, they are current enactments based upon twentieth century legislative concepts with the benefit of long experience.

In connection with the patent laws, it is not only possible, but it is required to name as inventors more than one person when two or more individuals have contributed to the inventive results. Thus, there is nothing in the statutes to limit the protection of a patent to only one person. When several people have cooperated to produce an invention or discovery, they all not only may be included as applicants, but must be designated as joint inventors if a valid patent is to be obtained. The patent laws, therefore, are not restricted to coverage for individuals, as appears to be Professor Melman's understanding, but expressly require the granting of the patent to all of those who have acted together as inventors.

Distinguishing Invention and Ordinary Technical Skills

Professor Melman's fundamental difficulty with this point, however, appears to be in a confusion between the creation of an invention and the exercise of technical skill of a more routine nature. In actual practice, the determination of

the true inventor or inventors of a development is not a matter of particular difficulty, and investigation into the facts will indicate that of what may be scores of persons involved in a project, only one, or perhaps a few, originated the inventive concept. The group has not in some mysterious manner acted as a single mind to achieve a result. It is made up of many independent minds and only one or a restricted number of these minds will have conceived of the matters that are truly inventive about the development. The others on the scene will be found to have done nothing more than contribute their everyday skills in assisting the inventor in bringing the invention to completion. Work of the latter nature is not invention and is not entitled to patent protection.

Even when a complex and scientifically advanced idea is born, the person who originated it conceivably could take all of the necessary developmental work upon his shoulders. By diligent study, he could become versed in such widespread arts as chemical, electronic, and mechanical engineering, as well as acquiring the abilities of various machinists and technicians. Some stalwart and gifted men take this course of action in bringing their inventions to fruition. However, this normally is a time-consuming, wasteful process. Rather than spending perhaps years in acquiring the skills of the practitioners in diverse fields, research laboratories are arranged so that the inventor simply consults the expert for the application of his knowledge to the problems in his own sphere. For chemical matters, he goes to the chemical engineer who can assist in his selection and utilization of the optimum chemical compounds. Circuitry necessary to operate or control may be obtained from the electronic engineer. The mechanical engineer will assure that the item is designed for adequate strength and rigidity. Experimental parts will be created by the machinist and assembled and tested by other skilled artisans. As a result, by calling upon the knowledge possessed by others in their own specialties, the invention may be brought to a fully-developed stage in a very short time. However, unless those who aided in this development added some new concept to the invention being produced, they are not inventors. This is true even though they may have spent many more hours in the developmental program than the one who actually thought of the idea. They are no more inventors than are the authors of text books which the inventor might have consulted during his developmental efforts. They do not become inventors any more than a teacher who might have lectured to the inventor should he have sought to extend his knowledge through added schooling. Reducing the proposition to an absurdity, the janitor who sweeps out the laboratory assists in his way in enabling the inventor to perfect his development. Yet, by this aid he does not become an inventor with him.

The Birth of Pioneer Inventions Yesterday and Today

In comparing past and present research and development, an all too common practice is considering the great pioneer inventors of the nineteenth century as strictly solitary developers of their ideas, while the standout inventions of the

twentieth century are spoken of as products of group activities in larger laboratories. An interesting study of this subject is found in the book, *The Sources of Invention* by Jewkes, Sawers, and Stillerman, St. Martins Press, New York, 1958. The authors show that such men as Eli Whitney, Charles Wheatstone, Alexander Graham Bell, and others, actually were well-educated and in communication with the learned men of the day through various technical societies then in existence, who based their inventive work on carefully laid out scientific foundations. This contrasts with the romanticized and largely fictionized picture of the struggling inventor of the past century, alone in his garret with his experiments. On the other hand, the authors point out that in the twentieth century many of the outstanding developments clearly were contributions of individuals acting outside of the giant research laboratories. Their list includes the inventions of bakelite, cellophane, xerography, air conditioning, and many more. The suggestion, therefore, that all important inventions today result from mammoth research organizations seems to have no basis in fact. Likewise, the degree of skill and method of operation of the inventors of the past century appears to have many similarities to present practices.

The Omnipresent Incentive of Patent Protection

Still, in connection with the undeniable prevalence today of large research organizations, Professor Melman emphasizes that a substantial portion of the scientific personnel of the country now is in a salaried status. For such persons, contractually bound to assign their inventions, extra payments for inventions may be nominal or non-existent. How, then, can the incentives of the patent system influence such persons and stimulate their creation of new ideas?

There are several factors which may alter substantially the picture which Professor Melman paints. In the first place, it is well recognized by both management and the workers that the inventions made by salaried personnel may be of extreme value to the company. There are many ways of compensating employees for worthwhile contributions to the company's welfare. Added salary, promotions to better positions, and periodic bonuses all are utilized in rewarding employees who assist the company's advancement by originating important inventions. Secondly, patents necessarily give recognition to the inventor. Each patent is required to bear the name of the individual or individuals who made the invention. Having patents issued in his name will enhance the professional standing of any scientist, and with this, increase his opportunity for profitable employment. Another especially important factor is that patent protection may act as a motivating stimulus to management, even in instances where the potential rewards to the salaried worker may be difficult to see. Without patents in the background, the worker might well not be confronted with problems to solve, facilities to reach the solution, and the very opportunity to invent. Without patents, both the laboratory and his job might not exist. In other words, the incentive afforded by the patent system always is present, regardless of whether it is shared by both management and the inventor.

The Elimination of Secrecy By the Patent System

One of the most important influences of the patent system has long been said to be its elimination of the need for excessive secrecy surrounding new developments. The very issuance of the patent comprises a full disclosure of the invention, and as such, adds to the general body of scientific knowledge. Also, the patent owner, secure in the protection that the patent affords, may disseminate freely information surrounding his invention. Technical articles may be written and published, and the gates of the laboratory and the factory may be thrown open to visitors. The stultifying effects of secrecy and suppression were obviated.

This facet of the patent system has caused considerable difficulty to Professor Melman. First, he contends that the disclosure contained in the normal patent is a rather inadequate type of publication, saying:

> The knowledge disclosed, even in the most elaborate patent coverage, often is not sufficient to enable another independently to duplicate the process involved.

Also, he alleges that prior to issuance of a patent it may cause active concealment of new developments, saying:

> When the search for patentable results is a guiding consideration, strict secrecy concerning work in progress and limitation on publication become necessary devices to serve the patent in process.

Professor Melman seems to have difficulty convincing himself, however, when later he considers what would be the effect upon secrecy if the patent system were thrown out, "Would still more secrecy occur?" he asks himself, and answers, "It is difficult to exclude that possibility. There are factors, however, that might well result in there being less secrecy than one might expect." To avoid stagnation, scientists would be forced to communicate with each other, he argues. Secrets are hard to keep and information would be bound to leak out. Besides, antitrust considerations would compel large organizations to furnish information to smaller ones. Also, business matters may dictate what will be disclosed and what will be kept secret, regardless of the patent situation. He states:

> If the business interests are promoted by secrecy, then the information is kept secret, however, much good in other respects might flow from its publication.

Professor Melman is well aware of the importance of an unrestricted flow of information, stating:

> Free publication of research results is an essential part of the process of inquiry, for it facilitates independent verification of findings.

again,

> The act of publication is a crucial aspect of the production of knowledge for publication of research findings in sufficient detail permits other investigators to check on the validity of reported findings, and opens the way for the extension of the frontiers of knowledge.

Despite this, however, Professor Melman attempts to gloss over an expected increase in secrecy in the absence of the patent system by contending that such

secrecy might be less than what one might expect from such an occurrence. It is curious that one dedicated to scientific progress could advocate a step which would augment secrecy in any amount. Regardless of the extent of added secrecy which would occur without patents, any increase must be recognized as exceedingly harmful. Professor Melman cannot justify more secrecy and its inhibiting results merely by the belief that the increase would not be as great as most would anticipate. Conversely, the patent system, by eliminating the need for such secrecy, in this manner alone effectively promotes the progress of science and the useful arts, regardless of the various other aspects of the operation of the patent system.

Professor Melman's own sampling of four large industrial research laboratories showed a strong belief that without patents more secrecy would be resorted to. The results of the survey of the Patent Law Association bear out this viewpoint. Included in the questionnaire was the question, "If it were impossible to obtain patent protection, would you keep more of your new ideas secret, or secret for a longer time, than you now do?" In answer to this, an overwhelming 78% of those responding to the question answered, "Yes," while only 22% said "No." The results appear conclusive in demonstrating that patents are an effective device for minimizing the natural tendency of invention owners to shroud new developments in secrecy.[5]

The Purpose of the Patent Disclosure

In criticizing the type of publication which a patent affords, Professor Melman seems to be confusing a disclosure of an invention with a document that might contain complete design specifications, test results, or various kinds of detailed technical information. Professor Melman feels that patents are not a good publication because in many instances upon reading the patent, one could not then immediately proceed to practice the invention described in it. However, what the patent does accomplish is to disclose the invention to an extent that one having ordinary skill in the art could practice the invention readily upon the exercise of this skill. The reader of the patent is expected to apply his own knowledge of the field to the practice of the invention set forth in the patent. Unless it is critical to the operation of the invention, the patent specification is not to burden itself with precise tolerances of parts, numbers and sizes of bolts, types of welds, or similar details. Such information would allow one to practice the invention upon reading the patent, but each patent then would become a long, bulky, confusing document in which the essence of the invention would be lost in the maze of material described. The patent specification is in the nature of a scientific article, comparable to those appearing in various technical publications where similarly routine details are omitted.

As to the use to which the disclosures of patents may be put, the recent state-

[5] Some reticence to disclose work in progress will be found regardless of patent considerations pertaining to new ideas. Laboratories are jealous of their reputations for scientific achievement and are loath to allow premature findings to become generally known for this reason. Often these early leads prove blind alleys and reputable research organizations wish to assure that their results possess some scientific merit before being broadcast generally.

ment by J. Thomas Smith, President of Detroit Harvester Company, is of particular significance:

> The search files of the Patent Office constitute for us an invaluable source of technical information. In many instances, this information is to be found in print nowhere else . . . Whenever our research department embarks upon a new venture, the research engineers to whom the project is assigned . . . call upon our patent counsel to acquaint them with the background and current state of the patent art in the particular field in which they will be working. At the same time, this patent information helps our management people to make a more accurate appraisal of the market potentialities of the product in question, and to evaluate intelligently the likely sources of competition. In many cases we find that the data dredged up in our search of the patent files points the way to a solution of related engineering problems and when, as not infrequently happens, a patentee in order to emphasize the novelty of his achievement describes his previous failures or unproductive efforts, that too is helpful to us. It saves us many valuable hours of research time by preventing false starts and keeping our men out of avenues of investigation that have already proved to be blind alleys. Finally, an important by-product of this patent information is that it seems to stimulate increased creative thinking and invention on the part of our own engineers.

Patent Activity and Our Total Complement of Engineers and Scientists

In concluding that patents have little effect upon research, and that with the absence of patents, research activities would continue their present growth and expansion, Professor Melman lays emphasis upon statistics indicating the number of patents granted compared with the number of scientists and engineers in the country at different times. These figures show a sixteenfold increase in scientists and engineers over a period of 54 years, while there has been little change in the number of patents issued annually. It is Professor Melman's position that if patents were an effective incentive to research activities, the number of patents would grow along with the number of scientists and engineers.

In this respect, apparently he makes the assumption that inventions must necessarily come from engineers and scientists. Actually, many important developments come from those outside of these technically trained fields. As one author put it:

> It is true that many of the most important inventions have been made by engineers, but this has been because some engineers . . . have been inventors also. But it is also true that only a small proportion of the engineers have made original inventions; and it is equally true that many inventions have failed—or have been slow in achieving success—because of the lack of engineering skill in construction or design. These facts show that the work of the inventor is very different from that of the engineer and that the inventor and the engineer are very different people, though an engineer and an inventor sometimes live together inside the same skin. In fact, it is by a combination of inventive genius and engineering talent in one man that the greatest results in invention have been achieved, though great results have often followed the intimate cooperation of an inventor and an engineer, the two being separate men.[6]

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[6] B. A. Fiske, *Invention, the Master Key to Progress* (New York, Dutton, 1921), p. 10.

The Patent Law Association survey showed that engineers and scientists can be expected to produce a substantial quantity of patentable ideas, but by no means all. Of the applications filed by employers who responded to the questionnaire, an average of 72% originated with those classified as engineers or scientists.

It should be remembered that engineers and scientists engage in many fields of operation which are not conducive to the creation of inventions. As noted above, even those dealing directly with an invention may perform work restricted to the development of another's idea. This does not mean that the work of the developer is not an important contribution to scientific progress. It does mean, however, that such a person is engaged in research involving an idea not his own.

It is doubtful that there ever could be any real correlation between statistics giving more numbers of scientists and engineers and numbers of issued patents. Too many other factors are involved to draw conclusions from such a comparison. In commenting on this problem it has been stated:

> An obvious possibility would be to seek to correlate statistics of patent applications or patents issued with an index of technological change allowing a time lag for the process of innovation to occur. Patent statistics have been used as measures of inventive activity, but the results of these investigations throw no light on the value of the patent system in *stimulating* invention. It is even doubtful that patent statistics furnish evidence on the volume of inventive activity. By definition, each patented invention is unique; therefore, they may differ from each other according to the standard of comparison employed. Consequently, numbers of patent applications filed or patents issued are "rubber" indexes consisting of nonhomogenous items. Since in the absence of a detailed examination in each case there appears to be no way to estimate the amount of "invention" connected with each patent, the use of patent statistics does not appear to be promising.[7]

Opposition by the Courts Inhibits Patenting

Before deciding whether to seek patent protection, one matter of very real significance to the owner of an invention is its prospective fate should it ever be necessary to test its validity in court. In recent years, the harsh treatment by the courts of the patents before them has undoubtedly discouraged many inventors or their financial backers from undertaking the labor and expense of securing patents. At the same time, the severity of the courts regarding issued patents has necessarily been reflected in the Patent Office in its actions involving pending applications. Not wishing to have its allowed patents continually held invalid, the Patent Office Examiners will be reluctant to permit issuance of patents which may be struck down by the courts. Thus, those who have applied for patents can expect to have a decreased chance for issuance when the attitude of the courts is unfriendly to patents that have been granted in the past. In other words, when patents are continually invalidated, the effect on patent statistics is twofold: (1) inventors are discouraged from making application for patent, and (2) more applications are rejected by the Patent Office.

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[7] "The Value of the American Patent System: An Inquiry into Possible Approaches to its Measurement" by Markham, Worley, and Brothers, *PTC J. Res. & Ed.* 1, No. 1, (June 1957), p. 20.

The data relied upon by Professor Melman in comparing the total number of scientists and engineers in this country and the number of patents issued cover the period extending from 1900 to 1954. There are some interesting comparable statistics concerning court action during this same era.[8] During the period from 1900 to 1909, eight patents were acted upon by the United States Supreme Court, and five of these, or 62.5% were held valid. The percentage of findings of validity then declined steadily to a mere 15.4% during the period of 1930 to 1939. A slight rise to 22.7% occurred for the years 1940 through 1949. However, in the next period of 1950 to 1957 two patents were before the United States Supreme Court, and neither of these was held valid, dropping the percentage of validity to zero. This change in philosophy by our highest court undoubtedly has had an important influence both on the patents applied for and the patents issued during the period covered by Professor Melman's statistics.

Additional Factors Affecting Patent Statistics

Other factors have considerable bearing on the number of patents which will be issued at any time. Hampered by limited budgets, the Patent Office gradually dropped behind in its consideration of patent applications until recently an average of three and one-half years passed between the time of application for patent and the ultimate determination regarding its issuance or final rejection. This kind of delay not only has decreased the patents issued during any year, but acts to deter inventors from making application for patent. Long postponement of patent protection in some instances can be disastrous in a rapidly progressing technology.

However, this time delay does not concern the underlying merits of the patent system. It is a matter which, by improved procedures within the Patent Office and increased funds to operate on, much headway can be made in materially reducing the time for securing patent protection. Considerable progress in this direction already has been effected through the current eight year improvement program of the Patent Office, and it can be expected that as time goes on this situation will continue to improve.[9]

Also, of note in considering the number of patents to issue in relation to the total of the scientists and engineers, is the fact that during the latter period of the time considered by Professor Melman, the vast development of atomic energy came into being. However, Congressional legislation has virtually taken this segment of our research activity outside of the patent system. Also, the performance of an ever larger amount of research and development by and for the government in fields other than atomic energy has necessarily cut down on the number of patents to issue. In such instances, the government generally takes either title to the invention or a royalty-free license for all governmental purposes. The incentive for patenting in either case is reduced drastically.

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[8] H. R. Mayers, "The Patent System in Historical Perspective," *PTC J. Res. & Ed.*, 3, No. 1 (Spring 1959), pp. 33-52.

[9] Cf. Department of Commerce, Annual Report of the Commissioner of Patents, Fiscal Year 1958.

Professor Melman also compares research activity in the United States and Great Britain to find an indication that patents have little to do with the expenditures for such purpose. In the United States the outlay for research expressed as a percentage of net sales has been significantly greater than in Great Britain. However, in the United States there have been around 40% more engineers and scientists per thousand of population than there have been in England. Both nations have patent systems, he reasons, and if patents have a bearing on the amount of research which is conducted, why should not the statistics for the two countries be substantially the same?

Of course, the amount of money that a nation spends upon research work and the number of engineers and scientists it produces may depend upon many factors outside the patent system. It has never been contended that the patent system acts as the only force in moving persons to choose engineering or science as their career, or in causing research activities to take place. Also, the patent system of Great Britain and that of the United States have important differences. Great Britain makes provision in its patent laws for annual taxes and compulsory licensing of patents. No such hindrances are found in our patent laws. In addition, Great Britain has socialized certain portions of its industry. Such socialization removes a prime stimulus for private research activities. Comparisons such as Professor Melman has proposed, therefore, appear to be worthless as the basis for any conclusions.

The Non Sequitur of Antitrust Consent Decrees

Professor Melman makes much of the fact that the American Telephone and Telegraph Company and the International Business Machines Corporation have continued to expand their research operations even after the antitrust consent decrees of 1956. By these decrees, those companies were effectively stripped of patent protection and required to license many of their patents royalty-free. Despite this, the pace of their research has not slackened noticeably.

It is noteworthy that both of these corporations are extremely sizable and the importance of patent protection to them would be far less than for smaller corporations and individuals. Also, Professor Melman does not mention that under the terms of these consent decrees, future patents obtained by the companies may be licensed at a reasonable royalty. In addition, they are granted permission to receive future grant back of licenses under the patents obtained by their licensees. Thus, while the consent decrees materially altered the positions of these large companies with respect to their patents on hand, they did not prohibit these concerns from obtaining valuable patent rights in the future.

Findings of the Patent Law Association Survey

The survey conducted by the Patent Law Association obtained data supporting the belief that the owners of inventions are anxious to secure patent protection, and that the number of issued patents could be much greater under proper circumstances. One of the questions in the survey was, "Is it your policy to seek

patent protection for all reasonably promising developments made by you or your organization?" A total of 263 answered this question in the affirmative, while only 30 replied "no." Thus, some 90% had an established policy of looking toward the protection of patents for all reasonably promising ideas. Next it was asked, "Of these ideas which investigation shows should be patentable, on what approximate percentage do you file applications?" The average figure named here came to 69%. This means that 31% of the reasonably promising developments which have been investigated and shown to be of a patentable nature never were made the subject of a patent application.

Also, the survey inquired, "Would you attempt to protect more of your developments by patent if a patent were easier to obtain, or if you thought it could be enforced more readily against someone who might infringe it?" Here, the reply numbered 182 in the affirmative with only 33 answering "no." Thus, 85% would attempt to obtain more patent protection if it were not for the pitfalls encountered in obtaining issuance of a patent and enforcing it after receiving the grant.[10] In fact, of the individuals (i.e., non-employers) responding, every one replied that he would cover more items by patent if the protection were more substantial. This indicates that numerous persons and companies possess promising patentable inventions, but are precluded from seeking patent protection because of difficulty of enforcing the patent or the problems in obtaining it. Professor Melman takes no such factor into account in concluding that patent activity has not kept pace with modern research operations. Making patent protection stronger and securing it more feasible, on the other hand, could significantly increase the number of patents which would be issued.

Patents and Research Activity as Shown by the Survey

Data also were obtained by this survey to show the direct connection that exists between the patent system and research activities. Among the questions were "Has expected patent protection stimulated your efforts to develop new things?" Here a total of 178 answered "yes," while only 114 replied "no," or 61% for the affirmative.[11] In other words, for those who replied "yes" to this question, hope for patent coverage had been a decided influence in the developmental efforts carried out. The research activity of this 61%, therefore, was definitely fostered by the existence of the patent system.

When asked whether patent considerations had ever hindered their research activities, 43% replied that it had, against a 57% negative response. The effect of such hindrance was not ascertained, and many of these must have been "hindered" similarly to those who had made efforts to design around patents owned by others. While offering an obstacle to a developer of new ideas, the patents of

[10] This, of course, did not include answers for those who filed applications on all their patentable ideas.

[11] One person simply responded by countering "What protection?" This signifies that many of the negative answers might be reversed if the patent laws were strengthened.

others do not form a complete barrier and stimulate effort in other directions, often expanding the research activity and yielding developments superior to the patented items. (See discussion *infra.*)

An additional question touching on the matter of patents as they affect research also was included asking, "If it were impossible to obtain patent protection (i.e., if patents did not exist) would you engage in as much research or developmental work as you now do?" In reply to this, approximately one-half would decrease their research and development programs if the patent system were to be abolished. This is directly in contradiction to Professor Melman's conclusion that without patents our research and development would continue to expand. The indications are from the Patent Law Association's survey that quite the opposite would be true.

Designing Around Another's Patent

One of the advantages often alleged for the patent system is that the efforts to design around patents of others may result in alternatives that prove even better than the patented invention. When blocked by patent coverage in one area, the competitor necessarily must turn his attention to producing salable goods not covered by these patents. As one judge put it:

> To illustrate, an inventor brings forth an apparatus which is better and made at less cost than anything heretofore made or used in this field. All competitors are threatened with loss and perhaps ruin if an equally good product is not made and sold at prices which meet the new patented product. At once, the inventive and creative talents of the competitors are aroused. They are spurred to their best efforts to produce, not merely as good but a better product, by a new, noninfringing method or apparatus. Thus, instead of displaying monopolistic traits the patent fosters competition among inventors and begets new and better products at lesser cost. As a result, the public is the beneficiary.[12]

Professor Melman does not touch directly on this aspect of the patent system, but implies that efforts to circumvent the patents of competitors largely are wasted. Without the patent system, he states that the character of research would be changed at least to the extent that efforts would no longer have to be made toward avoiding the patents of competitors. If anything, Professor Melman appears to regard this effect of the patent system as one of its shortcomings.

The Patent Law Association Survey shows that attempts to obviate another's patents actually can be expected to lead to better products, and to broaden and expand research and development activities. It was asked, "Have you ever attempted to 'design around' patents of others (i.e., to develop a directly competitive item not covered by the patent)? Has your own item produced in this manner been (a) not as good as, (b) equal to, or (c) superior to the patented item? Did these efforts open up any field of research or development for further work? Have additional inventions been made in the course of efforts to design around other patents?" One hundred sixty-one (161) of those responding to the question, or 67%, had made such attempts to design around the patents of others. Of these, 61% obtained results superior to the patented item. An addi-

[12] Chicago Steel Foundry Co. v. Burnside Steel Foundry Co. (CCA7) 56 USPQ 283, 285.

tional 26% had obtained items equal in merit to the patented invention, while only 13% were considered inferior. Furthermore, 75% indicated that their efforts to design around had opened up new fields of research or development. In addition, 78% had made additional inventions in the course of their efforts to design around the patents of others. In other words, the statistics bear out the contention that the patent system acts as a chain reaction, each invention leading progressively to further research, development, and improvement.

Intangible Benefits of the Patent System

One of the matters which Professor Melman has neglected in his report is the role of the patent system in permitting new businesses to come into being. To assess this factor, the following was asked in the questionnaire of the Patent Law Association Survey: "Has patent protection been influential in enabling you or your company to become established in business? Has patent protection led to the growth of your company?; enabled your company to expand into the production of new items?; led to a more active research program by your company?" In reply to this, a rather surprisingly high total of 160, or 58%, answered that patent protection had been influential in enabling them to become established in business. Sixty-one per cent (61%) stated that patent protection led to the growth of their company, while 66% had been enabled to expand into the production of new items as a result of patent protection. Also, 59% answered that patent protection had resulted in a more active research program for them.

Professor Melman has emphasized that his report is restricted solely to the influence of the patent system on the progress of science and the useful arts, and does not involve any other aspects of it.[18] He might counter that all but the last of these questions are not germane to the matter of patents and scientific progress. Becoming established in business, growing and prospering and producing new items, Professor Melman might argue, are not matters that have a bearing on the promotion of science and the useful arts. If this position were to be taken, it would have no foundation in reality. In the first place, the very existence of a patented item, when placed on the market, increases the body of scientific knowledge and educates in its own way, each person having contact with the invention so brought to the public. Also, the new patented product leads others to seek to design around the development as discussed *supra,* thereby fostering further development and research work leading to improved designs. In addition, a fledgling company, supported by its patent position, is enabled to undertake research and development involving other new ideas in order to expand its market and broaden its base of activity.

Without the initial patent protection allowing the company to come into existence, its research laboratory also would not come into being. The major in-

[18] It has been explained with compelling logic that according to Article I, Section 8 of the Constitution, the purpose of the patent system is to promote "useful arts" rather than "science." The latter term, at the time the Constitution was drafted, pertained to knowledge generally, and as written in the Constitution referred only to the protection to be afforded to authors rather than inventors.

dustrial research laboratories can result only from small and humble beginnings. When the creation of new companies is promoted, and such companies are allowed to grow and prosper, eventually reaching the stature of "big business," their research laboratories necessarily expand and become more active with them. The influence of the patent system in the origin of the small laboratory thereby results in the existence of the great research and development center.

The employment afforded by these small companies which are brought into being through their patent rights has an unending influence. Each wage-earner becomes a customer of countless other manufacturing concerns, buying with his wage the products of these other manufacturers. A percentage of the price paid for such products goes to support the research laboratories that these other concerns have. Basically, anything that advances the prosperity of our economy fosters to some degree the overall developmental program of the country. An impoverished people can produce little in the way of new scientific developments.

Also, in employing persons to work with the inventive product and to engage in the research programs of these small companies, the knowledge of these employees is increased. Many ultimately will leave and obtain positions in other organizations taking with them the research skills and a fresh approach to developmental problems gained as a result of their employment by the newly-created companies. All of these factors may be intangible, but their existence and effects are very real.

The Patent System Advances Even Basic Research

While Professor Melman purports to concern himself with the gamut of research in this country, he is preoccupied throughout his dissertation with the narrow field of basic research. By this, it is meant research which is carried out for expanding the body of scientific knowledge without regard to a specific product to be developed. It is Professor Melman's belief that the patent system has a harmful effect upon such basic research. He feels that it tends to contaminate the thinking of the scientists, resulting in diversionary sorties after specific results which may be made the subject of patent protection. Managerial control of such basic research, which Professor Melman believes to be one of its most evil influences, causes its efforts to be directed toward end products rather than pure scientific inquiry. Without the patent system, according to Professor Melman, the scientist in basic research would be more free to pursue his various whims, and thereby improved scientific investigation would be obtained.[14]

What Professor Melman overlooks in this regard is that the only real purpose for such basic research is to evolve scientific knowledge which may be usable in some yet undetermined manner in producing tangible end products. If it were not for the products made and sold by industrial corporations, certainly they would not be supporting costly laboratories which are devoted to basic research.

[14] For an indication that managerial policies vary considerably on this subject, and in some instances result in even more freedom of choice for basic research scientists in industry than for those in universities, see *The Wall Street Journal*, April 16, 1959.

To the extent that the growth of such companies and the sale of their goods are fostered by the patent system, so therefore is the basic research that they conduct assisted by the patent system.

It is not seen, also, how the absence of the patent system could have any significance on the attitude of management toward the basic research which is conducted by their organizations. Whether or not they have a patent picture, these corporations will require end products. If management today exerts an influence on the basic research scientists in an attempt to steer them in the direction in which results will be usable in products to be made, management would continue to exert such pressure if tomorrow the patent system no longer existed.

From the survey of the Patent Law Association, it would appear also that the patent system has a more direct and beneficial effect upon basic research than some have imagined. The questionnaire asked, "Do you conduct any basic research (i.e., research to expand your scientific knowledge rather than for developing a specific product)? Have patent considerations influenced the character of the basic research you conduct? Have patent considerations (a) increased, (b) decreased, or (c) had no effect upon the amount of basic research you conduct?" Of those responding to this question, 34% engaged in this type of research activity. Fifty-one per cent of the ones who do basic research said that patent considerations had influenced the type of basic research in which they engage. The results also showed that patent matters increased the amount of basic research for 45%, decreased for only 3%, and had no effect upon 52%. From this it would seem that patents often encourage and promote basic research and do not have the unfortunate influences which Professor Melman suggests.

The comments voluntarily appended to the end of the questionnaires provided additional clues of the opinions of the users of the patent system of the effectiveness of the patent system in stimulating their developments and protecting their positions. A large number of the comments were wholehearted endorsements of the patent system. For example, one employer of sixty-five stated, "Without patent protection our business would not have been started; the risks, always great, would have discouraged us completely." An owner of a small business commented, "Patent protection has proven very valuable and led to real success for me." Another employer noted simply, "This business built on patent protection." From an individual came the remark, "I believe patent protection has been the incentive that has inspired our present economy and will continue to do so. I have invented many useful articles of record because I anticipated patent protection." Numerous other comments in the same vein were included.

Conclusion

In conclusion, there can be no doubt from an examination of the record and from a consideration of the findings of the survey of the Patent Law Association that the patent system is an effective, essential part of our economy.

It is a dynamic force in stimulating the research and developmental efforts in this country, perhaps an even greater incentive than its advocates have realized.

Without patents, new developments would be engulfed in a morass of secrecy, and channels of scientific information would be closed.

Research activities would be stifled and inventions, in many instances, would not reach a full state of development.

Businesses would not be born and older businesses would not expand and prosper.

New developments would not be made public or serve to enrich the body of scientific knowledge.

Research laboratories would not come into being, let alone expand to major size.

In view of the vitality of the patent system and its extremely beneficial effects in countless ways, nothing should be left undone in protecting the patent system and assuring that it can operate to maximum effectiveness. Any general attack on the patent system, or proposals which would weaken it, should be dismissed summarily.

APPENDIX A

PATENT QUESTIONNAIRE

PATENT LAW ASSOCIATION OF LOS ANGELES

		Indiv.		1–100 Employees		101–1000 Employees		Over 1000 Employees		TOTAL	
		No.	%	No.	%	No.	%	No.	%	No.	%
1. Total number of employees (average)				35		310		7480			
Number of employees engaged in research or development (average)				4.5		31		927			
Number of employees classified as engineers or scientists (average)				3.2		21		894			
2. Is it your policy to seek patent protection for all reasonably promising developments made by you or your organization?	YES	34	100	135	89	73	88	21	88	263	90
	NO	0	0	17	11	10	12	3	12	30	10
Of these ideas which investigation shows should be patentable, on what approximate percentage do you file patent applications?			73		70		66		70		69
Of the applications that you file, what percentage originates with an "engineer" or "scientist?"					68		76		84		72
Would you attempt to protect more of your developments by patent if a patent were easier to obtain, or if you thought it could be enforced more readily against someone who might infringe it?	YES	22	100	98	88	49	79	13	68	182	85
	NO	0	0	14	12	13	21	6	32	33	15
3. Has expected patent protection stimulated your efforts to develop new things?	YES	30	83	84	59	43	52	16	67	178	61
	NO	6	17	61	41	39	48	8	33	114	39
Have patent considerations ever hindered your developmental efforts?	YES	16	48	65	45	30	37	11	48	122	43
	NO	17	52	78	55	52	63	12	52	159	57

		Indiv.		1–100 Employees		101–1000 Employees		Over 1000 Employees		TOTAL	
		No.	%	No.	%	No.	%	No.	%	No.	%
If it were possible to obtain protection (i.e., if patents did not exist), would you engage in as much research or developmental work as you now do?	YES	7	21	67	48	56	70	14	61	144	51
	NO	27	79	74	52	26	30	9	39	136	49
If it were impossible to obtain patent protection, would you keep more of your new ideas secret, or secret for a longer time, than you now do?	YES	30	94	113	78	57	72	17	74	217	78
	NO	2	6	32	22	22	28	6	26	62	22
4. Have you ever attempted to "design around" patents of others (i.e., to develop a directly competitive item not covered by the patent)?	YES	15	44	75	52	54	66	17	74	161	57
	NO	19	56	69	48	27	34	6	26	121	43
Has your own item produced in this manner been NOT AS GOOD AS		3	16	11	12	8	13	3	19	25	13
EQUAL TO		5	26	23	26	17	27	3	19	48	26
SUPERIOR TO the patented item?		11	58	55	62	38	60	10	62	114	61
Did these efforts open up any new fields of research or development for further work?	YES	9	69	57	81	31	67	11	73	108	75
	NO	4	31	13	19	15	33	4	27	36	25
Have additional inventions been made in the course of efforts to design around other patents?	YES	12	92	54	79	33	70	14	82	113	78
	NO	1	8	14	21	14	30	3	18	32	22
5. Has patent protection been influential in enabling you or your company to become established in business?	YES	20	74	91	61	35	45	14	64	160	58
	NO	7	26	58	39	45	55	8	36	116	42
Has patent protection led to the growth of your company?	YES	15	79	86	64	38	52	14	64	153	61
	NO	4	21	49	36	35	48	8	36	96	39

		Indiv.		1–100 Employees		101–1000 Employees		Over 1000 Employees		TOTAL	
		No.	%	No.	%	No.	%	No.	%	No.	%
Has patent protection enabled your company to expand into the production of new items?	YES	12	71	87	69	39	54	16	76	154	66
	NO	5	29	39	31	33	46	5	24	82	34
Has patent protection led to a more active research program by your company?	YES	14	78	81	63	30	43	15	71	140	59
	NO	4	22	48	37	40	57	6	29	98	41
6. Do you conduct any basic research (i.e., research to expand your scientific knowledge rather than for developing any specific product)?	YES	18	58	35	25	31	37	11	46	95	34
	NO	13	42	104	75	52	63	13	54	182	66
Have patent considerations influenced the character of the basic research you conduct?	YES	14	82	18	51	12	39	3	27	47	51
	NO	3	18	17	49	19	61	8	73	46	49
Have patent considerations											
INCREASED		11	65	17	55	8	26	5	45	41	45
DECREASED		1	6	1	1	0	0	0	0	2	2
HAD NO EFFECT upon the amount of basic research you conduct?		5	29	14	45	23	74	6	55	48	53

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This book is the outgrowth of the author's professional experience as a patent attorney dealing with new inventions relating to clothing, as well as his experience as founder and director of The Theater Guild. Mr. Langner's viewpoint is that clothes are inventions spurred by the inferiority feeling of man. The author's thesis is that clothes impart self-importance to the wearer. With the help of 300 illustrations, Mr. Langner reviews the evolution of clothes from primitive days down to modern times. He gives attention to everyday clothes of men and women, working clothes, military uniforms, head coverings, underwear, and clothes in the performing arts.

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This book is the outgrowth of the author's hobby of collecting salt shakers. Contains 550 photographs of existing salt shakers chosen for their pattern, shape, color or quality of glass and also many drawings selected from patents relating to salt shakers. The author located nearly 1,000 U. S. patents issued in the last 100 years. There are many interesting historical facts given regarding the mechanical development of salt shakers. Information is also included on condiment containers, salt dishes, sugar bowls and shakers, sirup pitchers, pepper shakes, mustard containers, and oil and vinegar containers.

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Nikola Tesla (1856-1943) was born in Yugoslavia and left for the United States in 1884 to work in Edison's laboratory. He was a prolific inventor and is noted for his asynchronous motor, polyphase system for transmission of electric power, high frequency currents, tuned radio circuits, remote control by radio, etc. All his documents are now collected at the Nikola Tesla Museum in Beograd. The text is in English. This volume contains five of his most important lectures given before technical societies relating to his electrical discoveries and inventions. A group of 25 of his U. S. patents are fully reproduced. They relate to his electrical motors and generators, 9 patents in another group relate to electric power transmission, 17 for controllers and high frequency apparatus, 12 relate to his radio inventions. The volume also contains 17 of his articles dealing with x-rays, his oscillator, high frequency cur-

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This book is a guide to the general precepts of trademark law rather than an exhaustive treatise. The subjects covered are concepts of trademarks, rights in trademarks, ownership in foreign countries, strong and weak marks, conflict between marks, adoption of new marks, use of marks, loss of trademark rights, federal registration, and infringement problems. The text is well annotated with leading and recent court decisions and periodical articles. The appendix contains the text of the 1946 Trademark Act, forms, a model state trademark bill, a table of cited cases and word marks. The volume is well indexed. The author is a practicing attorney in Chicago and lectures at the John Marshall Law School.

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The Society represents the first systematic attempt to encourage the study of the development of technology and its relations with society and culture. An interdisciplinary organization, the Society is concerned not only with the history of technological devices and processes, but also with the relations of technology to science, politics, social change, the arts and humanities, and economics.

In a foreword to the first issue, Professor Kranzberg states: "To accomplish what we regard as our threefold educational mission, namely, to promote the scholarly study of the history of technology, to show the relations between technology and other elements of culture, and to make these elements of knowledge available and comprehensible to the educated citizen, *Technology and Culture* will publish general articles dealing with society and culture as well as more specialized articles on the history of technological processes and devices. We hope to appeal to both scholar and non-academician, even though we realize that our insistence upon rigorous standards of scholarship may prevent ours from ever becoming a popular magazine of mass circulation."

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NOTES

Fourth Annual Public Conference

The fourth Annual Public Conference this spring will incorporate a new approach. On the basis of our experiences from year to year, we attempt continually to revise and improve our format in ways which will prove increasingly interesting and informative to our audience of diverse composition.

The Conference will be held the afternoon and evening of June 16 and the morning of June 17 at the Mayflower Hotel in Washington, D. C. The Foundation Research Reports will be divided into two sessions, the first of which will be organized as a panel. This medium will enable us to present the benefits of both specialization and re-combination. Our investigators and consultants for particular research projects are commonly drawn from different specialities and professions. Thus, in a broad sense the panel will present a demonstration of a coordinated attack by experts from different areas on the problems of gathering information in the fields of the Foundation's interest. The first session will be "A Panel Discussion of Findings," beginning at 1:30 p.m., June 16; the second, immediately following, will consist of "A Brief Discussion of New Studies."

Panelists will present their findings briefly and the other members of the panel will be allowed to question the speaker. Written questions submitted from the floor will then be put to the panel at the discretion of the Moderator.

Included in the panel are the following: Foundation Adviser on Research, Professor S. Chesterfield Oppenheim, who will act as Moderator; Director O. S. Colclough; Executive Director L. James Harris; Willard C. Asbury, Chairman of the Advisory Council; Theodore S. Kenyon, member of the Executive Committee of the Advisory Council; and the Principal Investigators: Dr. Robert B. Bangs, Dr. J. N. Behrman, Mr. George E. Frost, Dr. Jesse W. Markham, Dr. Joseph Rossman, Dr. Barkev S. Sanders, Dr. Irving H. Siegel, and Dr. Donald S. Watson.

A reception and dinner honoring Frank A. Howard, 1959 recipient of the Kettering Award, will highlight the evening of Thursday, June 16. Director O. S. Colclough will make the presentation of the award, and Mr. Howard will deliver his acceptance address.

The entire morning of June 17 will be given over to one of the most popular and stimulating features of the Conference, the "Special Session Devoted to Discussion of Current Issues." This part of the program combines short discussions of topical subjects with maximum participation from the floor.

The program in detail is reproduced below.

OBJECTIVES OF THE CONFERENCE

THE CONFERENCE IS an occasion for the presentation and discussion of the research findings of the Foundation, and discussion of current issues important in the fields of the Foundation's interest from which the Foundation itself may derive guidance on the planning of its future work. The Conference also provides an opportunity for people from different branches of learning and fields of endeavor who have a common interest in the patent and related systems to meet and enlarge their perspectives by participating in the stimulating and productive exchanges and contacts of the Conference.

The research work of the Foundation represents the first university attempt at a comprehensive study of the patent, trademark, copyright and related systems in the United States. This study is systematically planned and coordinated, inter-disciplinary in nature and utilizes a combination of specialties such as economics, statistics, psychology, sociology, and law; and empirical, that is, based on the facts gathered by the staff on the actual operation of the systems.

In attendance at this fourth Annual Public Conference will be key representatives from the different fields of activity throughout the nation: commerce, education, science, manufacturing, labor, finance, and the professions.

THURSDAY, JUNE 16

10:00 a.m.-REGISTRATION
1:30 p.m.

1:30 p.m.-FOUNDATION RESEARCH FINDINGS AND NEW DIRECTIONS OF
5:15 p.m. INQUIRY

PANEL DISCUSSION OF FINDINGS

FOUNDATION OFFICERS AND REPRESENTATIVES

O. S. COLCLOUGH, *Director*
L. JAMES HARRIS, *Executive Director*
S. CHESTERFIELD OPPENHEIM, *Adviser on Research;* Panel Moderator
WILLARD C. ASBURY, *Chairman*, Advisory Council
THEODORE S. KENYON, *Member*, Executive Committee, Advisory Council

PRINCIPAL RESEARCH STAFF	AREAS OF PRIMARY INTEREST
ROBERT B. BANGS	Taxation
JACK N. BEHRMAN	Foreign Licensing
GEORGE E. FROST	Antitrust
JESSE W. MARKHAM	Executive Decision-Making
JOSEPH ROSSMAN BARKEV S. SANDERS	Patent Utilization
IRVING H. SIEGEL	Small Business
DONALD S. WATSON	Government Patent Policies

BRIEF PRESENTATION OF NEW STUDIES

The Moderator will also call on other Research Staff Members for appropriate additional information on new studies.

7:30 p.m.-RECEPTION

8:30 p.m.-DINNER, HONORING FRANK A. HOWARD, President of the Sloan-Kettering Institute for Cancer Research, the recipient for 1959 of the "Charles F. Kettering Award for Meritorious Work in Patent, Trademark, and Copyright Research and Education."

Presentation of the Award; Address by Mr. Howard.

FRIDAY, JUNE 17

9:30 a.m.- 12:30 p.m. SPECIAL SESSION DEVOTED TO DISCUSSION OF CURRENT ISSUES

This session will be so organized as to encourage maximum participation from the floor.

MODERATOR: John C. Green, *Consultant to the Foundation*

SPEAKERS:

INDUSTRIAL RESEARCH

DAVID C. MINTON, JR., *Vice President*, Battelle Memorial Institute, Columbus, Ohio

CARL E. BARNES, *Vice President*, Research, Minnesota Mining and Manufacturing Company, St. Paul, Minnesota

GOVERNMENT

JOHN A. JOHNSON, *General Counsel*, National Aeronautics and Space Administration, Washington, D. C.

GILES S. RICH, *Judge*, United States Court of Customs and Patent Appeals, Washington, D. C.

SOCIAL SCIENCES

WARD S. BOWMAN, JR., *Professor of Law and Economics*, Yale University Law School, New Haven, Connecticut

HERBERT E. STRINER, *Staff Director*, Committee on Problems of the American Community, The Brookings Institution, Washington, D. C.

PATENT BAR

HARRY R. MAYERS, *General Patent Counsel*, General Electric Company, New York

WILLIAM H. WEBB, Webb, Mackey & Burden, Pittsburgh; *President*, American Patent Law Association

12:30 p.m.-ADJOURNMENT OF CONFERENCE

The Growing Importance of Chemical in Comparison with Mechanical Patents*

BARKEV S. SANDERS, Co-Principal Investigator
JOSEPH ROSSMAN, Co-Principal Investigator
L. JAMES HARRIS **

IN THE BODY OF THIS INTERIM report we found a rather wide range in the ratio of patent applications pending to patents owned by different industries. We inferred that industries with relatively high ratios of applications to owned patents were those showing more rapid growth.

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* Interest has been expressed in the Appendix dealing with a comparison of chemical and mechanical patents (Appendix B) referred to in the report "Patent Acquisition by Corporations," a research interim report on *Project 1a*, Patent Utilization, which appeared in *PTC J. Res. & Ed.*, 3, No. 3 (Fall 1959), pp. 217-61. For the convenience of *Journal* readers and others who may not have occasion to see Appendix B, we are printing it here with certain changes and additions. This is one of three appendices available upon request.

** The Co-Principal Investigators of this project have insisted that Executive Director L. James Harris join them as co-author in view of his invaluable contributions beyond his duties as Executive Director at every stage of the project.

The industries showing the highest ratio were petroleum products and extraction, followed by chemical and allied products. The industries with the lowest ratios were professional and scientific instruments, followed by machinery. These relationships were derived from the analysis given in Table 3,[1] based on a study of research and development expenditures in industry for 1953 and 1954 by the National Science Foundation.

In our sample the percentage of chemical patents compared with mechanical patents shows a marked increase in 1948 and 1952 as compared with 1938. This would tend to corroborate our inference of a more rapid growth of chemical companies and the chemical arts. At least this appears to be true with respect to patenting activity.

The Patent Office classifies patents into three broad classes, namely, mechanical, electrical, and chemical. In 1938 the percentage of mechanical patents issued to American corporations constituted 65, while chemical constituted less than 15, and the balance, about 20%, represented electrical patents.[2] In 1948 these percentages were 48 for mechanical and 26 for chemical as well as for electrical. This drastic shift apparently was partly the result of World War II. The patents issued in 1948 were applied for during the war. They were for inventions made during the war years.[3] In 1952 the percentages were 59 for mechanical, 23 for chemical, and less than 18 for electrical.[4]

These relationships for the 3 years represented in our sample are shown in Table AA. Columns 2 and 3 show the number and percentage distributions of patents by broad classes in our sample known to have been assigned to American corporations. Columns 4 and 5 are with respect to patents issued to corporations, and therefore are initially assigned patents. These are the percentages which we quoted above. Columns 6 and 7 show the corresponding percentages for patents assigned to corporations subsequent to issuance. Among the patents subsequently assigned, mechanical patents predominate. There is also some suggestion that this predominance of mechanical patents might be increasing with time, contrary to the trend shown with respect to patents issued to companies. Thus, the percentages of these subsequently assigned mechanical patents were about 78 for 1938, 88 for 1948, and 94 for 1952.

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[1] *Science and Engineering in American Industry, Final Report on a 1953-1954 Survey,* National Science Foundation, NSF 56-16. See, *PTC J. Res. & Ed.,* 3, No. 3 (Fall 1959), p. 228.

[2] It is reasonable to assume that most patents resulting from R & D work in the petroleum industry would be chemical patents and very few mechanical. Also the patents obtained by chemical companies would be overwhelmingly chemical in nature rather than mechanical or electrical.

[3] In an unpublished study made some years ago by Barkev S. Sanders, it was found that the effect of war was to reduce drastically the total number of patent applications. But patent applications with respect to armaments and related techniques increased 4 or 5 fold. The sharp proportionate increase in chemical and electrical patents among those issued in 1948 is a reflection of this relationship. See Joseph Rossman "War and Invention," *American Journal of Sociology,* Vol. 36, 1931, pp. 625-633.

[4] In recent years the Patent Office has compiled data for patents according to these three broad classes. Separate data are not available, however, for assigned patents.

For the three years combined, the comparative percentages by the three broad classifications are:

Class of Patents	Initially Assigned	Subsequently Assigned
Mechanical	58.5	84.6
Electrical	20.6	11.6
Chemical	20.9	3.8

The percentage of subsequently assigned patents classed as mechanical approximates the percentage of such patents among the unassigned.

Percentage distribution of unassigned patents in our sample by the three broad classifications are:

Class of Patents	Unassigned Patents No.	Unassigned Patents %
Total	612	100.0
Mechanical	540	88.2
Electrical	28	4.6
Chemical	44	7.2

The percentage differences between initially and subsequently assigned patents with respect to class would suggest a marked difference in the acquisition practices of different industries. The figures show that chemical companies (and petroleum companies whose patent portfolios are predominantly chemical) acquire almost all of their patents before issue and through their own employees. This means that they get very few patents from free lance inventors. Electrical companies acquire a small fraction of their patents subsequent to issue. This implies that they acquire a few patents from free lance inventors. Companies with mechanical patents obtain a somewhat higher proportion of their patents subsequent to issue. They get a larger proportion of their patents from free lance inventors than do the electrical and chemical companies. It appears, therefore, that the large majority of subsequently assigned patents are acquired by small companies in machinery and instrument industries.[5] These small companies concentrate on the production of certain simple

[5] These are the industries showing a minimum ratio of patent applications to patents owned in the National Science Foundation Study (see footnote 1). Reference to Table 3 in "Patent Acquisition by Corporations" would indicate the following ratios of patents owned to applications filed for companies in these industries grouped according to the number of employees.

Industry	Number of Employees: Less than 1,000	1,000–4,999	5,000 and over	All Combined
Machinery	.194	.214	.265	.208
Scientific Instruments	.325	.280	.133	.202
Chemical	.460	.472	.331	.365
Petroleum	.214	.500	.434	.433

Thus the ratio of patents owned to patent applications is .208 for machinery industry, .202 for scientific instruments, .433 for petroleum, and .365 for chemicals. With respect to the company size, however, the gradient is not consistent, this may mean that the range of grouping of companies is too wide to be discriminative. For all four industries combined, the ratios are .253, .307, and .306 for companies with less than 1,000 employees, those with 1,000 to 4,999, and those with 5,000 or more employees respectively. The R & D expenditures of these companies per patent application were:

Industry	Number of Employees: Less than 1,000	1,000–4,999	5,000 and over	All Combined
Machinery	$ 8,535	$14,156	$24,229	$15,164
Scientific Instruments	15,846	14,429	37,538	24,091
Chemicals	11,174	24,353	23,573	21,344
Petroleum	10,000	8,409	15,554	13,407

machines or mechanical gadgets. This seems to be borne out by the frequencies shown in Table CC where the highest concentration of used patents is among mechanical patents owned by "small" companies.

Based on our returns for subsequently assigned patents, we would estimate that had we had complete returns, the distribution of assigned patents in our sample with respect to classification would have been some 716 mechanical. Of these, 93 or 13% would be subsequently assigned, the balance initially assigned. About 232 would have been electrical patents, and of these, 13 or about 6% would be subsequently assigned. Two hundred twenty-seven patents would be chemical, of which only 4, or less than 2%, would be subsequently assigned.

As previously stated, a sizeable proportion of subsequently assigned patents involves small businesses, which inventors incorporate to exploit their patents. The concentration of subsequently assigned patents in mechanical class, in small companies, and probably in those organized by the inventor leads us to infer that many of these companies produce for the market some simple mechanical device or gadget.

The increasing proportion of chemical patents in comparison with the declining proportion of mechanical patents suggested by our data for 1938, 1948, and 1952 is supported by the overall figures regarding the class of patents since 1952 obtained by the Patent Office with respect to all patents issued. The percentages for chemical patents range from a low of 14 in 1952 and 1953 to high of 18 in 1958 and 1959. Conversely, the proportion of mechanical patents has tended to decline from a high of 72 in 1953 to a low of 62 in 1958 and 1959. These percentages are shown in Table BB.

Utilization Patterns: Utilization patterns of patents indicate marked differences by class as well as by company size. These associations are shown in Table CC.

Examining first the "total" line 5, the proportions of "never used" patents are 37, 51, and 48 for mechanical, electrical, and chemical, respectively. In other words a higher proportion of the mechanical patents are used or are about to be used in comparison to electrical and chemical. The largest proportion in mechanical patents are those which are in current use, 38. The corresponding percentages for electrical and chemical patents in current use are 20 and 21. With respect to the proportion of patents used in the past, the proportion is highest for electrical, almost 25, followed by mechanical, 19, and chemical, 14. For patents about to be used, the percentage is highest for chemical, 16, followed by mechanical, 6, and electrical, less than 4. These relationships strengthen our hypothesis that there is greater dynamism in the chemical industry as compared with other industries. Industries in the chemical field have by far the highest proportion of patents to be used in the future and the lowest that were used in the past.[6]

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[6] The 1953 R & D expenditures by industries show marked variations in the average expenditure per pending application.

Petroleum products and extraction	$13,407
Machinery	15,164
All other industries	17,730
Electrical equipment	19,393
Chemical and allied products	21,344
Professional and scientific instruments	24,091

If we combine as "used" the proportion of currently used patents with those used in the past and compare the combined percentages for the three classes, we would have the following:

Class of Patents	Per Cent of Used Patents
Mechanical	57.2
Electrical	44.8
Chemical	35.7

The proportion of used patents is highest for mechanical and lowest for chemical. This relative prominence of mechanical patents is partly associated with the fact that the "small" companies with their high utilization levels contribute 38% of the mechanical patents, but only 12% of the electrical, and 14% of the chemical. The generally higher utilization level for mechanical patents does not disappear, however, when we consider the percentages separately for the "large" and "small" companies. This is given below:

Class of Patents	Per Cent of Used Patents "large"	"small"
Mechanical	53.1	73.4
Electrical	43.0	57.2
Chemical	32.5	55.0

The proportion of used patents is higher for mechanical patents among "large" and "small" companies as compared with electrical and chemical, but differentials are not as large as in the combined. The "large" companies with chemical patents, which probably include most of the larger petroleum companies, show a proportion of used patents of less than 33%. This appears to be about the percentage of used patents that some oil companies have observed among their patent portfolios.[7]

Considering the "large" companies, there is some indication that companies with the largest patent portfolios have a somewhat lower utilization level. This difference is particularly marked with respect to mechanical patents.

The percentages in Table CC would also suggest that on the average, mechanical patents come into use sooner than electrical or chemical patents. These percentages also suggest that mechanical patents may remain in use, on the average, longer than electrical and chemical. These are relationships on which we have sought specific information in the Patent Utilization Study,[8] and the findings will be

[7] Robert O. Spurdle of Sun Oil Company states, "Now, with that background I give you a concrete picture to set against the broad frame that these remarks have developed and have provided for preliminary screening. My evaluation has shown that our usefulness factor is about 35%. This 'usefulness' factor is based upon patent assets developed within the last 15 years in a portfolio of 7 or 8 hundred patents having today an average unexpired life of 8 or 10 years." *PTC J. Res. & Ed.*, Vol. 3, 1959, Conference Number, p. 60 under "Patent Utilization."

[8] Question 10 in the assignee questionnaire reads: "If the sampled invention is or was ever used in production, what was the date when it was first used? (month and year)." Question 11 in the assignee questionnaire reads: "If the sampled invention was in use, but is no longer in use, what is the date when it was last used? (month and year)." *PTC J. Res. & Ed.*, 1, No. 1 (June 1957), p. 110.

analyzed in subsequent interim reports. These inferences based on Table CC are suggested by the proportions of patents in different classes in current use, past use, and to be used in the future.

Table CC is based on assignee replies. The relationships do not change too much if the inventor replies are used. Again, the utilization level is highest for mechanical patents and lowest for chemical. The utilization level is higher for "small" than for "large" companies. Within the "large" companies, however, there is no evidence of a lower utilization level for patents of companies with the largest patent portfolios.

(See tables pages following)

TABLE AA

NUMBER AND PERCENTAGE DISTRIBUTION OF ASSIGNED[1] PATENTS ACCORDING TO THE THREE BROAD CLASSIFICATIONS IN THE THREE YEARS SAMPLED, GROUPING FIGURES SEPARATELY FOR INITIALLY AND SUBSEQUENTLY ASSIGNED PATENTS.

PRELIMINARY

Year of Issue and Classification of Sampled Patent	Combined		Time of Assignment			
			Initially		Subsequently	
	No.	%	No.	%	No.	%
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1938 Total	391	100.0	364	100.0	27	100.0
Mechanical	258	66.0	237	65.1	21	77.8
Electrical	79	20.2	74	20.3	5	18.5
Chemical	54	13.8	53	14.6	1	3.7
1948 Total	266	100.0	258	100.0	8	100.0
Mechanical	131	49.2	124	48.0	7	87.5
Electrical	67	25.2	67	26.0	0	—
Chemical	68	25.6	67	26.0	1	12.5
1952 Total	460	100.0	443	100.0	17	100.0
Mechanical	278	60.4	262	59.1	16	94.1
Electrical	79	17.2	78	17.6	1	5.9
Chemical	103	22.4	103	23.3	0	—

[1] Includes only patents of resident inventors assigned to American corporations.

TABLE BB

PERCENTAGE DISTRIBUTION OF PATENTS ISSUED BY THE UNITED STATES PATENT OFFICE BY THE THREE BROAD CLASSIFICATIONS, 1952 TO 1959.[1]

Year of Issue	Percentages		
	Patent Classification		
	Mechanical	Electrical	Chemical
(1)	(2)	(3)	(4)
1952 [2]	71	15	14
1953	72	14	14
1954	69	16	15
1955	70	15	15
1956	66	18	16
1957	65	18	17
1958	62	20	18
1959 [3]	62	20	18

[1] These percentages were made available to the Foundation by the United States Patent Office.
[2] For the period July through December, 1952.
[3] For the period January through November 17, 1959.

TABLE CC

PERCENTAGE DISTRIBUTION OF ASSIGNED PATENTS BY THE THREE BROAD CLASSIFICATIONS ACCORDING TO UTILIZATION STATUS, SEPARATING THE PATENTS OF LARGE[1] COMPANIES BY RANK OF COMPANY ACCORDING TO ITS PATENT PORTFOLIO.

PRELIMINARY

Companies Ranked by Number of Patents Issued to Them 1939–55 Including All with Assets of $100 Million or More As Listed.[1]	Utilization Status Based on Assignee Replies							
	Total	Current use	Past use	Used	Future use	Used & about to be	Unknown	Never used
	No.	%	%	%	%	%	%	%
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Mechanical								
Total	334	38.0	19.2	57.2	5.7	62.9	.3	36.8
First quartile	74	23.0	17.6	40.6	6.8	47.4	—	52.7
Second quartile	83	34.9	18.1	53.0	4.8	57.8	1.2	41.0
Remaining "large" companies	49	34.7	12.2	46.9	6.1	53.0	—	46.9
All "large" companies	206	30.6	16.5	47.1	5.8	52.9	.5	46.6
"Small" companies	128	50.0	23.4	73.4	5.5	78.9	—	21.1
Electrical								
Total	114	20.2	24.6	44.8	3.5	48.3	.9	50.8
First quartile	54	16.7	24.1	40.8	1.9	42.7	—	57.3
Second quartile	34	17.6	29.4	47.0	5.9	52.9	2.9	44.2
Remaining "large" companies	12	16.7	25.0	41.7	—	41.7	—	58.3
All "large" companies	100	17.0	26.0	43.0	3.0	46.0	1.0	53.0
"Small" companies	14	42.9	14.3	57.2	7.1	64.3	—	35.7
Chemical								
Total	140	21.4	14.3	35.7	16.4	52.1	—	47.9
First quartile	58	20.7	10.3	31.0	19.0	50.0	—	50.0
Second quartile	45	8.9	22.2	31.1	13.3	44.4	—	55.6
Remaining "large" companies	17	35.3	5.9	41.2	23.5	64.7	—	35.3
All "large" companies	120	18.3	14.2	32.5	17.5	50.0	—	50.0
"Small" companies	20	40.0	15.0	55.0	10.0	65.0	—	35.0

[1] *Distribution of Patents Issued to Corporations (1939–55)* Study of the Subcommittee on Patents, Trademarks, and Copyrights of the Committee on the Judiciary, United States Senate, 84th Congress, 2nd Sess., Pursuant to S. Res. 167, Study No. 3, Washington, 1957, pp. 19–34. Large companies include (1) all companies issued more than 100 patents during 1939–55 by the United States Patent Office; (2) all companies with assets of $100 million or more to which one or more patents were issued during 1939–55; (3) most companies with 75 to 100 patents turned up in compiling the other two groups.

Third Educational Booklet Published

The Foundation has recently published the third booklet in its educational series, *The Patent System All Around You.* This series is directed to young people of secondary school level. Booklet number three will take up problems of priority and is called "Who Invented It First?" Outlined are the steps and measures necessary to protect an invention. These procedures are dramatized by short histories of several famous and interesting cases which turned on the question of priority.

The Patent System All Around You series is receiving excellent notice from various quarters. Below is a quotation from a review by Howard I. Forman of current patent literature available to the layman which appeared in the *Bulletin* of the American Patent Law Association.

> Publications [*The Patent System All Around You*—Booklet No. 1 and *The Patent System All Around You,* "How You Get a Patent Today"—Booklet No. 2] . . . . are directed at high school students specifically . . . They are undoubtedly the most attractive and eye-catching of all. The art work, the illustration of youngsters and items which undoubtedly would capture their interest, all tend towards fine reader appeal. I find only one difficulty with the art presentations in [Booklet No. 1] which are in shaded outline as backgrounds to the printed material—in some cases, it makes reading of the print a bit troublesome. It might have been better if the sketches had been a bit more subtle, perhaps by use of lighter inks or more skeletal type drawings. Apparently the publishers felt the same way, for [Booklet No. 2] has this objection eliminated. Similarly, an improvement exists in the later publication over its predecessor in the fact that the pagination has been simplified so as to be turned and read more easily. Essentially, the material covered by both pamphlets is interesting and informative, telling a bit about the origin and purpose of patents and how they are obtained, then launching into stories about actual inventions and their development into well-known items of commerce. The writing style is breezy, easy to read and understand. All in all, the brochures are well designed to capture the attention, the imagination, and the thoughts of young readers. As they are part of a series, it is expected that these pamphlets will have the best opportunity of all to meet changing demands and attitudes of their intended readers as views are obtained of the reaction to the first two.

"Know-How" Licensing and Capital Gains*

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SUMMARY

The licensing of "know-how" either separately or perhaps more usually in conjunction with patents and trademarks [1] is a business practice of extensive and growing importance in both domestic and foreign licensing. Our inquiry is into the Federal tax aspects of know-how licensing, with the principal focus on the eligibility of proceeds therefrom for capital gains treatment under the income tax law.

DEFINITION OF KNOW-HOW

The term "know-how" is not susceptible to exact definition. In the broadest sense, it may consist of inventions, processes, formulae, or designs which are either unpatented or unpatentable; it may be evidenced by some form of physical matter, such as blue-prints, specifications, or drawings; it almost invariably includes trade secrets; and it may involve accumulated technical experience and skills which can best, or perhaps only, be communicated through the medium of personal services.[2]

It can be seen that know-how as a general descriptive term comprehends a variety of forms and natures. This fact necessarily complicates a tax analysis

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* This is an interim report on *Project 7a,* "Taxation and Patents".

[1] See Behrman and Schmidt, "New Data on Foreign Licensing," *PTC J. Res. & Ed.,* 3, No. 4 (Winter 1959), p. 370, in which the authors' analysis of more than 1200 foreign license agreements of 55 large United States corporations resulted in the following breakdown of the subject matter covered by the agreements:

	Number of Agreements
Patents only	585
Patents, Trademarks and Know-How in combination	246
Patents and Know-How	172
Trademarks only	111
Trademarks and Know-How	57
Know-How only	40
Patents and Trademarks	4
	1215

[2] For a full discussion of the subject matter of know-how, see Eckstrom, *Licensing in Foreign Operations,* Chapter VI (Foreign Operations Service, 1958).

of know-how licensing and renders unfeasible any broad statement regarding the availability of capital gains treatment on resulting proceeds.

CAPITAL GAINS—THE LEGAL PROBLEM

To result in long-term capital gains under the Internal Revenue Code, the transfer of know-how must generally constitute: (1) the "sale or exchange" (2) of a "capital asset" (3) held for more than six months by the transferor.[3] There exists scant judicial precedent for the application of these requirements to know-how transfers. Accordingly, the analysis which follows must in great part rest on the analogous cases involving the taxation of patents and on the judicial precedents interpreting know-how for purposes other than taxation.

KNOW-HOW AS A CAPITAL ASSET

Section 1221 of the Internal Revenue Code defines a "capital asset" as "property held by the taxpayer (whether or not connected with his trade or business)" other than certain specified or excluded categories of property. The first essential then is that know-how qualify as "property" if it is to be accorded status as a capital asset.

"Property" as a general term is frequently used but not precisely defined in the Internal Revenue Code.[4] The only specific references in the Code to the property aspect of a species of know-how are found in Sections 861 and 862 (dealing with determination of income from sources within and without the United States), which construe rents and royalties to include payments for the use of "patents, copyrights, *secret processes and formulae,* goodwill, trade-marks, trade brands, franchises *and other like property*" [5] The implication is clear that not only secret processes and formulae, but probably also other forms of licensable material falling within the scope of know-how, have the character of property.

INVENTIONS, SECRET PROCESSES, AND FORMULAE AS PROPERTY

It is indisputably clear that patented inventions constitute property for purposes of taxation.[6] The case of *Samuel E. Diescher* [7] demonstrates that the prop-

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[3] Int. Rev. Code of 1954, Sec. 1222(3).

[4] Specialized definitions of property are contained in the following sections of the Code: Sec. 317, (corporate distributions); Sec. 614, (depletion allowance); Sec. 1231, (property used in a trade or business); and Sec. 1235, (patents as property). These sections, however, contribute little to the generic definition of the term.

[5] Emphasis added.

[6] The United States Code, Title 35, Sec. 261, provides that "patents shall have the attributes of personal property." The Internal Revenue Code of 1954, Sec. 1235, explicitly describes patent rights as property. In the cases dealing with capital gains on patent transfers, the Treasury has usually grounded its case on the theory that the patents were held primarily for sale to customers and therefore were not capital assets [e.g., Harvey v. Comm., 171 F.2d 952 (9th Cir. 1949)], or that the patent was not sold or exchanged [e.g., Edward C. Myers, 6 T.C. 258 (1946)]. The Treasury did not contest the property nature of patents in these cases.

[7] 36 B.T.A. 732 (1937), *aff'd,* 110 F.2d 90 (3d Cir. 1940), *cert. denied,* 310 U.S. 650 (1940).

erty in an invention does not derive from issuance of a patent. The following language is pertinent:

> Under the common law, the property right of the inventor, to make, use and vend, was recognized. The patents issued under statute are merely the grant of the right to exclude others from that use for a period of 17 years. The inventor's property right in his invention does not come into being upon his obtaining of a patent but exists prior to that time upon his reduction of an original invention to actual practice. *Crown Die & Tool Co.* v. *Nye Tool & Machine Works,* 261 U. S. 24; *Six Wheel Corporation* v. *Sterling Motor Truck Co.,* 50 Fed. (2d) 568. As the court said in the last cited case:
>
> "From the foregoing, it will be seen that the irreducible quantum of the inventor's right in the res [the invention], even under the common law, is that of making, using and vending. The Federal Constitution and the statutes passed thereunder simply make that right exclusive. The statutes certainly do not curtail the natural right; they enlarge it."
>
> We think, therefore, that petitioners had a property right in each of the inventions which they had reduced to practice. These rights represented something of exchangeable value which the partnership possessed since it was able to exchange them for a valuable consideration. See *Gayler* v. *Wilder,* 10 Howard, 477; *Individual Drinking Cup Co.* v. *Osmun-Cook Co.,* 220 Fed. 335; *Hershey Manufacturing Co.,* 14 B.T.A. 867; affd., 43 Fed. (2d) 298; *George Washington, Sr.,* 36 B.T.A. 74. That answers the only question presented here. So, we conclude that these particular patents and inventions perfected and demonstrated more than two years prior to September 28, 1932, constituted property owned by the partnership for more than two years.[8]

It is apparent from the above passage that property inheres in an invention upon its reduction to practice, and that the patent grant merely creates the additional monopoly right to exclude others from the use of the invention for 17 years.[9]

Several tax cases have dealt with the status of secret processes as property. In *George S. Mepham*[10] the taxpayer, engaged in the manufacture of dry color and pigments, acquired the rights to certain inventions (formerly covered by British patents) which at considerable expense he adapted to his business. He was thereby able to eliminate the emission of sulphuric fumes from his manufacturing operation while his competitors continued to encounter constant trouble from this source. The process as adapted was never patented and at the time the taxpayer sold his business it was unknown both to the trade and to the public. The Board of Tax Appeals[11] acknowledged the property nature of the secret process when it stated that ". . . the taxpayer, in disposing of his business, sold not only the tangible property used in the business, but also the good will and other intangible assets, including the secret process. . . . "[12]

In *Wall Products, Inc.*[13] the question involved was the deductibility of royalty payments to two stockholders for use of a secret formula employed in curing concrete. The formula was never patented. The government contended that the licensors had no property interest in the formula, which admittedly was simple

[8] *Id.* at 743-44.
[9] *Accord,* Franklin S. Speicher, 28 T.C. 938 (1957), Edward C. Myers, 6 T.C. 258 (1946).
[10] 3 B.T.A. 549 (1926).
[11] Predecessor of the Tax Court.
[12] 3 B.T.A. at 553.
[13] 11 T.C. 51 (1948).

and could be broken down into its constituent parts by a competent chemist. In sustaining the deductions the court found that the formula was secret and was therefore *property* which formed a proper basis for the payments made under the license agreement. The property rights of the licensors were held to be unaffected by the fact they had not applied for a patent on the formula.

The case of *Nelson v. Commissioner*[14] involved similar facts. The taxpayer in that proceeding was the president and majority shareholder of a corporation which had contracted to pay royalties to his mother in consideration of the assignment of a secret process involved in spinning metals. The Commissioner argued that the royalties were in fact disguised dividends to the son. The process incorporated the "know-how" acquired by long experimentation and experience in spinning heavy metals. It did not consist alone of mechanical skill but involved ingenuity and was evidenced by notes, sketchings, and drawings. In finding against the Commissioner the court stated:

> It is well settled that secret processes may constitute property and be dealt with contractually as such. Moreover, the courts will prevent the unlawful use of processes without the permission of the owner of the process. *Durand v. Brown,* 6 Cir. 236 F. 609; *Allen-Qualley Co. v. Shellmar Products Co.,* D.C. Ill. 31 F.2d. 293 affirmed 7 Cir., 36 F.2d 623; *O. & W. Thum Co. v. Tloczynski,* 114 Mich. 149, 72 N.W. 140, 38 L.R.A. 200; *Glucol Manufacturing Co. v. Schulist,* 239 Mich. 70, 214 N.W. 152; *Hoeltke v. C. M. Kemp Mfg. Co.,* 4 Cir. 80 F.2d 912, certiorari denied 298 U.S. 673, 56 S.Ct. 938, 80 L. Ed. 1395; *A. O. Smith Corp. v Petroleum Iron Co.,* 6 Cir., 73 F.2d 531, 538, 539.[15]

TRADE SECRETS AS PROPERTY

It can be seen from the foregoing tax cases that the courts recognize the property aspects of invention and secret processes and formulae. A broader inquiry is into the status of trade secrets as property. "A trade secret may consist of any formula, pattern, device, plan, or compilation of information which is used in one's business and which gives him an opportunity to obtain an advantage over competitors who do not know it or do not use it."[16] As so defined, trade secrets comprehend all or nearly all of the varied elements and forms which comprise know-how.

Litigation involving trade secrets has occurred principally in the area of "unfair competition." It is well settled that the possessor of a trade secret may enlist the aid of equity to enjoin its use or disposition by another to whom it has been disclosed in confidence.[17] The cases have typically involved the right of an employer to preclude disclosure or exploitation by an employee or former employee of confidential information or data gained in the course of his employ-

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[14] 203 F.2d 1 (6th Cir. 1953).

[15] 203 F.2d at 6.

[16] 4 Restatement of Torts, Section 757, cited in the following cases: Sandlin v. Johnson, 141 F.2d 660 (8th Cir. 1944); Schreyer v. Casco Products Corp., 97 F. Supp. 159 (D. Conn. 1951). International Industries, Inc. v. Warren Petroleum Corp., 99 F. Supp. 907 (D. Del. 1951).

[17] E. I. du Pont de Nemours Powder Co. v. Masland, 244 U.S. 100 (1917); John D. Park & Sons Co. v. Hartman, 153 Fed. 24 (6th Cir. 1907). See also cases listed at 170 A.L.R. 449, 451 at n. 11.

ment.[18] The relief accorded the employer in these circumstances extends to prohibiting the use of such trade secret by one acquiring it from another with knowledge of its secret character.[19]

The unfair competition cases have referred variously to an owner's "property" or "right of property" or "kind of property" in trade secrets.[20] But without necessarily contradicting these premises, it should be apparent that the rights inhering in trade secrets are something different from and lesser than the absolute and exclusive property rights—as to use, dominion, and disposition—accruing to the owner of physical things, or the monopoly rights granted by a patent; in other words, if a trade secret is property, it is not such in the full sense. The owner of a trade secret, provided he takes the necessary cautions to safeguard its secrecy, is merely protected in the unfair competition cases against its use and disclosure without his consent.

The following language of Mr. Justice Holmes in *E. I. du Pont de Nemours Powder Co. v. Masland* might suggest that the relief accorded owners of trade secrets in such cases is not grounded on a concept of property:

> The word "property" as applied to . . . trade secrets is an unanalyzed expression of certain secondary consequences of the primary fact that the law makes some rudimentary requirements of good faith. Whether the plaintiffs have any valuable secret or not the defendant knows the facts, whatever they are, through a special confidence that he accepted. The property may be denied but the confidence cannot be. Therefore the starting point of the present matter is not property . . . , but that the defendant stood in confidential relations with the plaintiffs, or one of them. These have given place to hostility, and the first thing to be made sure of is that the defendant shall not fraudulently abuse the trust reposed in him. It is the usual incident of confidential relations. If there is any advantage in the fact that he knew the plaintiffs' secrets he must take the burden with the good.[21]

This case should not be interpreted as contradicting the existence of property rights in trade secrets. While the injunctive relief granted by the Court in that case may have been premised on the confidential relationship of the parties, the existence of intangible property in the trade secrets may nonetheless—as the opinion perhaps implies—be the consequence of such relief. Such a conclusion is consonant with the definition of intangible property as a relationship between persons which the law recognizes by attaching to it certain sanctions enforceable by the courts.[22] In other words, it would seem that intangible property rights by their nature *normally* derive from or are an expression of some primary relationships between persons which entail legal responsibility.

The unfair competition cases are perhaps not conclusive of the status of trade secrets as property. More appropriate for the purposes of this inquiry are the

[18] See, *e.g.*, Pomeroy Ink Co. v. Pomeroy, 77 N.J. Eq. 293, 78 Atl. 698 (1910). See also 43 C.J.S. Injunctions, Section 148 (1945).

[19] Lamont, C & Co. v. Bonnie Blend Chocolate Corp., 135 Misc. 537, 238 N.Y. Supp. 78 (Sup. Ct. 1929).

[20] Wilson v. Rousseau, 4 How. (45 U.S.) 646 (1846); Sandlin v. Johnson, 141 F.2d 660 (8th Cir. 1944); Herald v. Herald China & Pottery Co., 257 Fed. 911 (6th Cir. 1919); Allen-Qualley Co. v. Shellmar Products Co., 31 F.2d 293 (N.D. Ill. 1929).

[21] 244 U.S. at 102.

[22] Curry v. McCanless, 307 U.S. 357 (1939).

precedents involving the sale of trade secrets. It is firmly established that trade secrets may form the subject matter of a sale (or assignment).[23] A "sale" is legally defined as the transfer of *property* for a valuable consideration.[24] Accordingly, it is necessary to conclude, at least for the special purpose of sale, that trade secrets are property.

Our concern, of course, is whether trade secrets constitute property within the tax meaning of that term. The courts have consistently given a broad interpretation to the term "property" as applied in the field of taxation. As stated by the 10th Circuit in *Citizens State Bank of Barstow, Texas v. Vidal:*

> "Property" is a word of very broad meaning and when used without qualification may reasonably be construed to include obligations, rights and other intangibles, as well as physical things. "Property" within the tax laws should not be given a narrow or technical meaning.[25]

That property in the tax sense includes intangibles is confirmed by other cases. A franchise or good will can be the subject of property.[26] So also can be a partnership interest,[27] a lease,[28] or an exclusive agency.[29] Most of the tax cases dealing with the property status of intangibles have involved their sale or exchange. And the fact that these various incorporeal subjects could be sold has been cited as proof of their nature as property. As stated by the 7th Circuit in *Commissioner* v. *Stephens-Adamson Mfg. Co.:* "We think it a fair definition to say that what may be sold or assigned is property." [30]

On the basis of the foregoing discussion, it can be reasonably concluded that trade secrets, and hence know-how, constitute property for purposes of taxation. This conclusion is supported by a number of private rulings issued by the Commissioner under Sections 367 and 351 of the Internal Revenue Code in transactions involving the transfer of know-how by United States corporations to foreign subsidiaries.[31]

Section 351 provides for the nonrecognition of gain (or loss) arising from the exchange of property for stock in a controlled corporation. Where the transferee of such property is a foreign corporation, taxation of such gain cannot be averted unless, prior to the transaction, a ruling or clearance is obtained from the Internal Revenue Service under Section 367 to the effect that tax avoidance is not a principal purpose of the exchange. In the private rulings referred to above, the Commissioner in granting the Section 367 clearance has thereupon ruled that under Section 351 no gain will be recognized on the transfer of know-how in ex-

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[23] Fowle v. Park, 131 U.S. 88 (1889); Coca-Cola Bottling Co. v. Coca-Cola Co., 269 Fed. 796 (D. Del. 1920); Anderson v. Distler, 173 Misc. 261, 17 N.Y.S.2d 674 (Sup. Ct. 1940).

[24] Jones v. Corbyn, 186 F.2d 450 (10th Cir. 1950).

[25] 114 F.2d 380, 382-83 (1940).

[26] Grace Bros., Inc. v. Comm., 173 F.2d 170 (9th Cir. 1949); Cleveland Allerton Hotel, Inc. v. Comm., 166 F.2d 805 (6th Cir. 1948).

[27] Comm. v. Shapiro, 125 F.2d 532 (6th Cir. 1942).

[28] Louis W. Ray, 18 T.C. 438 (1952).

[29] Elliott B. Smoak, 43 B.T.A. 907 (1941).

[30] 51 F.2d 681, 682 (1931).

[31] Recent private rulings include one dated January 20, 1960, and another dated September 28, 1959.

change for stock of the foreign subsidiary. Since the very essence of a Section 351 transaction is the transfer of property in exchange for stock, it necessarily follows that the Commissioner has construed know-how as property in these rulings.

KNOW-HOW AS A CAPITAL ASSET

Having determined the property character of know-how, we turn next to the question of its qualification as a capital asset. The latter term is defined in the Internal Revenue Code to comprise all "property" other than specified categories which are excluded from this status. The relevant portions of the definition statute are set forth below:

> [T]he term "capital asset" means property held by the taxpayer (whether or not connected with his trade or business), but does not include—
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> (1) stock in trade of the taxpayer or other property of a kind which would properly be included in the inventory of the taxpayer if on hand at the close of the taxable year, or property held by the taxpayer primarily for sale to customers in the ordinary course of his trade or business;
>
> (2) property, used in his trade or business, of a character which is subject to the allowance for depreciation provided in section 167, or real property used in his trade or business. . . .[83]

Regarding the second exception to the classification of property as a capital asset, it should be recognized that know-how normally cannot be depreciated since it has no fixed or ascertainable life, but rather has an indefinite duration.[83] In this sense know-how differs from a patent which, because of its certain statutory life of 17 years, can be depreciated if used in the taxpayer's trade or business, in which circumstance it is not a capital asset.[84] Thus, the classification of know-how as a capital asset will generally hinge on whether or not it falls within the first excluded category described above.

It should be readily apparent that know-how is not "property included in the inventory of the taxpayer." Hence the salient question is whether and in what circumstances know-how is "property held by the taxpayer primarily for sale in the ordinary course of his trade or business." (Our reference is basically to corporate taxpayers, as they are principally responsible for the development and hence licensing of know-how.) The question has never been judicially decided. However, it would seem that the nature and origin of know-how normally tend to refute any contention that it is held primarily for sale. Know-how is essentially an accumulation of the methods, techniques, and processes derived from experience and experimentation in manufacturing a product. Thus, know-how is normally an incident—and indeed a derivative—of manufacture, rather than property held primarily for sale.

It is significant that in analogous cases involving capital gains from corporate transfers of patents the Commissioner has not usually urged that the patents

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[83] Int. Rev. Code of 1954, Sec. 1221.

[83] Inecto, Inc., 20 B.T.A. 566 (1930), *aff'd per curiam*, 50 F.2d 1078 (2d Cir. 1931). See also A. R. R. 339, 3 Cum. Bull. 169.

[84] It should be noted, however, that a patent not qualifying as a capital asset because it is depreciable will normally be a Section 1231 asset (a depreciable asset used in a trade or business) with the result that its sale or exchange will result in capital gain under that section.

were held primarily for sale.[85] And while in these cases the patents, as depreciable property, were Section 1231 assets rather than capital assets, the point is the same since a finding that the patents were held primarily for sale would have defeated any attempt to classify them as Section 1231 property and accordingly would have resulted in ordinary income rather than capital gain on their sale or exchange. The inference to be taken from these precedents is that, when it is evident that patents have been developed and used for manufacturing purposes, the Commissioner does not attempt the difficult argument that they are held primarily for sale. It would appear that this analysis applies *a fortiori* to the corporate sale of know-how, which, unlike a patent or invention owned by a corporation, is inevitably involved in and a product of manufacturing operations. The reasonable conclusion must then be that know-how is normally held by a corporation for manufacturing purposes and not for sale. There may, of course, be exceptions to this statement.

It may be that fragmented sales of know-how, for example, on a country-by-country or item-by-item basis, will incur risk of classification as property held primarily for sale.[86] Even in these circumstances, however, it would seem that an attempt at such classification should fail if it can be shown (as it normally can) that the corporation develops and uses its body of know-how principally in connection with its own manufacturing operations and that the sale of know-how is merely incidental to this much broader purpose.[87] This would seem especially true where the corporate taxpayer can point to a long history of utilizing the transferred know-how in its business.[88]

We have concluded that know-how will generally satisfy the statutory definition of a capital asset. It should be recognized that this definition has in some instances been narrowed by judicial determination. The Supreme Court decision in *Corn Products Refining Co.* v. *Commissioner*[89] represents perhaps the leading example of this practice and must be considered for purposes of the present analysis. In that case the taxpayer, a manufacturer of corn products, engaged in the purchase of corn futures in order to assure itself of adequate supplies of corn. The sale of these futures gave rise to income which the taxpayer reported as

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[85] See, e.g., Merck & Co., Inc. v. Smith, 155 F. Supp. 843 (E.D. Pa. 1957); National Bread Wrapping Machine Co., 30 T.C. 550 (1958).

[86] In cases involving individual inventors, a past history of selling patents has sometimes lead to the finding that the patent in controversy was held by the inventor primarily for sale. See, e.g., Harold T. Avery, 47 B.T.A. 538 (1942). It should be appreciated, however, that these cases have involved inventors who have not utilized their patents in any manufacturing trade or business and accordingly could not argue that the inventions were held primarily for manufacturing purposes.

[87] Cf., Carl G. Dreymann, 11 T.C. 153 (1948).

[88] This standard is somewhat analogous to the "age test" employed by the courts (prior to the Revenue Act of 1950) in determining whether livestock was held for purposes of breeding or dairy as opposed to sale. The presumption created by this test was that if animals were sold at an immature age, they were held for sale, and that otherwise they were held for breeding or dairy uses, with the result that proceeds from their sale were capital gains. See Fox v. Comm., 198 F.2d 719 (4th Cir. 1952).

[89] 350 U.S. 46 (1955), *rehearing denied,* 350 U.S. 943 (1956).

capital gain on the theory that the futures were capital assets. In rejecting this argument the Court stated:

> We find nothing in this record to support the contention that Corn Products' futures activity was separate and apart from its manufacturing operation. On the contrary, it appears that the transactions were vitally important to the company's business as a form of insurance against increases in the price of raw corn. Not only were the purchases initiated for just this reason, but the petitioner's sales policy, selling in the future at a fixed price or less, continued to leave it exceedingly vulnerable to rises in the price of corn. Further, the purchase of corn futures assured the company a source of supply which was admittedly cheaper than constructing additional storage facilities for raw corn. Under these facts it is difficult to imagine a program more closely geared to a company's manufacturing enterprise or more important to its successful operation.
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> * * * * *
>
> Admittedly, petitioner's corn futures do not come within the literal language of the exclusions set out in that section. [now Section 1221]. They were not stock in trade, actual inventory, property held for sale to customers or depreciable property used in a trade or business.
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> * * * * *
>
> Since this section is an exception from the normal tax requirements of the Internal Revenue Code, the definition of a capital asset must be narrowly applied and its exclusions interpreted broadly.[40]

It is perhaps no answer to the holding in *Corn Products Refining Co.* to characterize the Court's redefinition of the term "capital asset" as yet another illustration of judicial legislation. But that point aside, it appears from a close examination of the decision that it has questionable application to the problem before us. That case involved hedging transactions which, on the basis of prior cases and rulings, were found to be a form of insurance rather than a dealing in capital assets.[41] It is unlikely that the decision can reasonably be applied to situations not concerned with commodity futures. It is perhaps significant that the Commissioner has not attempted to apply the holding to patent assignment or to the sale of good will. Its application to know-how transfers would appear to be equally without warrant.

SALE OR EXCHANGE REQUIREMENT

It is reasonable to assume that the sale or exchange requirement as interpreted in the patent cases applies generally to know-how transfers. It is well settled that the transfer of the exclusive right to make, use, and sell a patented article for the full term of the patent results in an assignment, that is, a sale, rather than a mere licensing of the patent.[42] Certain later cases have employed a less rigid

[40] *Id.* at 50-52.

[41] Moreover, the Internal Revenue Code of 1954, Sec. 1233, explicitly excepts hedging transactions from classification as the sale or exchange of capital assets.

[42] This was the test employed in the classic infringement case of Waterman v. MacKenzie, 138 U.S. 252 (1891), and adopted by subsequent tax cases in determining whether the transfer of rights had effected an assignment of the patent. See Edward C. Myers, 6 T.C. 258 (1946); Ernest Gustave Hoffman, 8 B.T.A. 1272 (1927).

standard in allowing capital gains upon a showing that the transferor had retained no right of "provable substantial value." [43]

The application of either of these standards to the transfer of know-how presents this very difficult problem: the transferor corporation's continued use or reserved right to use the know-how in licensing its use to others would apparently mean that it had granted something less than the *exclusive* right to make, use, and sell under the know-how; or in the alternative, that it had retained a right of provable substantial value. And, of course, in normal circumstances the transferor will wish to reserve the right to make continued use of the subject know-how.

On the other hand, there is ample authority that the exclusive licensing of a patent within a given industry or limited geographically results in the sale of the patent. In *Vincent A. Marco* [44] the Tax Court ruled that the transfer of the exclusive right to make, use, and sell a patented article in that portion of the United States west of the Mississippi River amounted to a sale of the patent.[45] In *First National Bank of Princeton* v. *United States* [46] the taxpayer invented and patented a method of rounding ends of brush bristles. He exclusively licensed the right to make, use, and sell the invention with respect to toothbrushes, but reserved to himself the right to use and license the invention for other types of brushes. The court held that there had been a sale of the patent.[47]

These precedents as applied to our inquiry would appear to provide sound support for construing the exclusive licensing of know-how with territorial or industry limitations as a sale of the property. The geographical limitation would seem to have special practical application in the foreign licensing of know-how, which could be on a country-by-country basis.

The grant of exclusive rights to a patent must extend for its full term if a sale is to result.[48] The elements of know-how, unlike patents, do not have a fixed or ascertainable life, but are of indefinite duration and capable of perpetual existence. Accordingly, to accomplish a sale of this property, it is probably necessary to grant the licensee not only exclusive but perpetual rights. This conclusion is confirmed by the cases involving the licensing of trademarks, which can also be said to be capable of perpetual existence.[49]

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[43] United States v. Carruthers, 219 F.2d 21 (9th Cir. 1955). Cf., Rollman v. Comm., 244 F.2d 634 (4th Cir. 1957).

[44] 25 T.C. 544 (1955).

[45] *Accord,* Thornton G. Graham, 26 T.C. 730 (1956); Lamar v. Granger, 99 F. Supp. 17 (W.D. Pa. 1951).

[46] 136 F. Supp. 818 (D. N.J. 1955).

[47] See also Carruthers v. United States, 219 F.2d 21 (9th Cir. 1955), involving the exclusive licensing of a patent for use in the tuna industry.

[48] Waterman v. MacKenzie, 138 U.S. 252 (1891); Arthur M. Young, 29 T. C. 850 (1958).

[49] See Thomas D. Armour, 22 T.C. 181 (1954), where it was held that the transfer of rights to a trademark must be perpetual in duration to constitute a sale. See also Seattle Brewing & Malting Co., 6 T.C. 856 (1946).

METHOD OF PAYMENT

The courts have traditionally held that the method of payment is not a factor in determining the eligibility of a patent transfer for capital gains.[50] Notwithstanding this fact, the Commissioner, in Mimeograph 6490,[51] issued in 1950, took the official position that the assignment of a patent in consideration of payments measured by the assignee's production, sale, or use of the patented article was *not* to be regarded as a "sale" of the patent. The arrangement was said rather to provide for the payment of royalties taxable as ordinary income. While this position continued to meet consistent defeat in the courts, it nonetheless resulted in considerable uncertainty in the tax law. Recently, however, the Service, because of its repeated failure to obtain judicial support on the question, has revoked Mimeograph 6490.[52] Thus, the existence of a royalty arrangement no longer poses a threat to the realization of capital gains on patent assignments. This conclusion would seem logically to apply also to transfers of know-how.

SERVICE ELEMENT OF KNOW-HOW TRANSFERS

In the usual case, the grant of know-how involves some element of personal services which are to be rendered by the grantor. These services may take the form of teaching and instructing, or may involve consultation or technical assistance in adapting the know-how to the particular manufacturing operations of the grantee. In certain situations such technical services may be the principal or only medium of communicating the know-how to the transferee.

It is, of course, clear that the performance of personal service in the normal course results in ordinary income rather than capital gains. Where it has been determined that proceeds arising from the transfer of know-how are basically eligible for capital gains, the question arises as to what portion, if any, of such payments must be allocated to the personal services and reported as ordinary income. In cases involving the sale or assignment of a patented device which is technical and intricate, services of an advisory nature have generally been construed as ancillary and subsidiary to the sale of the patent and the complete proceeds of the transaction held taxable as capital gains.[53] The duration and extent of the services are important factors in determining whether such services are ancillary and subsidiary to the patent grant. In *Arthur C. Ruge*[54] the taxpayers, in transferring all right, title, and interest to certain inventions, agreed to give the assignee a certain number of man-days consulting service per year if requested, but not to exceed 60 days per year. Certain percentage payments called for by the agreement were in consideration of the inventions and of the consulting services. The Tax Court found that the services were merely ancillary to the assignment of the patents and of a type and kind usually called for to

[50] Comm. v. Hopkinson, 126 F.2d 406 (2d Cir. 1942); Edward C. Myers, 6 T.C. 258 (1946).
[51] 1950-1 Cum. Bull. 9; Rev. Rul. 55-58, 1955-1 Cum. Bull. 97.
[52] Rev. Rul. 58-353, 1958-2 Cum. Bull. 408.
[53] Arthur C. Ruge, 26 T.C. 138 (1956); Raymond M. Hessert, 6 T.C. Memo. 1190 (1957); William M. Kelly, 6 T.C. Memo. 646 (1947).
[54] Arthur C. Ruge, 26 T.C. 138 (1956).

implement the sale of highly technical and intricate inventions. Accordingly, the percentage payments in their entirety were held to constitute consideration for the sale of the inventions and were thus taxable as capital gains.

The application of the "ancillary and subsidiary doctrine" to technical services rendered in connection with know-how transfers would appear wholly reasonable. This conclusion finds support in Revenue Ruling 55-17,[55] which involved these facts: A foreign corporation not engaged in business in this country licensed a domestic corporation to use certain techniques and methods ("commonly referred to as 'know-how'") for recovery and purification of chemicals, which know-how the domestic corporation wished to apply to commercial production in the United States. The foreign corporation was to provide instruction in certain techniques to the employees of the domestic corporation, and these services were to be performed abroad. The question at issue was the allocation of payments made by the U. S. company between royalties attributable to the use of know-how, on which portion tax was to be withheld, and amounts attributable to personal services on which no withholding was required. The following extract from the Ruling is significant for our purposes:

> The essence of the contract is the making available to the domestic corporation the technical knowledge, methods, experience, that is, the "know-how" of the foreign corporation. While manufacturing "know-how" is of a nonpatentable nature, it is something that its possessor can grant to another for a consideration. The right to use such "know-how" is not materially different from the right to use trademarks, secret processes and formulae, and, if the right thereto is granted as part of a licensing agreement, it becomes, in effect, an integral part of the bundle of rights acquired under such an agreement.
>
> The payments made under the contract are applicable both to the specific rights therein granted, that is, the right to use the "know-how," and to services performed abroad in instructing and training the employees or technicians of the domestic corporation. Such payments should therefore be allocated between the license to use the "know-how" and the personal services. Since the personal services have only nominal value apart from the license to use such "know-how", all but a nominal sum should be allocated to the license.[56]

The Ruling in its provision for an allocation of only a nominal sum to the personal services is basically consonant with the "ancillary and subsidiary doctrine" enunciated in the cases involving the sale or assignment of a patent. Hence, it can be reasonably concluded that if technical services are merely incidental to the grant of know-how, all, or nearly all, of the payments made under the transfer agreement will be eligible for capital gains, provided, of course, the transfer effects the sale or exchange of a capital asset as discussed earlier in detail.

The Ruling is not directly concerned with the problem before us, that is, the allocation of payments between capital gains (representing the price of the property [know-how] which was sold or exchanged) and ordinary income (representing compensation for personal services). But the essential thrust of the Ruling is the same, in that it segregates payments into amounts attributable respectively to the know-how and the personal services. The Ruling reflects a realistic appreciation of the fact that technical services have little intrinsic value apart from

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[55] 1955-1 Cum. Bull. 388.

[56] *Id.* at 389.

their connection with the know-how, and accordingly, it limits the sum allocated to such services.

It would appear that the Revenue Ruling has a broader application than the "ancillary and subsidiary doctrine" developed in the patent transfer cases. It would appear appropriate to those situations in which technical services are not merely incidental to the know-how grant, but in fact constitute the principal or only method of transferring the know-how. Even in these circumstances, it would seem, as stated in the language of the Ruling, that "[t]he essence of the contract is the making available to the domestic corporation of the technical knowledge, methods, experience, that is, the 'know-how' of the . . . [transferor] corporation" and that "the personal services have only nominal value apart from the . . . [grant of] such 'know-how'. . . ."

The point would seem to be this: Even where the technical services are extensive and the primary means of communicating the know-how, they have little independent value. Accordingly, in these cases it would appear reasonable to fix this value at the cost, including salaries, of the employees of the transferor company who perform these services. In this manner, the predominantly greater part of the payments made by the transferee would be attributed to the transfer of the property in the know-how, and hence eligible for capital gains if the requisite conditions for this treatment are satisfied. As a practical matter, it is probably advisable in these circumstances to make specific provision in the know-how agreement for the grantor to be compensated for the services of its technical personnel (if extensive) on such a cost basis. This would tend to assure that all other payments would relate to and be in consideration of the know-how grant.

THE SIX MONTHS HOLDING PERIOD

We have concluded that know-how will generally qualify as a capital asset which is capable of sale or exchange. It is, of course, necessary that the know-how—as any capital asset—be held by the transferor for more than six months if long-term capital gains, to which preferential tax rates attach, are to result from such sale or exchange.[57] In the usual situation, the holding period would appear to pose no problem with respect to the grant of present know-how. This is because such know-how will normally consist of proven techniques, processes, and accumulated experience which by their very nature and development have existed for a time substantially greater than six months. And even in the exceptional circumstances where some such element of know-how may have existed for a shorter duration, it is a relatively simple matter to defer its assignment until the holding period requirement is satisfied.

A more difficult problem is presented in the case of the grant of continuing know-how. Frequently, a corporation acquiring the existing know-how of another corporation will also wish for obvious reasons to have the use of future improvements and developments of the know-how of the transferor corporation. In view of the holding period requirement, it is highly questionable whether payments made

[57] Int. Rev. Code of 1954, Sec. 1222.

for or allocated to the grant of rights to such future know-how will be eligible for treatment as long-term capital gains.

The question is similar to that involved in assignments of future patents and inventions. It is clear that such assignments are valid and may be specifically enforced.[58] There is, however, a conflict as to whether such transactions can result in capital gain. Denial of this treatment has been predicated on either of these two grounds: (1) The inventor, because of the future assignment, never owned the invention and hence could not sell it;[59] or (2) assuming ownership, the inventor had not satisfied the six-month holding period required for long-term capital gains, the complete rights to the invention being deemed automatically to vest in the assignee upon its reduction to practice.[60]

Other decisions adopted the theory that the future assignment could not affect a present sale of an asset not yet in being, and that ownership of the invention could vest in the transferee only upon formal assignment by the inventor after the invention had come into existence. Thus, if the inventor held the invention for six months prior to formal assignment, he was entitled to long-term capital gains.[61]

These precedents would appear to have logical application to transfers of future or continuing know-how, with the result that the capital gains eligibility of payments therefor is most uncertain, if not unlikely, and probably would be opposed by the Treasury. If a corporation contemplates the grant of rights to continuing know-how in conjunction with the transfer of existing know-how in a capital gains situation, it is clearly advisable to provide for a specific and reasonable allocation of total payments between such existing and future know-how. (It may even be desirable to employ separate agreements for this purpose.) Failure to make a fixed and definite allocation may result in an allocation being made by the Commissioner in a manner which will minimize the amounts attributed to existing know-how and hence available as capital gains.

It has been suggested that the holding period problems arising in connection with assignment of future inventions and improvement patents can be averted if the inventor or assignor merely gives the prospective assignee an option to acquire such future inventions or patents.[62] It has also been suggested that these problems can be eliminated, and the transferee's interest at the same time protected, by requiring in a formal agreement that all future inventions or improvement patents must be offered to such party by the inventor or assignor once they come into existence.[63] Either of these methods can be utilized to guarantee that there will be no completed sale of the future property until the six months holding period has elapsed. There appears to be no reason why these solutions cannot be adapted to the future know-how situation in order to produce a capital gains result.

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[58] Littlefield v. Perry, 88 U.S. (21 Wall.) 205, 226 (1875); Conway v. White, 9 F.2d 863, 866 (2d Cir. 1925).

[59] Blum v. Comm., 183 F.2d 281 (3d Cir. 1950).

[60] Paul L. Kuzmick, 11 T.C. 288 (1948).

[61] Carl G. Dreymann, 11 T.C. 153 (1948). Cf. Richard W. Te Linde, 18 T.C. 91 (1952).

[62] Bailey, *The Inventor*, 15 N.Y.U. Inst. on Fed. Tax., 285, 308 (1957).

[63] *Patent Licensing*, Practising Law Institute, 95, 96 (1958).

CONCLUSION

We conclude that know-how is property and that it usually constitutes a capital asset. To accomplish its sale or exchange, it is necessary that there be a grant of the exclusive right to make, use, and sell under the know-how. The continued use or retention of the right to use such know-how by the transferor—which is the normal practice—will generally prevent the transfer of *exclusive rights.* There is, however, authority to support the proposition that the transfer of exclusive rights to know-how for utilization within a given industry or limited geographically will be construed as a sale, with capital gains as a consequence. The exclusive grant in these circumstances would permit the continued use of the know-how by the transferor. The transfer with territorial limitations would appear to have special practical application to foreign licensing, which could be on a country-by-country basis.

It should be recognized that the path to capital gains on know-how transactions is both tortuous and uncharted. There is presently lacking the body of direct precedents necessary to achieve a definite clarity and predictability in resolving the many issues we have raised. Nonetheless, our exploratory analysis, which relies principally on the analagous tax cases involving patent transfers, leads us to conclude that, within the limitations outlined here and with proper attention to drafting of license agreements, the grant of know-how can yield capital gains results.

A Study of the Professional Color Motion Picture Antitrust Decrees and Their Effects*

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This is the analysis and conclusions of the report published in the Spring 1960 issue (Volume 4, Number 1) of the Journal on "A Study of the Professional Color Motion Picture Antitrust Decrees and Their Effects." The summary preceding that report is reprinted below for the convenience of our readers who may not have ready access to the previous number.

SUMMARY

AN UNAIDED SINGLE SENSITIZED photographic medium is "color blind." That is, the image produced can be displayed only in some range of colors and as a single image. Where the range of colors approximates the visible spectrum, conventional black and white reproduction is obtained. Motion pictures in full color have generally required some method of making color separation images on emulsions responsive to three primary colors and of reconstituting the separations in their respective colors and in registration to give the illusion of a single picture in full color.

Color separation and image reconstitution can be accomplished directly by "additive" techniques. These methods are based on taking a motion picture frame for each color and thereafter projecting the positive prints in registration through appropriate filters onto the viewing screen.[1] This theoretically simple approach was the subject of much interest. Stubborn practical problems, however, prevented commercial application of "additive" techniques. As a result, until about 1935 the only commercially significant professional[2] color motion picture techniques were inherently unfaithful two-color processes used by Technicolor, Multicolor, and others.[3]

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* The authors acknowledge the aid of Mr. and Mrs. Richard Kasperson and Mr. Neil Twomey in the preparation of this report on *Project 4a,* Effects of Certain Antitrust Decrees Involving Patents as a Major Factor.

[1] See, e.g., Edison patent 1,138,360, filed June 16, 1913.

[2] The term "professional" motion pictures is here used to designate shorts and features intended for theatre exhibition on paid admissions and using 35mm. or larger film size. Such motion pictures are here distinguished from amateur, scientific, and commercial motion pictures. Professional motion pictures usually differ from other motion pictures in (a) more exacting standards of quality (including color fidelity), (b) greater use of fades, laps, dissolves, and artistic effects generally, and (c) a larger number of prints.

[3] Technical Appendix, Parts 2 and 6.

The Technicolor three-color process was perfected about 1935. From that time until at least 1945 this process was the only available source of quality professional color motion pictures. The process was based on the three-strip camera for live action photography and the imbibition process for print making. The camera exposed three motion picture films in unison. It was necessarily bulky, intricate, and expensive.[4] The imbibition process entailed printing of the three primary color images in sequence by dye transfer to the imbibition "blank" film. It required a high degree of skill, careful process control, and a heavy investment in equipment.[5] By concentrating on these difficult techniques until success was achieved, Technicolor provided full color professional motion picture services much sooner than they would otherwise have been available.

Despite the extensive technical development required for the Technicolor three-strip camera and the imbibition release print making process, the basic procedures and arrangements in each instance were old and well known. Technicolor has not, therefore, ever had basic patent rights to the camera and print making process it employed.

Technicolor was formed in 1915. Prior to development of the three-strip camera and the imbibition print making process, it explored a number of other techniques. In some instances it pursued approaches found impractical by others. These efforts had an important consequence in Troland Reissue patent 18,680. This patent was directed to what may be termed "monopack" color photography.[6] The patent issued after a Patent Office interference proceeding involving a number of patent applications, including an application by Mannes and Godowsky, to which Eastman had rights.[7] The subject matter of the interference was sufficiently broad to encompass Kodachrome, soon to be introduced by Eastman. After Troland (and hence Technicolor) won the interference, Eastman took license from Technicolor. The license included a complex provision, effective as to motion picture film of 35mm. size and larger, giving Technicolor a limited period during which it would be the exclusive processor of such film.[8]

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[4] *Ibid.*, Part 4.

[5] *Ibid.*, Part 3.

[6] Full data on the patents here cited are given in the Bibliography, p. 146. Unless otherwise indicated the term "monopack" is here used to designate multilayer film type color materials generally. Commercially important monopack films include Kodachrome, Ektachrome, Anscochrome, and the Eastman professional color motion picture camera, intermediate and release print films. The term "monopack" is sometimes used in more narrow senses, such as 35mm. color reversal film (e.g., Kodachrome). Paragraph 11(3) of the complaint filed in the case here studied (U.S. v. Technicolor, Inc., Technicolor Motion Picture Corp. and Eastman Kodak Co., No. 7507-M, Southern Dist. of Cal., 1947) defines the term "monopack" in the more narrow sense of reversal type film, such as Kodachrome. The term appears in this more narrow sense in the various court documents, although in most instances the distinction is not important. In the Eastman-Technicolor processing agreement of April 5, 1938, Exhibit C to the complaint, the term is not confined to reversal type film, although the only film processed under the agreement was Kodachrome, which is of the reversal type.

[7] Eastman Kodak Company is referred to herein as "Eastman." The company is referred to in many of the court documents as "Kodak."

[8] See *PTC J. Res. & Ed.*, 4, No. 1 (Spring 1960), p. 7.

From the date of the Troland license to December 1945, Eastman advised inquirers that Kodachrome was not commercially feasible for professional motion pictures and that the film would have to be processed by Technicolor. The license provisions as to Technicolor processing were cancelled in December 1945. The license as a whole terminated in 1948 when the Troland patent expired.

Technicolor purchased essentially all of its film requirements from Eastman. Beginning about 1939, it engaged in developmental efforts with Eastman on the use of monopack camera film in lieu of the three-strip camera technique. Technicolor and Eastman also entered into contracts under which Technicolor agreed to purchase at least 50% of its negative and positive raw film from Eastman, provided that Eastman invested certain sums in imbibition process research.

The antitrust action here studied arose on government complaint filed in May 1947 against Technicolor and Eastman. Violations of the Sherman and Clayton Antitrust Acts were charged. As to the defendants jointly, the Troland patent license agreement and the imbibition process agreements were given primary emphasis. It was charged that through the license, Technicolor foreclosed Eastman competition in professional monopack film. As to the imbibition process agreements, the government contended that Technicolor had obtained the benefits of the Eastman research facilities and had foreclosed competitors from imbibition process developments in consideration of agreement to purchase film requirements from Eastman. Additional allegations of the complaint were directed to Technicolor alleged tying practices relating to the three-strip camera, the imbibition process services, film, and other items.

The antitrust action was concluded as to Eastman by consent decree entered in 1948. It was concluded as to Technicolor by a consent decree entered in 1950. Each consent decree required licensing of some patents royalty free and other patents on royalty basis, and in addition required that technical information be furnished to licensees. The Eastman decree required licensing of some 27 patents, either on a royalty-free basis or at a royalty rate not in excess of royalties paid by Eastman to others. The Technicolor decree was more stringent in that it required royalty-free licensing of some 92 patents constituting all or nearly all of the patents then owned by Technicolor. The Eastman decree did not require licensing of Hansen patent 2,449,966 or Vittum patent 2,428,054. These patents were destined to have considerable importance in connection with the major post-decree industry development, namely introduction to the Eastmancolor materials.[9]

It is concluded in the present report that none of the compulsory licensing decree provisions has had substantial effect on professional color motion picture industry, that the key industry development since the decrees (Eastmancolor) occurred without regard to the decrees, and that research and development in

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[9] The term "Eastmancolor" is here used to designate collectively the monopack color motion picture films introduced by Eastman in 1950. The full terms "Eastman Color Negative," "Eastman Color Intermediate," and "Eastman Color Print" are used by Eastman to identify the various films making up what is here referred to as the Eastmancolor materials. Motion pictures made with these materials are sometimes referred to as in "Eastmancolor."

the industry has a much greater effect on market competition than the antitrust decree provisions.

The Eastmancolor materials were introduced in 1950. These materials included Eastman Color Negative Film, Eastman Color Print Film, and intermediate films. The color negative film was of the monopack type suitable for use in conventional motion picture cameras. It was similar to Kodacolor still camera film. The color print film was likewise of the monopack type and was intended primarily for printing from a monopack negative intermediate film, thus providing a relatively simple optical procedure. Eastman initially recommended that to preserve color fidelity in the usual four-step motion picture print-making procedure, at least one step should be made using color separations. By 1953 improvements in the color negative and intermediate films led to the recommendation of an all-monopack printing sequence without the use of color separations and the attendant expense and complexity.

Two main technical developments were used in the Eastmancolor materials. One was the colored coupler principle.[10] The other was improved methods of coating the film base with emulsions having the required uniformity of thickness. At least the colored coupler principle did not exist until shortly before the Eastmancolor materials were introduced. It was a significant contributing factor to the overall color quality attained. For this and other reasons it is not believed that Eastmancolor in the form offered could have been introduced at an earlier date, regardless of the antitrust decree. It is further concluded herein that the Eastman failure to promote professional motion picture monopack materials at an earlier date was consistent with good business judgment, taking into account the quality of the available materials, the Technicolor competition, and the existing Eastman market position. This conclusion finds support in the experience of Ansco. Beginning in 1945, this experienced film manufacturer introduced professional monopack materials, exerted every effort to promote the materials, and yet failed. The experience of du Pont provides some further support for this conclusion.

In considerable measure the government viewed Eastman as the victim of Technicolor demands based on the Troland patent rights, including demand that Eastman not offer a monopack film. It is obvious that Eastman preferred the license to litigation. The facts do not support a conclusion that Technicolor was in a position to coerce Eastman, or that it did so. Eastman was at all times entirely free to introduce a professional monopack film—the patent and license expired in 1948—and there is no reason to believe that the 1945 cancellation of the criticized provisions was less than genuine. Yet the Eastmancolor materials were not introduced until 1950, and then in a form subject to substantial later improvement. A more realistic appraisal of the Troland license is that Technicolor feared the inevitable monopack competition, it sought a head start in adapting itself to the new technique when it came, and Eastman agreed to the provisions because they did not limit its right to introduce the film or form a substantial impediment to the successful promotion of an otherwise acceptable film.

[10] Technical Appendix, Part 5b.

The body of this report concludes with a discussion of research and development in photographic industry generally and the effect of such activity on market competition. The conclusion is reached that research and development is a major influence on competitive marketing activity and that patent rights are an important stimulus to such research and development. It is also concluded that the industry, especially in the professional motion picture field, exhibits a definite tendency toward concentration. New products based on research and development provide some balancing market force to this tendency, and a continuing threat to entrenched market positions. As the facts of the present study indicate, antitrust decrees are relatively ineffective on the industry as compared with the influence of new technical developments.

The Technical and Historical Appendix to the report traces the development of the important color motion picture techniques and the business concerns whose activities have been predicated upon these techniques. This appendix is available on request.

Part III

ANALYSIS AND CONCLUSIONS

Conclusions as to the Antitrust Charges

THE ANTITRUST ACTION OF 1947 against Eastman and Technicolor responded to a felt need on the part of a segment of the motion picture producers and independent processors. For over a decade Technicolor had been the only available source of high quality professional color motion picture camera and processing services. By the early 1940's the Technicolor facilities were inadequate to supply the demand. Indeed, in some instances Technicolor camera and processing contracts were bought and sold as instruments of value. From the viewpoint of the producers the alternatives to Technicolor were black and white or decidedly inferior color processes. In this seller's market Technicolor—probably inevitably—acquired a reputation for high handed arrogance in dealing with the producers. Demands for government action were equally inevitable.

It was no answer to the disgruntled producers that Technicolor was increasing its camera and processing facilities.[1] Nor was it important that practical monopack camera and release print film seemed just around the corner, that Ansco monopack film was available after 1945, and that du Pont, Polaroid, and others were working on competitive full color release printing materials and processes. The key facts were that the existing alternatives to Technicolor did not satisfy

[1] Technicolor had a strike in 1945 and 1946 that accented the limitations of its capacity. Its actual production of release prints was 160 million feet in 1945. The figures for 1946, 1947, and 1948 were, respectively, 165, 222, and 265 million feet. *Technicolor Annual Reports.* Prior to World War II there were 26 Technicolor three-strip cameras in the U. S. By 1949, ten additional cameras had been built. *Saturday Evening Post,* Oct. 22, 1949, p. 26.

the quality requirements of these producers, that Technicolor was known to have agreements with Eastman, and that at least a segment of the producers saw no technical reason why market competition did not exist.

The Kodachrome situation aggravated the matter. Kodachrome had been available in 16mm. motion picture form since 1935. By 1939 Kodachrome 16mm. duplicating film had been placed on the market and was in substantial use in making duplicates of Kodachrome 16mm. originals. And by 1947, Kodachrome commercial camera film especially designed for direct reversal printing onto Kodachrome duplicating film was on the market. These materials provided 16mm. reversal transparencies and prints of high quality. To many it appeared that by merely enlarging the 16mm. Kodachrome films to 35mm. sizes, Eastman could have supplied an entirely competitive alternative to Technicolor services which would not be dependent upon any special camera or the imbibition process. Yet, Eastman was not promoting 35mm. Kodachrome or other monopack materials for professional use.[2]

It was no answer to the critics that 35mm. Kodachrome for professional use had its limitations. The key factor was the apparent reluctance of Eastman to

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[2] The provisions of the Troland reissue license agreement relating to Technicolor processing rights were cancelled in December 1945. As stated at paragraph K-236 of the *Second Supplement to the Agreed Statement of Facts:*

> "Thereafter (at least through the end of 1949) when requests for 35mm. Kodachrome film were received, Kodak advised that the process was not commercially feasible, but, if experimental quantities of the film were desired, it would be furnished and processed by Kodak free of charge."

Paragraph K-237 of the same *Agreed Statement* states:

> "Prior to January 1, 1949, Kodak had received no formal requests from anyone in the professional motion picture field for a license to process monopack release print material. However, some interest has been shown. Kodak still believes that the process as a printing method is not commercially feasible for the production of release prints for the motion picture industry, but if someone should desire film for such purpose and a license to process, Kodak is willing to supply the film and to grant the license. Kodak furnished Cinecolor approximately 1,000 feet of this type film which was returned to Kodak for processing in April 1948. Cinecolor has not ordered any such film in commercial quantities, nor has it used it for making release prints. In October 1947 Kodak processed approximately 2,000 feet of this type film for Consolidated Film Laboratories. The monopack film processed for these two companies was limited to the amounts shown above."

Prior to December 1945 inquirers as to Kodachrome film for professional use were told:

> ". . . that they could have the film but that the process just was not commercially feasible for use by the professional motion picture trade in making release prints. They were also advised of the license agreement with Technicolor, under which they would have to go to Technicolor to have it processed. Technicolor had limited rights to process it, which if the process had been successful, Technicolor would have long since lost by virtue of the 1934 Agreement." *Revised Technicolor Statement of Facts, para. 157.*

With respect to camera film the government and Technicolor agreed to a statement that:

> ". . . the use of monopack as a taking film involved much difficulty. . . . Kodak is still trying to overcome these coating difficulties. It has continued to supply Technicolor and others with such film and it has been used as an original taking material for a few professional motion pictures." *Second Supp. to Agreed Statement of Facts, para. K-239.*

let the producers find out for themselves what could and what could not be done. The known experimental efforts of Technicolor in conjunction with Eastman fanned the suspicions that Technicolor and Eastman were engaged in action designed to retard, rather than advance, the industry.[3] And Cinecolor at least was using 16mm. Kodachrome as a camera film despite its limited performance as compared with the 35mm. product.

These considerations motivated the antitrust investigation by 1945 and the complaint in 1947. The theory—reflected in the complaint—was that Technicolor had, through the Troland patent license and other practices, prevented the emergence of competitive color processes and materials based on monopack technique. Under "Effects" the Complaint alleged that:[4]

We can now look to the industry events of more than a decade to evaluate the extent that these contentions were justified, the extent the industry has changed, and the influence of the antitrust decrees.

There have been drastic changes in the industry. The changes have been brought about principally by the introduction of the Eastmancolor negative-positive monopack materials in 1950. Eastman color camera film has not only provided an alternative to the Technicolor three-strip camera, but also has displaced that camera. In the field of release print making, the Technicolor imbibition process continues to be used by Technicolor and is used on the bulk of the features requiring large numbers of prints. Both the studio-owned [5] and independent lab-

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[3] Eastman had sold over $500,000 in 35mm. professional monopack film through 1948. Sales were first made in 1939. The peak year was 1945, when sales totalled about $134,000. *First Supp. to Agreed Statement of Facts,* para. 125. Virtually all of this film was used by Technicolor and was used to make the color separations required by the imbibition process. The first feature having any portion filmed with monopack was "The Forest Rangers," released by Paramount in 1942, in which the fire scenes were taken with such film.

[4] *Complaint,* para. 27.

> (a) The development of the art of professional color cinematography by others than Technicolor has been retarded. . . .
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> (d) Motion picture producers and others have been hindered, delayed, and prevented from establishing facilities of their own for color processing and from engaging on their own behalf in the business of professional color cinematography.
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> (h) Technicolor has been enabled to maintain, and has maintained, high, arbitrary, and non-competitive prices for unexposed negative film, for development and other processing services, and for positive film prints, in the conduct of its business of professional color cinematography.
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> (i) Technicolor has been enabled to maintain . . . a monopoly of professional color cinematography. . . .

[5] Following the introduction of the Eastmancolor materials, many of the major studios set up their own laboratories for color processing. More recently, the producers have been disposing of these facilities, in many instances to independent processors who have paid for portions of the purchase price in the form of release printing services. See, e.g., *New York Times,* Sept. 23, 1958, p. 45 (Pathé acquisition of Columbia Pictures.) Technicolor purchased the facilities of Warner Brothers Laboratories in 1958, in part for release printing services. *1948 Technicolor Annual Report,* p. 2.

oratories have made definite inroads on the Technicolor release print processing volume, including the processing contracts for many features well within the range where the Technicolor imbibition process enjoys an economic advantage.[6] Technicolor has reduced prices despite rising costs, the current base price being about 5¢ per foot as compared with about 6¢ per foot in 1949.[7] The seller's market enjoyed by Technicolor prior to 1950 has definitely come to an end.

Did the antitrust action bring about the introduction of Eastmancolor? If it did, it seems clear that the proceedings can be credited with bringing about a drastic change in the state of the industry and a considerable resolution of the color problems that beset the producers. On the other hand, if the advent of Eastmancolor was the consequence of other forces, it can be said with equal certainty that the really important change in the professional color motion picture field has been independent of the antitrust action.

Eastman physically could have introduced a 35mm. monopack motion picture film prior to 1950. Kodachrome duplicating film dated back to 1939. After 1947 the company was offering 16mm. Kodachrome "professional" film that was particularly suitable as camera film from which duplicates were made. Eastman's commercial experience with negative-positive color (as distinguished from reversal color) dated back to the introduction of Kodacolor in 1942. In both Kodacolor and Ektachrome Eastman had experience with incorporated coupler type monopack films. The 35mm. motion picture monopack film experiments with Technicolor began by 1939.[8]

It is equally clear that the Eastmancolor materials could not have been introduced in the 1950 form at any substantially earlier date. Probably the most important single development in this connection was the colored coupler principle. Through the use of colored couplers, color separations and prints in color could be made from the camera and intermediate monopack films without undue color degradation and without undue expense. This is of definite importance in a professional motion picture film. The producers desire a first printing step to provide "dup" films and to make possible photographic effects such as laps and dissolves. At least one successive printing step is required for making release print films.[9] Technicolor provided these features. In addition, it is desirable that at least the last printing step be from a monopack negative in order to avoid the need for registering color separation exposures at this stage. As discussed in the Appendix,[10] the colored coupler principle facilitated these successive printing steps as well as the preparation of good quality color separation negatives for use in release print manufacture by the Technicolor, Cinecolor, or Polacolor processes, or on monopack Eastman, Ansco, or du Pont stock.

There is no evidence that Eastman delayed the introduction of Eastmancolor

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[6] In general, Technicolor imbibition release printing has the economic advantage when more than about fifty prints are required. *1957 Technicolor Annual Report,* p. 4.

[7] *Business Week,* March 11, 1950, p. 25; *1954 Film Daily Year Book,* p. 141.

[8] *Agreed Statement of Facts,* No. 125.

[9] See *Revised Technicolor Statement of Facts,* No. 154.

[10] Part 5b.

once the colored coupler development was available. Commercial use of the principle can be traced to products quite unrelated to professional motion picture film. The first step was Kodacolor monopack negative camera film, in 1942. This was a negative-positive material using incorporated couplers. By about 1945[11] a silver masking layer was incorporated in Kodacolor camera film to reduce the effects of the most troublesome dye overlap and the incident color distortion on print-making. Colored couplers—the technique employed in Eastmancolor—were introduced in Kodacolor in 1949. The first Eastman patent application to the development was filed in 1944.[12]

The history and introduction of the colored coupler principle—with incentives wholly apart from the motion picture field—strongly indicate that Eastman just could not have previously introduced Eastmancolor in the form it was actually introduced.

Some industry personnel feel that the colored coupler principle was less important to the success of Eastmancolor than the above paragraphs state. The fact is, however, that Ansco first offered professional monopack materials without provision for masking and later went to silver type masking, which is a less refined and less effective way to overcome the same technical problem. In connection with its monopack camera film, du Pont expected to use stripping-type film to overcome this problem in a somewhat different manner. Also, Technicolor gave the competitive monopack product a very high standard of quality which had to be met. All of these considerations support the conclusion that the colored coupler principle was a very important factor in the ultimate success of the Eastmancolor materials.

There is also evidence that very serious production problems were encountered by Eastman in making monopack film prior to 1950. Tolerable variations in the thickness of the emulsion layers on 16mm. film became most troublesome on 35mm. sizes, especially for professional use. Prior to about 1949 over 60% of the monopack film made by Eastman for Technicolor was rejected by one company or the other.[13]

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[11] The silver mask principle is discussed in the Technical Appendix, Part 5b. Patent applications directed to the principle were filed at least by 1936 (Gaspar patent 2,340,656.) Ansco applied the silver mask principle in 35mm. motion picture film about 1945.

[12] Hanson Patent 2,449,966. See Technical Appendix, Part 5b.

[13] An agreed statement of fact on this experience states:

> "However, the use of monopack as a taking film involved much difficulty. Kodak believes that the quality of the results obtained must approximate those made in the Technicolor cameras. One of the major difficulties was the periodic variation in the color arising from differences in the thickness of the coating of the different layers on the film which resulted in flicker. The unevenness of coating, which was satisfactory in 16mm. amateur pictures, provoked severe criticism when judged by professional standards. Of the 35mm. Kodachrome film coated by Kodak for Technicolor, over 60 per cent, on the average, as compared with approximately 15 per cent for Kodak's regular black and white negative, has been discarded as unsuitable by Kodak before shipping or has been returned by Technicolor as unsuitable. Kodak is still trying to overcome these coating difficulties. . . ." *Second Supp. to Agreed Statement of Facts*, K-239.

Even in the form introduced in 1950, the Eastmancolor materials were recommended for use only with two successive reproduction steps.[14] In the words of a December 1953 publication by Eastman authors:[15]

> . . . . The system shown in Figure 1D [a three-step monopack process without the use of color separations at any point] has the disadvantage that no protection is provided against loss of the color original or intermediates due to possible change of the dye images. Separation positives or negatives would have to be made if such protection were desired. *In addition, it is unlikely that adequate reproduction quality could be obtained with such a system at the present time.* [Emphasis added].

In April 1957, another Eastman publication stated:[16]

Again we have conduct that is hardly consistent with the availability of a product in entirely satisfactory form during the time period involved in the government charges.

Other data confirm the conclusion that Eastmancolor was introduced promptly after there was a substantial prospect of success. A two-year period passed between the entry of the Eastman decree and the 1950 introduction of the Eastmancolor materials. The antitrust investigation was in progress by at least 1945. The complaint was filed in 1947. If Eastman really were holding back a competitive monopack film because of pressure from Technicolor or for some similar reason, it would seem likely that the product would have been introduced when the antitrust complaint was filed in 1947 or at least more promptly after the 1948 decree. Certainly Eastman was not likely to allow Technicolor to influence Eastman on this matter after the complaint was filed, if it really did so before.

The experience of Ansco throws additional perspective on the role of the antitrust judgment. By 1945 Ansco had introduced a 35mm. monopack film for professional use.[17] This film was made available in a negative-positive form and for at least a period of time used silver masks to provide improved printing

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On the coating problem see Technical Appendix, Part 5b.

> "The more precise coatings required for 35mm. professional monopack motion picture film posed a problem unique to this type film. The writers have not been able to ascertain the techniques by which it was overcome. Accordingly, it is not possible in this study to form a conclusion on whether this problem would have been overcome at an earlier date had the decree not been entered. So long as the duplicating problem existed—and it remained a problem until approximately the time that Eastmancolor was introduced—the details as to the coating problem do not alter the conclusions here reached. It is the personal opinion of the writers that if the coating problem was the only problem to be solved in connection with 35mm. professional monopack film, it might well have been solved at an earlier date."

[14] Hanson and Kisner, "Improved Color Films for Color Motion-Picture Production," 61 *Jl. SMPTE* 667 (1953).

[15] *Ibid.*, pp. 668-9.

[16] Bello *et al.*, "A New Color Intermediate Positive-Intermediate Negative Film System for Color Motion-Picture Photography," 66 *Jl. SMPTE* 205, 206 (1957).

> Recent improvements in the color characteristics of the dye images now make it possible to obtain satisfactory color quality in an all-color film system involving four films from negative to release print. . . .

[17] *First Supp. Agreed Statement of Facts*, para. 189.

quality. There is little doubt that Ansco did all that it could to make the film practical, nor can there be any doubt that Ansco would work with any financially responsible producer or laboratory. The first short in Ansco color was "Climbing the Matterhorn," released in 1947.[18] This was followed by "Sixteen Fathoms Deep," a feature released by Allied Artists in the same year,[19] and by the M.G.M. feature "Man on the Eiffel Tower," released in 1948.[20] It was reported that in 1948, 20 million feet of Ansco color film were processed.[21]

The Ansco experience indicates that the market for a 35mm. monopack film, short of a product such as Eastmancolor, was quite limited. The Ansco 35mm. monopack film production and sale, for example, does not appear to have exceeded the production of Cinecolor. Compared with the Technicolor footage it was quite insignificant. The volume was so low that it accented the difficulties of maintaining film quality. The Ansco product never enjoyed anything like the later acceptance of Eastmancolor, even though the film was tried by Pathé, Warner Brothers, M.G.M., Allied Artists, and others. This was also despite the fact that the film was designed for use in 35mm. professional motion picture production.[22] To be sure, Eastman might well have done better in an intense effort to promote the use of its pre-1950 films for motion picture production, but the Ansco experience certainly indicates that the producers were not ready to give substantial business to any color film or process that did not have a high degree of reliability and quality. Ansco print film has been withdrawn from the market and the negative camera film, although available, is not currently being used in substantial quantity by the industry.

In the Complaint and elsewhere the government contended that Technicolor had retarded Eastman in the introduction of a 35mm. motion picture monopack film. The contentions were based on (a) the Troland patent license agreement and (b) the status of Technicolor as an Eastman customer.

For several reasons it seems clear that the Troland patent license was not in fact responsible for any delay by Eastman. The license provisions relating to the introduction of a 35mm. film by Eastman were cancelled on December 14, 1945.[23] The writers are unaware of any indications that this action was not in good faith. Moreover, the license never did forbid a 35mm. monopack film by Eastman, but rather gave Technicolor a limited period of exclusive processing.[24] And, finally, the license (and the Troland patent) expired in 1948. For all of

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[18] *1948 Film Daily Year Book,* p. 111.

[19] *Id.*

[20] *1949 Film Daily Year Book,* p. 91.

[21] *Id.*

[22] It is essentially impossible to compare the Ansco product in terms of quality with what would have resulted if Eastman had marketed Kodachrome in 35mm. motion picture lengths. In some respects each product would be better than the other. It is believed, however, that such an evaluation would be beside the point in any event since the Ansco film was clearly a genuine effort to do the best that could be done, there appear to have been no patent barriers to Ansco, and Ansco was an established and experienced film manufacturer.

[23] *Complaint,* para. 18.

[24] See *PTC J. Res. & Ed.,* 4, No. 1 (Spring 1960), p. 7.

these reasons, it is believed that the patent license agreement was not responsible for any real delay on the part of Eastman in entering the 35mm. color motion picture field.

Contentions based on the status of Technicolor as an Eastman customer have a theoretical foundation. Prior to at least 1948, Technicolor had made virtually all of its film purchases from Eastman.[25] The terms of the imbibition process agreement indicate that Eastman was not indifferent to the film sales made to Technicolor.[26] Technicolor was purchasing in the neighborhood of a sixth of the 35mm. motion picture film sales of Eastman—a total of perhaps $4 millions annually.[27] Even if Technicolor did not press the matter, the inference can be drawn that Eastman would pause before alienating such a customer by introducing a competitive product.[28]

Subsequent events dispel these contentions and support the Technicolor position that it purchased from Eastman only for reasons of quality.[29] At the present writing—ten years after the Technicolor decree—Technicolor continues to purchase essentially all of its film stock from Eastman. It has done so even though prices of the stock used in the Technicolor process have increased and there have been some price decreases in Eastmancolor materials.

To be sure, varying estimates might be made of the possible sales volume of the monopack films Eastman could have offered prior to 1950. It may well be that Eastman could have done better than Ansco. Considering all of the factors, however, it seems clear that Eastman made a reasonable business decision in awaiting the development of the improved products that were introduced in 1950.[29a] It is not believed that history supports any conclusion that Technicolor pressure did or could retard Eastman in this connection. The consensus of personnel engaged in the manufacturing side of the photographic industry is that, prior to about 1950, monopack materials had not been developed to the point where they could offer successful competition to Technicolor.

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[25] *Statement of Facts,* para. 89.

[26] See *PTC J. Res. & Ed.,* 4, No. 1 (Spring 1960), p. 8.

[27] In 1948 the Eastman dollar volume of 35mm. motion picture film sales was about $22.5 millions. *Agreed Statement of Facts,* para. 125. In that year Technicolor purchased 17.3% of the Eastman footage. *Ibid.,* Schedule D. Assuming that Technicolor paid about the average price per foot of film, this entailed a dollar volume of $3.9 millions. In 1948 Technicolor total purchases of all raw materials totalled about $6 millions. *1952 Technicolor Annual Report,* p. 14.

[28] Cf., U. S. v. Griffith, 334 U.S. 100 (1948).

[29] Technicolor actually did purchase from du Pont, Agfa (Ansco) and Bay State. It contended that Eastman was the best and most consistently reliable source. See *Revised Technicolor Statement of Facts,* para. 21 and 22. This is consistent with the attitude of professionals in other fields of photography.

[29a] Eastman had some practical experience from which to evaluate the market potential. After December 1945, Eastman followed the practice of advising inquirers that 35mm. Kodachrome motion picture film was not feasible and of offering experimental quantities, with processing free of charge. *Revised Technicolor Statement of Facts,* No. 158. Yet prior to December 1948 Eastman had only processed 35mm. Kodachrome motion picture film on three occasions, all in 1947 and 1948, and aggregating less than 3,000 feet. *First Supp. Agreed Statement of Facts,* No. 124.

The commercial prospects were drastically altered when Eastmancolor type film became possible. Two successive prints could be made without undue color degradation. The flicker problem was resolved. The possible printing steps from camera film to release prints could be conducted by the producers and the independent laboratories. Motion pictures that previously would have been black and white would—at least in many cases—use the color materials. The color film product value per foot was at least twice that of black and white. There was a corresponding prospective increased dollar value of processing chemical sales.

Actual experience since 1950 demonstrates the point. Beginning in 1950 the dollar value of professional motion picture film sold by Eastman began a steady climb from about $40 millions to a peak of over $80 millions in 1955, from which value it has somewhat declined. The 1957 figure was slightly under $80 millions.[30] In contrast, the Technicolor volume increased from 312 million feet in 1950 to 560 in 1953 and has since declined steadily from that figure. In 1958 its volume was 272 million feet, or less than half the peak.[31]

Another consideration was becoming important at about the time Eastmancolor was introduced in 1950. This was the chance that a competitor would occupy the monopack field before Eastman moved in. With respect to Ansco, the efforts as of about 1945 probably gave Eastman little pause. But improvements were made from time to time, and by 1950 Ansco had made definite progress. A Patent Office interference at least advised Eastman that Ansco was working on colored couplers. Du Pont was known to be working on monopack film. Indeed, this company did introduce a release print film in 1949. Polaroid likewise had some interest in the field and in 1947 had introduced its Polacolor process for release printing. This process utilized some features of monopack film. With these various efforts converging on the matter, it seems clear that by about 1950 the possibility was definitely increasing that one competitor or another might bring forth an effective camera film and release printing process. The Eastman management surely did not overlook this risk.

No one can say with certainty what would or would not have happened in the absence of the antitrust decrees, or what would have happened if the antitrust proceedings had occurred at an earlier date.[32] It is the writers' conclusion, based on the foregoing, that until about 1950 Eastman did not have a color motion picture film that warranted marketing in the light of the limited prospective market. After about 1950, Eastman did have such a film with a large potential business volume. Moreover, by about 1950 the possibility of a successful competitive film could not be ignored. For these reasons it is concluded that the technical development in the industry—not the antitrust action—brought about Eastmancolor and the present radically changed industry conditions.

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[30] *Eastman Annual Reports.*

[31] *Technicolor Annual Report.*

[32] It has been reported that "opinion in the industry differs as to whether the decrees contributed to the development and use of competitive color processes or not." Whitney, *Antitrust Policies,* (1958) p. 187.

Conclusions on Effects of the Compulsory Licensing Decrees

The compulsory licensing provisions of the Eastman and Technicolor decrees here studied have had little, if any, practical effects on the 35mm. color motion picture industry. The provisions as to Eastman did, however, accelerate 16mm. Kodachrome processing by independent laboratories.

With respect to Technicolor, the compulsory licensing provisions related to a large number of patents touching on many subjects. For practical present purposes, however, they may be considered in relation to (1) the three-strip camera and (2) the imbibition process. In the case of the three-strip camera, Eastman color negative has displaced the Technicolor technique and has made the question of patent rights academic. Finally, in the case of the imbibition process, DeLuxe did take a license in 1953 but then decided to use Eastmancolor instead.[83] The fact that DeLuxe pursued the matter to the negotiation of a license indicate that it was not clear even as late as 1953 that monopack release printing was most attractive for new installations. The subsequent decision, however, indicates clearly that obstacles to entry other than patent rights (especially the cost of setting up facilities) are responsible for the continued status of Technicolor as the sole source of imbibition processed release prints.

As above discussed, the patent rights of Eastman covered by the 1948 decree relate to several different types of film and processing. Some relate to lenticulated film, perhaps because the government had some thought that this technique would ultimately have some practical application in professional 35mm. motion pictures. The continuing research by Eastman on lenticulated film supported such a prediction.[84] In any event lenticulated film is not now and is not likely in the future to be used for 35mm. professional motion pictures.[85] Others of the patents relate to monopack film, especially of the Kodachrome variety. So far as is known, there has been no occasion for any competitor to seek license under these patents for purposes of making film. Ansco is the only present domestic competitive producer of monopack film and—with a single exception—its film is based generally on the independent German large-molecule coupler development dating back to 1935.[86]

The most curious aspect of the whole matter is that the two principal Eastman patents to the colored couplers, Hanson 2,449,966 and Vittum 2,428,054, are not covered by the Eastman decree in any respect. While this appears to be the result of a fluke, it illustrates the problem inherent in an effort to spell out

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[83] See *PTC J. Res. & Ed.*, 4, No. 1 (Spring 1960) pp. 17-18.

[84] On the status of lenticulated film at the time of the Eastman decree see Technical Appendix, Part 5a.

[85] Lenticulated film is used for color television for technical reasons that do not apply to 35mm. motion picture uses. See, e.g., *Holm et al.*, "Elements of Color in Professional Motion Pictures," *Jl. SMPTE* (1957), pp. 91-94. It is not considered that even here access to the patents listed in the Eastman decree is at all important.

[86] See Technical Appendix, Part 5b. The exception is Ansco Moviechrome 8mm. amateur motion picture film, introduced in 1959 and based on the Kodachrome principle of introducing the color couplers during development.

a highly technical matter in an antitrust decree. The omission has not substantially altered the situation since Eastman has offered licenses to the trade on both of these patents and at the present writing no competing film manufacturer is making a film with colored couplers.

The compulsory licensing provisions of the Eastman decree have, however, had significant effects on 16mm. Kodachrome processing. Under paragraph VIII of the decree, Eastman was required to provide licensees with manuals describing its own processing information. And under paragraph X-F of the decree Eastman was forbidden from selling professional color motion picture film on condition that the purchaser have it processed "by any one or more specified persons." Together, these decree provisions opened to the independent laboratories the prospect of engaging in 16mm. Kodachrome processing. This possibility was not clearly present at an earlier date because of the Eastman practice of selling the film with processing included and the lack of detailed information as to the most practical ways to carry out Kodachrome processing. The writers do not consider that patent rights really were a barrier to Kodachrome processing in 1948,[37] but the combined effects of the Eastman sales policy and the lack of detailed processing information unquestionably retarded independent processors who might otherwise have entered the field.

Following the decree, a number of processors became interested in 16mm. Kodachrome processing. By late 1949, Eastman reported that:[38]

> Since the entry of the consent decree, Kodak has granted a number of license agreements under which the licensee was given full rights under its patents to process monopack type film, and it has also given upon request to such licensees, a manual covering the methods by which Kodak processes the various kinds of such type of film. Kodak believes that a number of these licensees are working on the problem of processing, but to date it has no knowledge or information indicating that any of them have begun commercial processing on any large scale basis of such film. Prior to the entry of the consent judgment, no such licenses were granted by Kodak.

So far as is known, no concern obtained license from Eastman with any intent to process 35mm. Kodachrome film for the professional industry.

The effects of the 1948 Eastman decree on 16mm. Kodachrome processing are closely related to the influence of the 1954 "Kodachrome" decree.[39] Under the latter decree, Eastman was required to grant similar licenses for the processing of Kodachrome film generally, and not just "professional" motion picture film. The 1954 decree also specifically enjoined Eastman from selling Kodachrome film with processing charges included. Prior to the decree here studied, Technicolor was the principal processor of Kodachrome film other than Eastman. The Technicolor processing was strictly limited as to purpose, namely for 16mm. reductions of 35mm. imbibition prints and to 16mm. Kodachrome rush prints.[40] At the present writing a substantial number of independent laboratories offer

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[37] See Technical Appendix, Part 5b.

[38] *Second Supp. to Agreed Statement of Facts*, K-220.

[39] *Final Decree*, U.S. v. Eastman Kodak Co., C.A. No. 6450, W.D.N.Y., (1954).

[40] *Complaint*, Exhibit C, article 3 (16mm. reductions of 35mm. imbibition prints); *Complaint*, Exhibit D, article 1 (16mm. Kodachrome rush prints).

16mm. Kodachrome motion picture film processing, and a number of other laboratories, including Technicolor, offer amateur Kodachrome processing.

The initial Eastman decision to process Kodachrome in 1935 was doubtless essential in the light of the facilities then available, the unusual and intricate processing required for Kodachrome film, and the importance of successfully introducing the new film.[41] Indeed, many industry personnel believe that even today Kodachrome processing is too intricate for conduct other than by a very few of the best equipped processors and by Eastman. The Eastman policy of selling the film with processing charge included facilitated handling of a film sold through dealers and processed by the manufacturer. However reluctant Eastman may have been to engage in processing in the first instance—and however necessary the initial decision may have been—conditions were different by 1948. In the case of sheet and medium and large sizes of roll still film, Eastman was happy to be rid of the processing responsibility and did so by discontinuing Kodachrome in favor of Ektachrome. In the case of small size roll film and amateur motion picture film, Eastman continued to sell the Kodachrome film with processing included until 1955, a policy hardly calculated to encourage the independent laboratories. Whether Eastman would have gone in one direction or the other in the case of 16mm. Kodachrome motion picture film is open to question. The limitations in the Technicolor Kodachrome processing licenses suggest that Eastman then preferred to engage in the Kodachrome processing business. The Eastman decree here under study must accordingly be credited with encouraging 16mm. Kodachrome processing by the independents.

The changes in Kodachrome processing have been singled out as a dramatic example of what can be accomplished by antitrust compulsory licensing decree provisions. It has been reported that 56 companies have been licensed by Eastman to process Kodachrome and that the present share of the total domestic processing market held by Eastman is estimated at about 60%.[42] It is felt that this result is a great deal more attributable to the prohibitions against tying processing to the sale of film than to the compulsory patent license provisions. The decree as to Eastman here studied is entitled to credit as the first step in these very significant changes in the Kodachrome processing business.

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[41] See *Second Supp. to Agreed Statement of Facts,* K-240.

[42] Bicks, "The Relation Between Antitrust Patent Relief and the Patent Laws," 41 *JPOS* 791 (1959), pp. 795-6.

Dynacolor Corporation of Brockport, New York, is the largest of the independent Kodachrome processors. Its 1958 sales volume was in excess of $6 millions, essentially all in Kodachrome processing. The company has stated that it is processing about 20 to 25% of all Kodachrome processed, that Eastman is processing about 60%, and the remaining 15 to 20% is distributed among about seven other companies. *Prospectus, Dynacolor Corporation,* filed with Securities and Exchange Commission on April 23, 1959. Technicolor has reported about $10 millions and $12 millions "computed at retail prices" for its 1958 and 1959 sales, respectively, of consumer processing and printing services. *1959 Technicolor Annual Report,* p. 8. These figures suggest that Technicolor Kodachrome processing volume is comparable to that of Dynacolor.

There can be no doubt that the Technicolor market position has changed drastically since the antitrust proceedings. Nor can there be any doubt that the change has been in the direction the authors of the antitrust complaint and the complaining motion picture producers desired. However, for the reasons expressed above, it is felt that the change has been due to the introduction of the Eastmancolor materials and that the antitrust proceedings cannot be credited with this event. In short, as events have worked out, the objectives of the antitrust action have been obtained, but not by reason of the antitrust action.

The compulsory licensing decree provisions have had a substantial effect in starting the train of events leading to Kodachrome processing by others than Eastman. This result is unrelated to the relief initially sought in the antitrust action, does not appear to have been contemplated at the time the complaint was filed, and came about as an unanticipated consequence of the proceedings. In other respects, the compulsory licensing decree provisions do not appear to have had any significant effects.

Conclusions on Competition and Technical Development in 35mm. Color Motion Pictures

The present study has traced the business and technical history of professional motion picture technique and the effects of the antitrust decrees. In so doing it provides some basis to assess broader questions of public policy. Have actual technical developments in the industry increased or decreased market competition? Has competition developed when technology has been available for the asking? What light does the experience of the industry throw on the role of the patent system? What can antitrust law enforcement accomplish? In the following pages the experience of the respective companies involved in the 35mm. color motion picture business is summarized and some conclusions are offered as to the applicable public policy.

Research and development is of key importance in photographic industry and particularly in professional color photography. Without such development the industry would not exist. It has been changed many times over by successive developments. The magnitude of current research is brought out by the investment of Eastman of more than $3 million in color research alone in 1948.[43] Eastman also expended over $15 millions in color research over the 1921-1948 period. By 1935 Technicolor had an accumulated loss of over $2 millions, which can be regarded as a minimum measure of the investment of Technicolor in research.[44] At the present time there are a number of practical methods of taking color motion pictures and making release prints. Twenty-five years ago there were none. It was not until at least 1950 that a monopack process capable of matching the three-strip camera and imbibition technique was available. Today at least Eastmancolor provides such an alternative in highly perfected form. Continued

[43] *Second Supplement to Agreed Statement of Facts,* Schedule 1. This figure is a minimum figure.

[44] *Ibid,* para. 89.

emphasis on research and development is obviously important in terms of the results to be obtained. As the following discussion brings out, it is of equal importance in bringing about market competition and is definitely related to such competition.

It is equally clear that the film manufacturing portion of photographic industry is highly concentrated. The Federal Trade Commission reports an "index of concentration" of 10.5 for the "photographic sensitized film" industry in 1950.[45] The reported sales upon which the figure was based were $196 millions. Calculations based on these figures indicate that Eastman alone sold about $156 millions in film in that year, or about 80% of the total. The remaining $40 million of sales was divided among Ansco, du Pont and McGraw-Hill Publishing Company. Although no published figures are available, it is likely that at least 90% of all 35mm. monopack professional color camera film used today is Eastman color negative and that essentially all 35mm. monopack release printing is Eastman color print film.

Considerable concentration must be expected in the motion picture film supply industry, especially in camera film. The producers tend to accept an established product as "best" and to resist experimentation with new films. Film failures may require the prohibitive expense in retaking scenes, as reportedly occurred with the "Man on the Eiffel Tower." There is every indication that the industry will continue to be very difficult to enter.

Eastman has a clear record of both business and technical leadership. For the period here reviewed Eastman has maintained a commanding position in substantially all phases of photographic industry. Its research expenditures have been at a consistent relatively high level, its research efforts have been well-managed, and its accomplishments in research have been of a high order. But effective research is only one basis for the success of Eastman. Additional factors of at least equal importance include a consistently high quality product and a high order of marketing judgment. A measure of the former factor is found in the need for accuracy of the order of 2/100,000ths of an inch in the manufacture of monopack type color film.[46] The difficulty of meeting this exacting standard had much to do with the lack of acceptance of the Ansco product between 1945 and 1950. While Eastman has had some unhappy marketing experiences, it is doubtful that any manufacturer in the industry can point to a more consistent record of product success.

The extent of Eastman research effort is brought out by the financial data. Between 1921 and 1948 the company invested over $15 millions in research specifically directed to color processes.[47] Of this sum, over $4 millions was directly related to Kodachrome. Of more immediate significance to the present study, a slightly greater sum was specifically directed to the Kodacolor, Ektacolor, Ektachrome developments between 1940 and 1948. This research laid the basis for the Eastmancolor professional motion picture materials. In 1948 alone, East-

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[45] *Report of Federal Trade Commission on Industrial Concentration,* January 1957, p. 252.
[46] Neblette, *Photography, Its Materials and Processes* (1951), p. 457.
[47] All figures from *Second Supplement to Agreed Statement of Facts,* Schedule 1.

man expended at least $683,000 in Kodachrome research, $845,000 in Kodacolor, Ektacolor, Ektachrome research and over $1.1 millions in general color research activity. In addition, the company expended large sums in photographic research not specifically related to color. Eastman has reported total anticipated research and development expenditures of $55 millions for 1960.[47a]

Eastman research seems clearly intended to maintain the Eastman competitive position and to take advantage of new product opportunities. The company does, of course, obtain patents. In 1955 it owned some 3,800 patents—placing it among the top ten companies in terms of numbers of patents.[48] All of the currently important Eastman patents discussed herein are offered for license to the industry. Antitrust considerations doubtless bear on this policy. But the fact remains that the offers have had no discernible effect on the status of Eastman as the technical leader in the industry or on the continued investment of Eastman in research. The patent interferences involving Eastman in recent years have been settled by licenses.[49] There is no known record of patent litigation involving Eastman in the field of color film. At the present writing it seems clear that the Eastman market position and research are not significantly based on the exclusionary use of patent rights.[50]

[47a] *Wall Street Journal*, April 27, 1960, p. 6. This figure includes non-photographic research and development.

[48] Federico, *Distribution of Patents Issued to Corporations*, Study No. 3, Subcommittee on Patents, U.S. Senate, 84th Cong., 2d Sess., 1957.

[49] E.g., Interference 79,368 between the Gaspar application leading to patent 2,340,656 and Carroll patent 2,218,229 assigned to Eastman; interference 82,933 between the application that became Hanson patent 2,449,966, assigned to Eastman, and Heimback and Morreall application S.N. 593,144, assigned to Ansco.

[50] In a publication entitled *The Kodak Patent Story—How One Thing Leads to Another* Eastman states:

> "Today Kodak organizes and gives substance to the creative efforts of hundreds of scientists in its Research Laboratories and of other technicians and engineers in its plants. Without the incentives provided by the patent system, much of this creative effort might not be possible or would be expended fruitlessly for lack of necessary help and facilities." (p. 5)
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> ". . . .photographic research has not languished. Black-and-white films have acquired higher speed and better quality. Color films have become commonplace as typified by Kodachrome, Ektachrome and Kodacolor films. The knowledge gained from patents has enabled others, too, to produce both black-and-white and other films. Kodak has voluntarily listed with the Patent Office on a regular basis literally hundreds of its patents in which licenses are available in the photographic field as well as others." (p. 7)

A more general survey reports as to the role of patent rights that:

> "The survey results showed clearly that competitive exigencies were far more important among established corporations as reason for research and development than considerations of potential patent protection. Once a company has reached the point where it can regard itself as a going concern, the need to remain on an even plane with, or to surpass, competitors is a far more active incentive to do research and development than the lure of possible exclusive rewards. In many cases, then, the cost of research and development and technical change may be regarded more as cost of staying in business than as investments in the highly uncertain future."

Important elements of "know-how" and trade secrets constitute exclusive rights to Eastman. One area of such secret technology is found in emulsion manufacture.[51] The specific problem of coating the 35mm. monopack film with emulsions having the requisite accurate thickness appears to have been overcome by such secret know-how rather than by inventions recorded in issued patents. While the antitrust decrees, including the Eastman decree here studied, have required the disclosure of some Eastman "know-how" relating to film processing,[52] the company does not appear to be limited in retaining its manufacturing "know-how" and trade secrets.

It is rather significant that, since at least the end of 1954, there has been no patent reason why a competitor could not market a film made along the lines of Kodachrome and suitable for processing in the same manner as Kodachrome. It would appear that such film could be sold for processing through various Kodachrome processors. To date no such film has been marketed and sold in substantial quantity.[53] The nearest significant approach is the recently-introduced Ansco Moviechrome 8mm. amateur motion picture film.[54]

The commanding market position enjoyed by Eastman has given it a measure of independence in introducing new film products. The history of monopack professional motion picture film is an excellent example. Eastman has had great success with the Eastmancolor materials, even though it did not introduce a monopack professional film until 1950. Prior to that date there appears to have been no competitor on the verge of occupying the market. At the time, du Pont had monopack film materials under development and had introduced its release print film. Ansco professional monopack materials had been on the market for some time. It is difficult to resist the conclusion that had du Pont or Ansco brought out monopack materials competitive with Technicolor at an earlier date, or had the Ansco materials been of quality comparable with Technicolor and the Eastman-

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Scherer, *et al., Patents and the Corporation—A Report on Industrial Technology Under Changing Public Policy* (1959), p. 149. On this report see Crews, "Is It Necessary to Sacrifice Patent Property in Antitrust Consent Decrees? The Effect Upon the Patent System," 41 *JPOS* 801 (1959).

[51] See Mees, *The Theory of the Photographic Process* (1942). Mr. Donald L. Brown, vice president of Polaroid Corporation has stated:

> ". . . .That field [emulsion techniques] is a closed book. In that field there is no interchange, or very little interchange, of information. It is largely unprotected by patents . . ." *PTC J. Res. & Ed.*, Conference Number (1959), p. 79.

[52] *Final Decree*, U. S. v. Eastman Kodak Co., No. 6450, W.D.N.Y. (1959), especially para. VII. Para. VIII of the Eastman decree here studied.

[53] Between 1949 and 1955 Dynacolor Corporation, now of Brockport, New York, manufactured and processed film similar to Kodachrome. *Prospectus, Dynacolor Corporation,* filed with Securities and Exchange Commission on April 23, 1959, p. 6. In April 1959 that company reported that it hoped to market in 1959 a film of the same type as Kodachrome. *Ibid.*, p. 7. Gevaert of Belgium announced in 1959 that it would export to the American market a motion picture film designed to be processed like Kodachrome. *1959 Popular Photography Color Annual,* p. 134.

[54] Moviechrome film is intended to be processed by Kodachrome processors. Boxes containing the film indicate that Ansco does not process the film.

color materials, Eastman might well have lost the color market position it now enjoys.[55]

Technicolor technical development is in many respects the antithesis of Eastman research. Technicolor concentrated on the narrow objective of a practical professional color motion picture technique. During the periods of its most important developmental activity, the company faced the absolute necessity of achieving this objective. The alternative was complete business failure. The company went through a series of unsuccessful efforts, including the two color additive processes, with monopack films, two color cemented films, and finally two color imbibition processing before it finally succeeded in providing a practical full color process after 1932. In many respects Technicolor traced the unsuccessful efforts of others. Until after 1932, when Technicolor went to a three color process, its results did not differ in character from what Multicolor and others were capable of producing. It is fair to say that the ultimate Technicolor success was due more to perseverance in going to the three color process than to any other single step. And in so doing the company gave the industry practical high quality color motion pictures long before these would otherwise have been possible.

The two great Technicolor developments were the three-strip camera and practical motion picture imbibition processing. Neither involved new principles. Each did, however, require solution of stubborn practical problems and engineering development of a high order. In this respect the company represents an excellent example of immensely important creativity short of "genius." But for the company, these developments would have come much later, if at all. In the writers' opinion, the tendency—resulting in part from the antitrust proceedings—to damn Technicolor and overlook the real debt the industry owes to Technicolor was a definitely unfortunate result of the antitrust action.

Technicolor was risk enterprise in the narrowest sense of the term. On a number of occasions it narrowly escaped extinction. One was when the cemented films failed. In 1923, its first year, Technicolor had a net loss of about $350,000.[56]

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[55] Polaroid provides the outstanding example of a significant market lost by Eastman. The Eastman management apparently failed to appreciate the market potential of a self-developing camera and film and the ability of the diffusion-transfer-reversal technique to provide such camera and film. Exploitation of this item is largely responsible for the Polaroid success.

Another related example is found in the office copying machine and paper business. Apeco placed the first major office copying machine on the market in 1952, using the transfer-diffusion process. Eastman followed with its Verifax machine and paper based on a modification of the transfer-diffusion process. It has been estimated that Apeco enjoys 75% of this market. Whether this is high or not, there is little doubt that through its early entry into this field Apeco has obtained a segment of a market that Eastman, with its existing sales of photostating paper and interest in photographic processes, could have been expected to occupy first. Minnesota Mining and Manufacturing Company has a large share of the office copying machine market through its quite different Thermofax copying machine and process. On the office copying machine development generally, see "Out to Crack Copying Market," *Business Week*, September 19, 1959, p. 86.

[56] These financial data are from paragraph 89 of the *Technicolor Statement of Facts*. They represent the figures taken from the Technicolor books, with deduction for taxes but not for dividends.

Each of the next six succeeding years increased the losses, until in 1928 the accumulated loss was over $1.8 millions. The accumulated losses were reduced somewhat in 1929 and 1930 when the two-color imbibition process enjoyed some success. But each of the succeeding years up to 1935 were loss years, leading to an accumulated loss of over $2 millions by 1935. Not until 1939 did the company books show a net accumulated profit after taxes. This was 16 years after operations commenced, and during nearly all of this time there was no assurance that the company ever would succeed.

Public policy clearly must foster developmental activity like that of Technicolor. This activity can be brought forth in a free enterprise economy only by the hope of unusually attractive profits. Dr. Kalmus and others at Technicolor looked to an exclusive color processing market as the source of such profits. During the course of the developmental activities—especially such work as actually producing features such as "The Covered Wagon" and "The Viking"—Technicolor acquired a valuable fund of knowledge as to what to do and what not to do in color photography. But the prospect of patent rights appears to have been the most readily identified property anticipated from the technical development. Financial and business reports on the company reflect such thinking.[57] The unusually heavy expenditures for patent rights reflect a like emphasis.[58] In this respect it is believed that the patent system was an important factor in bringing about the continuing investment required for the ultimate Technicolor success.

Once Technicolor became firmly established, the importance of patent rights to the three-strip camera and to the imbibition process diminished. By 1949, for example, Dr. Kalmus was said to state that patent rights and know-how were unimportant. His point was that the company would have a superior process and product before a competitor could apply the existing technology.[59] This was perhaps an over-generalization. Yet there is real substance to the point. It is confirmed at least in the fact that the 1953 license to Deluxe was not strictly under the antitrust decree, but rather included provisions for continuing access to Technicolor developments.[60] Certainly the recent changes in the Technicolor imbibition process required to provide increased resolution were impelled almost entirely by the need to preserve the existing imbibition plant investment and market position

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[57] The following is typical of the statements to be found in financial reports on Technicolor:

". . . process is patented in numerous foreign countries as well as, in the United States . . ." *Moody's Industrials,* 1938, p. 1689.

[58] In 1939 Technicolor showed a capitalized patent cost of $19,108 and a total research cost capitalized of $45,483. The cumulative capitalized patent and research costs as of that year were $2,020,016.

[59] *Saturday Evening Post,* Oct. 22, 1949, p. 133:

". . . know-how is more important than patents in the color business. He [Dr. Kalmus] contends that he could give all his secrets to rivals and still not fear them as competitors, because by the time they had the equipment setup and the know-how teams to use it, Technicolor would be offering something else still better."

[60] See *PTC J. Res. & Ed.,* 4, No. 1 (Spring 1960) p. 7.

rather than possible patent rights.[61] In the case of special projects outside the main field of Technicolor interest, Technicolor currently looks to patent rights. The Geer television tube and the TV Bandwidth Reduction System, upon which Technicolor invested perhaps $250,000 to $1 million, are examples of such projects.[62]

Dr. Kalmus is entitled to personal credit for the initiative and perseverance that made the Technicolor business possible. From the start, however, he was compelled to rely upon investments by others. The business success largely rested on his personal ability to bring in the required capital. Actual and potential patent rights were at least a talking point in this connection. As matters turned out, the practical success of the company rested on fundamentally old techniques. For this reason it is doubtful that at any time the Technicolor patents ever could have prevented the independent development of fully equivalent competitive facilities. The impressive royalty income from the Troland reissue patent and the license to Eastman was the consequence of a line of inquiry that proved ineffective in attaining the main Technicolor objective but nevertheless resulted in an unusually valuable patent.[63] But whether the patents to the three-strip camera and imbibition process would or would not have prevented the development of equivalent facilities —and whether the patent rights did or did not bring in substantial royalty income— the important point is that they had the potentiality of doing so. It was because of this potentiality that they were at least a substantial factor in bringing about an essential investment.

The motion picture producers need Technicolor. Until 1950 the company was the only source of practical full color motion picture services. Today it is the principal source of release prints that is not heavily reliant upon Eastmancolor print stock. However much the independent processors may compete with each other, the print stock is a raw material cost which they cannot vary. So long as Technicolor continues imbibition processing, the company will provide an important competition to monopack release printing. And for just this reason it seems clear that the

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[61] For another example of research motivated by the threat of a competitor occupying the market see "Brunswick's Automatic Money-Maker," *Fortune,* November 1959, p. 157.

[62] "The value of patents as a stimulus to technical investment in large and well-established corporations is similar to their value to the independent inventor or to the small and struggling firm. As long as other factors such as distribution channels, relative costs of production, brand preference, and engineering know-how are well established, patents are relegated to an unimportant niche in the decision-making process. But when corporations contemplate moving into areas where they have very little experience or market following, where they must in effect begin all over again just as the small company must begin, then patents become a critical factor. The security of good patent protection makes up for the lack of security regarding those other factors upon which the company's day-to-day business success is based." Scherer *et al., op. cit.,* p. 150.

[63] In the year ending December 31, 1948—the last year of royalty payments under the license to Eastman—Technicolor reported a royalty income of $252,199.14. *1948 Annual Report,* p. 15. This corresponded to an annual rate of about $600,000. As discussed in the Technical Appendix, Part 5b, the issuance of the Troland patent has been severely criticized —and there is much basis for this view. The patent may well be considered a windfall to Technicolor. Nevertheless, it did bring in royalty income of substantial amount in the period prior to 1940, when Technicolor's accumulated profits were most inadequate in relation to investment, risk, and the long period of losses.

continuance of Technicolor as a viable competitive entity is of major importance to the maintenance of market competition in release print making.

It is unfortunate that the Technicolor three-strip camera has been displaced by monopack film. This has made the producers heavily reliant upon Eastman for color camera film. To be sure, Eastman is benevolent and cooperative, and Ansco film provides one alternative. But the 35mm. color camera film business is highly concentrated; Eastman sells essentially all 35mm. professional color camera film; and the displacement of the three-strip camera has made Technicolor unimportant in supplying camera and camera film facilities. The present situation is certainly more healthy than the conditions prior to 1950—and especially prior to 1945. The fact remains, however, that the industry structure in this area is far less satisfying than with respect to release print making.

One further matter of Technicolor history warrants discussion. In the three-strip camera and in the practical imbibition process, Technicolor developed the facilities for the two essential successive steps of color motion picture production. The three-strip camera made possible the color separation prints from which release prints could be made in color either by the Technicolor imbibition process or by some other process such as the Cinecolor three color process. The Technicolor imbibition release printing process at least in theory could be used to print from color separation prints, whether obtained from the three-strip camera or otherwise. In the years immediately prior to Eastmancolor both Cinecolor and Polaroid had three color release printing facilities, but did not have adequate sources of live-action color separation prints comparable to the three-strip camera. To the extent Technicolor could, and did, deny the three-strip camera facilities to them, it theoretically discouraged competition with the imbibition release printing facilities.[64]

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[64] Paragraph 26 of the *Complaint* charged Technicolor with a number of tying practices, including tying its color camera facilities with release printing. This tie was primarily between the three-strip camera and the imbibition release printing process. As charged in the *Complaint,* Technicolor required its customers to use the camera facilities entirely on productions release printed by Technicolor and required the customers to use Technicolor release printing entirely on productions printed in any part by Technicolor.

The position of Technicolor on the tying charges is brought out by the *Revised Technicolor Statement of Facts,* filed on June 3, 1949 which stated:

> "106. The Technicolor three-strip camera was the only camera for taking live action three-color motion pictures prior to the introduction of monopack in 1941, on an experimental basis. Even if other three-strip cameras had been available, producers would not have used them because they wanted to hold Technicolor responsible for anything that happened in the photographing of the picture.
>
> "108. One reason why producers wanted the services of Technicolor color consultants was to hold Technicolor responsible for the final color results. Even though the producer's own art departments have become more experienced in the use and values of color, the producers still want the benefits of the knowledge and experience of Technicolor color consultants.
>
> "109. Even if the producers had been able to obtain film from a source other than Technicolor they would not have done so because they could not then have held Technicolor responsible for the quality of the final print.
>
> "110 . . . Producers would not have signed a contract to have Technicolor photograph

The antitrust and patent law decisions embody a considerable body of law relating to the tying of separable processes or products.[65] The Technicolor situation as it actually existed, however, raises questions of what really can be accomplished by forbidding the actual tying of the three-strip camera to imbibition printing. The problem was not one of patent licenses. Rather, it was one of getting the cameras made. No concern other than Technicolor appears to have had either the desire or the ability to undertake the construction of a three-strip camera for use by the industry. This was especially true after about 1945. Monopack film then seemed just around the corner and any such cameras seemed to be heading for obsolescence. The cost of the cameras to Technicolor has been reported at $30,000 each.[66] Technicolor needed all the cameras it had to provide color separations for the release prints it made. Any effective requirement that Technicolor furnish the scarce cameras for use in making color separation negatives for release print processing by Cinecolor, Polacolor, or other competitors requires that some price be established. At the very least, such a requirement imposes a formidable price-setting problem.[67]

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a picture if Technicolor had not guaranteed to make the prints that the producer required."

Cf., Electric Pipe Line Inc. v. Fluid Systems, Inc., 231 F.2d 370 (2d Cir. 1956).

[65] See, e.g., Northern Pacific RR. v. U.S. 356 U.S. 1 (1958); Times-Picayune Pub. Co. v. U.S. 345 U.S 594 (1953); International Salt Co. v. U.S., 332 U.S. 392 (1947).

Analytically it can be contended that Technicolor was furnishing a single service directed to a single end product, the release prints. So viewed, there was no tying, or at least Technicolor could arrange its contracts in a manner not involving tying. Similar thinking prevailed in the *Times-Picayune* case, *supra*. And see Turner, "The Validity of Tying Arrangements Under the Antitrust Laws," 72 *Harv. L. Rev.* 50, 67-72 (1958).

[66] *Saturday Evening Post,* Oct. 22, 1949, p. 26.

[67] What weight should be given to the fact that others apparently would not construct such cameras, quite apart from patent rights? How should the price reflect the undesirability of indolent attitudes by possible competitors? What weight should be given to the prospect of a successful monopack film? The situation is similar to that in U.S. v. United Shoe Machinery Corp., 110 Fed. Supp. 295. Judge Wyzanski found that United had fixed the prices of its machines in a manner that discriminated between various types of machines, and in a manner to minimize competition. See 110 Fed. Supp. 325-329. He nevertheless refused to deal with this problem in the decree because of the administrative problem. In his language:

> ". . . And while price discrimination has been an evidence of United's monopoly power, a buttress to it, and a cause of its perpetuation, its eradication cannot be accomplished without turning United into a public utility, and the Court into a public utility commission, or requiring United to observe a general injunction of non-discrimination between different products—an injunction which would be contrary to sound theory, which would require the use of practices not followed in any business known to the Court, and which could not be enforced." (110 Fed. Supp. 349)

See also Kaysen, United States v. United Shoe Machinery Corp. (1955), pp. 114-146, 280.

The matter of three-strip cameras is covered by paragraphs IX and X of the *Technicolor Decree.* Paragraph IX enjoined Technicolor from "conditioning the availability of any Technicolor . . . facilities upon . . . the procurement or use of . . . any release prints, from Technicolor." Paragraph X-B requires Technicolor to hold two three-strip cameras available for rental "at a reasonable cash rental." The decree leaves Technicolor entirely free to set as high a price as it chooses for the camera rental and as low a price as it chooses for its release print services. In theory, at least, Technicolor could therefore achieve the same effect as

It is very doubtful that the Technicolor three-strip camera policies were as significant as the government apparently assumed. Three companies actually did offer three-color professional release printing techniques without having a camera technique equivalent to the three-strip camera. These were Polaroid (Polacolor), Cinecolor, and du Pont. Each is discussed in more detail hereafter. At this point it is sufficient to note that Ansco camera film was available to each, as was the successive exposure method of making color separations for cartoons. The latter technique was especially suitable for experimentation. In the case of each of these three companies, factors unrelated to the three-strip camera led to discontinuance of activity. In no instance does the availability of the three-strip camera appear to have been a decisive factor.

As matters turned out, Eastman color made the whole three-strip camera question academic. The two three-strip cameras set aside pursuant to the decree have not been leased and at the time of the decree Cinecolor indicated that its interest lay in Ansco and Eastman camera films.[68]

Ansco is of particular importance in assessing competitive endeavor in the field of photography and especially 35mm. color motion picture photography. We have seen how Ansco preceded Eastman by five years in offering a 35mm. monopack motion picture film for professional use. Ansco is the only present domestic manufacturer of monopack still and motion picture film other than Eastman.

Ansco is a division of General Aniline and Film Corporation. Since 1942, stock representing 98% of the voting control of General Aniline has been vested in the Alien Property Custodian. This stock is currently involved in litigation that has prevented sale and restoration of the company to private ownership.[69]

The Ansco current business volume is of the order of $50 millions per year, less than a tenth of the corresponding Eastman volume.[70] In the past it has been especially weak in the black and white 35mm. motion picture film field.[71] This doubtless dictated the efforts of the company to perfect and sell a practical monopack 35mm. motion picture film. Ansco has preceded Eastman in other fields, such as for example "Superanscochrome" which was introduced in 1957.[72]

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tying the camera and release print making by charging a sufficiently high price for the camera services and a sufficiently low price for release prints and, with respect to all cameras other than the two to be set aside, the decree at least implies that Technicolor may deal to a considerable extent on a package basis as to the camera and printing services.

[68] See *PTC J. Res. & Ed.*, 4, No. 1 (Spring 1960) p. 12.

[69] For a recent report on the complex situation that now prevails as to ownership of the General Aniline and Film stock, see *Wall Street Journal*, December 22, 1959.

[70] According to a withdrawn prospectus, 37.1% of General Aniline sales in 1956 were attributable to the Ansco division. This represented a sales volume of $49.5 millions. See *Wall Street Journal*, Nov. 13, 1958, p. 2.

[71] In the 1946-1948 period, for example, Ansco sold less than one percent of the 35mm. motion picture film. *Agreed Statement of Facts*, Schedule A. Du Pont in that period sold 15-20% of the film.

[72] *1957 General Aniline Annual Report*, p. 5. Superanscochrome has a speed rating of 100, obtained at the expense of increased grain size. Early in 1959 Eastman introduced a new Ektachrome film (E-3) having a daylight speed rating of 80 (as compared with 32 for the earlier product), and a high speed Ektachrome with a daylight rating of 160. On the tech-

Research and development expenditures by Ansco are at a much lower level than Eastman. Between 1952 and 1957 General Aniline expended about $5 millions per year on research. In proportion to sales volume, this would indicate an annual expenditure of $1.5 to $2 millions per year by the Ansco division for all photographic research.

The colored coupler development illustrates the importance of research and development by Ansco. The principal Eastman patent application to this development was the Hanson application, filed on May 3, 1944.[73] Ansco filed an application on May 11, 1945 which was placed in interference with the Eastman application.[74] While the interference was settled, the Ansco application certainly brought home to Eastman the fact that it was not entirely alone in pursuing this very important development. Of course some time was required before the development received practical application. But Ansco's appearance on the scene certainly gave notice to Eastman that it could not indefinitely delay either its research or its marketing and placed a corresponding limit on Eastman's freedom of action.

As the sole domestic competitor to Eastman in monopack camera film, Ansco presently occupies a key role. It occupies a similar key role as the only domestic full-line film and camera product competitor to Eastman. As the colored coupler history indicates, Ansco plays a role far more important than comparative sales volumes and research expenditures would suggest. Aggressive competitive endeavor by Ansco is one of the most important competitive goads to Eastman. Less effective competition by Ansco would leave Eastman considerably more free from domestic competitive stimulus in important segments of the Eastman business.

Ansco activity in the professional motion picture field at the present writing is very limited. Ansco negative and positive monopack duplicating films are no longer offered. Ansco color negative film is now used primarily for film strip and slide work, although reports have been received of its limited use in professional motion picture production where Eastman color negative was considered to give inferior color quality.

Continued Alien Property Custodian ownership of nearly all of the General Aniline stock definitely impedes Ansco.[75] An appropriate disposition of this stock to private owners would increase the prospects of a more aggressive competi-

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nical significance of Superanscochrome see Miller, "First Color Portraits of the Heavens," *National Geographic,* May 1959, pp. 670-9. On the new Ektachrome, see Schwallerg, "Fastest Color Film Yet," *Popular Photography,* July 1959, p. 72.

[73] The Hanson application became patent 2,449,966.

[74] Heimback and Morreall, application S.N. 693,144, Interference 82,933. The application was abandoned.

[75] A dramatic example of how the unsettled stock ownership of General Aniline affects Ansco competition is found in the court order of late 1959 enjoining the purchase of a paper company. *Wall Street Journal,* December 17, 1959, p. 6. It is reported that Ansco purchased its paper from Eastman and that Eastman advised Ansco that the available productive capacity was required for the Eastman product. The court ruling was obtained by Interhandel —claimant to stock seized by the Alien Property Custodian—on the ground that purchase of the paper company in a stock exchange transaction would impair rights in the stock in dispute.

tive activity by Ansco and the introduction of a line of improved color professional motion picture films competitive with the Eastman products.[76]

Polaroid Corporation is of importance to the present study for several reasons. First, it enjoys the second largest sales volume in the photographic industry today. Second, it undertook one of the most important efforts to develop a release printing process competitive with Technicolor—namely, the Polacolor process.

Polaroid was formed in 1937 and from that time until about 1947 was engaged almost exclusively in the manufacture and sale of light polarizing products.[77] These products led directly to a form of three-dimensional motion picture exhibition utilizing polarizing glasses to separate the stereo images. It has been reported that the three-dimensional motion picture boom led to the sale of almost 100 million viewing glasses by Polaroid at a price of some $6 million.[78]

The Polacolor release printing process began production in 1947. At that time Polaroid looked upon the project as one of several to take up the work capacity of its existing staff and facilities, previously used in war work. In that year the company had an operating loss of some $2 million.[79] By the end of 1947, a cartoon printed by the Polacolor process was released.[80] Other cartoons followed. The Polacolor process was similar in some respects to the Technicolor imbibition process and in some respects to the coupling development used with monopack films. Polaroid had a processing capacity of about 4 million feet of film per year and actually processed over 2.5 million feet in 1948.[81] The process was discontinued by about 1950.

Polaroid dropped the Polacolor development because it was considered less promising than the Land camera, introduced in 1947. At the time the decision was made, the Polacolor process had been developed with a limited investment in processing facilities. Further commercialization of the process would have entailed a very substantial investment and, of equal importance, required the continued efforts of technical personnel. It was thought that the company would do better by concentrating its finances and personnel on the Land camera, which was done. Subsequent events have vindicated this judgment. The personnel previously working on the Polacolor process were largely transferred to the Land camera activities.

The decision to drop the Polacolor process and concentrate on the Land camera was necessarily dependent upon many factors. The major consideration was

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[76] It has been reported that Ansco might eventually be sold to Paramount Pictures, Inc. See e.g., *Wall Street Journal,* November 13, 1958, p. 2. Such sale would seem likely to increase the Ansco activity in the professional motion picture field.

[77] For a discussion of Polaroid, see Bello, "The Magic That Made Polaroid," *Fortune,* April 1959, page 124.

[78] *Ibid.,* p. 157. For litigation on the Polaroid light polarizers see Marks v. Polaroid, 237 F. 2d 428 (1st Cir. 1956).

[79] *Id.,* 1947 sales volume was $1.5 millions, as compared with the 1945 figure of $17 millions.

[80] See *Business Week,* December 27, 1947. The process is described in Ryan patent 2,471,547. See Technical Appendix, Part 7.

[81] *First Supp. to Agreed Statement of Facts,* Schedule E.

the prospective profitability of this enterprise in relation to the alternatives, such as the Land camera development. The Polacolor process faced the competition of Technicolor with a product of established high quality. It also faced the prospect that an Eastman or du Pont monopack release print film of high quality would emerge from "just around the corner." In contrast, the Land camera offered the opportunity of entering a unique and previously unoccupied field. It seems clear that the Technicolor three-strip camera—even if available to Polacolor—would not have brought about any different decision than the one that was made.

Polaroid Corporation is particularly notable for its successful exploitation of the diffusion-transfer-reversal process in the so-called Land camera.[82] Like many basic photographic processes, this process can be traced to a comparatively early date. Yet it was given little practical application until the Land camera. The camera and film were introduced by Polaroid in 1948 after a brilliant development by Land and his associates. The advantage of the Land camera and film lay in the availability of photographic prints very shortly after camera exposure. In appreciating the marketing potential of this type camera and in developing the camera and process, Polaroid created a segment of the photographic industry not previously exploited by the established concerns in the field. Polaroid sales volume was about $1.5 million in 1947 and the company sustained a net loss of almost $1 million. In 1958 sales were $65 million and the net profit before taxes was about $16 million. Land camera and film sales account for essentially all of the increase and have been estimated at $35 to $45 million for the cameras and $20 to $25 million for the film.[83] At the present writing Polaroid sales volume exceeds that of Ansco, and camera sales exceed those of any other manufacturer.[84]

Polaroid is the result of the work of Edwin H. Land. His work commenced with polarizing light filters, which were manufactured when the company was formed in 1937. Land obtained about $375,000 in capital at this time, largely upon the basis of his patent rights.[85] Throughout, the company has placed heavy emphasis upon research and the resulting patent rights. In 1955 the company advised the Congress:[86]

> The company obviously places great reliance upon its patents. Its business is very largely dependent upon its patent structure, and it has from the outset followed a vigorous patent policy of obtaining protection on all its commercial products and, in addition, on such developments of its research group as may possess potential competitive value.
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> We think there is no question but that Dr. Land's success in commercializing and developing his inventions in light-polarizing materials was to a large extent due to the patents obtained on those inventions. We know that during the early stages of the de-

[82] The diffusion-transfer-reversal process is described in Neblette, *Photography, Its Materials and Processes* (1952), p. 234. For the business history of Polaroid, see Bello, "The Magic That Made Polaroid," p. 124.

[83] *Ibid.*, p. 126.

[84] *Ibid.*, p. 125-6.

[85] *Ibid.*, p. 154.

[86] Hearings before Senate Subcommittee on Patents pursuant to S.Res. 92 Oct. 10-12, 1955, p. 265.

velopment some of the country's largest corporations carefully investigated Dr. Land's patents. No financially responsible established manufacturer infringed on any of his patents.

We also know that the strength of the patent picture was largely instrumental in securing adequate capital to finance Polaroid Corp. under conditions which permitted Dr. Land to retain control of the new corporation, and we have no question but that the strength of the company's patent picture in the photographic field has over the past several years permitted the company to develop that field and safely to spend large sums on research and engineering in this and other fields.

On the role of the patent system more generally, Dr. Land has stated: [87]

> It should be the role of our patent system to bring encouragement, a sense of reward, and a stimulus to prompt publication to men in applied science. There are a thousand new fields ready to be opened. Only a handful of these will be explored by large corporations, leaving many areas untouched. Without the protection of the patent system, young scientific entrepreneurs cannot be counted on to develop the rest.

For many years du Pont has been an important producer of 35mm. professional black and white motion picture film. Its peak proportion of the sales volume in the years prior to 1949 was about 25%, reached in 1943.[88] Through this black and white film production, du Pont had a continuing association with the professional industry and a knowledge of the industry problems and requirements. The company has also displayed an interest in research and development leading to new products. For these reasons, du Pont was a likely company to enter the professional monopack color film market.

In 1949 du Pont introduced a 35mm. monopack professional color release print film. The product was distinctive in that the usual gelatin layers were replaced by synthetic polymers which served both to carry the silver halides and to form the colored images upon development.[89] The product was designed for sequential printing of the three-color images, as distinguished from direct full-color single exposure monopack printing of three colors in unison. The product was withdrawn from the market by about the beginning of 1954. Prior to that time some 25 million feet were used, and some 15 feature pictures were printed with the film.

The duPont release print film was withdrawn because it was rendered obsolescent by single exposure monopack printing from Eastman color negative onto Eastman color print film. The Eastman products did not require the successive registered exposures demanded by the du Pont film. While, in theory, it might be possible to print from the Eastman products on the du Pont film, the procedure was not practical.

The availability of the Technicolor three-strip camera, or its lack of availability, had nothing to do with the fate of the du Pont release print film. Du Pont intended to produce a stripping film for use as a camera film and source of color separations.[90] The product as finally envisioned was in the form of a monopack camera film in which two separate stripping operations would physically separate

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[87] Land, "Thinking Ahead: Patents and New Enterprises," 37 *Harv. Bus. Rev.* (1959), pp. 7, 10.

[88] *First Supp. Agreed Statement of Facts,* Schedule A.

[89] See, Jennings *et al.*, "Synthetic Color-Forming Binders," 55 *Jl. SMPTE* (1950) 455.

[90] Technical Appendix, Part 5c.

the three emulsion layers to give the color separations. As it turned out, the Eastmancolor materials made the entire du Pont program unattractive.

Du Pont possesses research, production, and marketing capabilities of a high order. It was also abreast of the professional motion picture industry during the entire time of the Troland license agreement criticized by the government. It was ready to exploit any competitive opportunity in relation to Technicolor and Eastman, as its 1949 activity showed.[91] It is not believed that du Pont was, or should have been, deterred in any respect by the Troland patent. The release print film actually marketed by du Pont was of the incorporated coupler type and—like the Ansco films—is not considered to pose any questions of Troland patent infringement. The du Pont failure to act prior to 1949 stands as a substantial independent indication that the government charges that Technicolor held Eastman back were dubious.

As matters have turned out, the du Pont Photo Products Division concluded that monopack color film did not offer a promising field after introduction of the Eastmancolor materials. The facilities of the department have accordingly been directed to other products, such as the plastic printing plate recently announced.[92] There appears to be no doubt that if an opportunity arises to develop and exploit some new and attractive form of monopack or other film, du Pont will not hesitate to do so.[93] This risk is believed to be a strong stimulus to maximum effort on the part of Eastman.

Cinecolor discontinued active color processing operations by 1954. A number of factors were responsible for the discontinuance. One was management difficulties in the immediately preceding years. Another was the Eastmancolor competition. While Eastmancolor camera film gave Cinecolor a source of 35mm. color separations comparable with those available from the Technicolor three-strip camera, the Eastmancolor release print film provided new competition in the three-color release printing business. It is very doubtful that the Cinecolor process would have survived, even apart from the management problem.

Prior to 1950 Cinecolor was perhaps the most important competition to Technicolor. Developmental activity by Cinecolor, however, was largely on an engineering-improvement basis as distinguished from substantial investment in long-term research. Improvements were made from time to time, especially in the Cinecolor three-color process, and the company did enjoy a period of real

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[91] Indeed, the fact that du Pont marketed a product in 1949 that was so quickly superseded by the Eastmancolor materials is a vivid indication that the companies were entirely competitive in their research and marketing.

[92] See "Case History of a New Product," *Business Week*, February 20, 1960, p. 105.

[93] In its *Revised Statement of Facts of* June 3, 1949, Technicolor stated that:

> "117. Du Pont's research work on monopack was not influenced at all by any relationship between Technicolor and Kodak. Its policy was to study the market, analyze the need, and formulate its own research program irrespective of such relationship."

The du Pont release print film introduced in 1949—based on a distinctive technical development—is consistent with the above statement, as are the product developments by du Pont outside the photographic field.

success.[94] It is probable that the infusion of substantial capital into Cinecolor and a long-term product development effort would have led to an effective three-color camera and an effective three-color release print-making process competitive with Technicolor. There never was such capital, and Cinecolor was accordingly confined to camera techniques inferior to Technicolor, and when the Eastmancolor camera film became available, the accompanying Eastmancolor release print process made Cinecolor release printing obsolescent.

A number of foreign manufacturers produce monopack color film. These include Agfa of Germany, Gevaert of Belgium, and Ferrani of Italy. At the present writing the tariff on raw 35mm. film is 0.1 cents per foot, about 10% of the average value of the film imported. Imports of 35mm. motion picture film in 1958 totalled some 238 million feet, of which over 200 million feet were manufactured by Gevaert. It is not known how much of this total was in monopack color film, but the $2 million stated value of the Gevaert film, an average of about one cent per foot, indicates that this film was principally black and white film. The problem of setting up domestic processing facilities impedes the sale of foreign monopack film.[94a]

The value of imported 35mm. motion picture film is very small in relation to the dollar volume of some $80 millions in Eastman sales.

A substantial proportion of Kodachrome processing has shifted to the independent processors in the years since the antitrust decrees. Technicolor itself is one such processor. Another processor enjoying a larger Kodachrome processing volume is Dynacolor Corporation. From 1949 to 1955 Dynacolor offered a film similar to Kodachrome. After that date its activity was confined largely to the Kodachrome processing business. In 1959 this company reported that:[95]

> The Sensitized Products Division is currently developing three new products which the Company hopes to market in 1959. Dynacolor Universal Contrast Paper, used for printing black and white prints, and Dynachrome film, a film of the same type as Kodachrome film, have been made available in quantity to the photofinishing trade for market testing. Microfilm for use in a majority of 16mm. microfilm machines is currently under initial development but has not been market-tested as yet. The Company intends to purchase the raw materials for its Universal Contrast Paper, Dynachrome film and microfilm from others. These raw materials will consist of paper base, plastic film base and various chemicals. The equipment for the preparation of the necessary emulsions, for film and paper coating, and for necessary slitting and perforation, has been developed by the Company. In the Company's opinion, the manufacturing operations proposed to be performed by it will not require it to obtain licenses under any patents. However, should any such licenses be required, in the opinion of the Company such licenses will be available at a reasonable royalty.

Dynacolor has reported 1958 sales, almost entirely in Kodachrome processing, of $6 millions and research expenditures at an annual rate of the order of $100,000.[96]

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[94] See Technical Appendix, Part 6.

[94a] Agfa negative-positive monopack film is the only foreign color film still being currently advertised. See *Popular Photography*, June 1960, p. 85.

[95] *Prospectus, Dynacolor Corporation*, filed with Securities and Exchange Commission, April 23, 1959, p. 7.

[96] *Ibid.*, pp. 5-6.

Emphasis in the Kodachrome processing business is on volume processing, not on technical development. Current Technicolor research effort is primarily in other fields. The reported Dynacolor research expenditures amount to less than 2% of total sales. Other Kodachrome processors appear to be even less concerned with research and development.

The processing sales volume of Dynacolor or some other Kodachrome processor may ultimately serve as the financial base for an important entry into photographic film manufacture. Perhaps it will come by way of competitive manufacture of existing products, such as those set forth in the above-quoted Dynacolor report, leading to further growth and ultimately important competitive manufacture. In the field of Kodachrome processing chemicals, Dynacolor is currently making many of its own chemicals and thereby engaging in chemical manufacture.[97] At the present writing, however, the level of research and development effort by the processors is very small in relation to that of Eastman, Polaroid, du Pont, and Ansco and their emphasis upon volume processing is so great that their prospects of introducing important new products are small.

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The history of professional color motion pictures—and the history of photographic industry as a whole—indicate that new products and processes are a major source of competitive activity. The major competition in the field has come from distinctly new products and processes thought by their promoters to offer definite advantages over the existing techniques. The Technicolor three-strip camera and imbibition process, and Kodachrome film—both introduced about 1935—illustrate such activity in relation to the existing, less expensive monochrome techniques. Ansco color film, the Eastmancolor materials, the du Pont release print film and associated monopack camera film under development, the Polaroid Land camera, and others also illustrate the point. As has been pointed out in broader studies, however, the chief characteristics of the developments lie. in the variety of sources from whence they came.[98]

Kodachrome evolved from the efforts of two musicians, Mannes and Godowsky. Initially they worked independently. Later they were associated with Eastman. Significantly, their early efforts included an exploration of some of the techniques (including the additive process) that others had found unsatisfactory. Finally, they concentrated on the idea of incorporating the couplers in the developing process rather than in the film, thereby overcoming the problem of coupler diffusion. This became the basis of practical Kodachrome.[99]

Technicolor, the first entry into the field of three-color technique, was largely the consequence of the initiative and ability of Dr. Kalmus. He obtained risk investment on the strength of anticipated profits arising from an exclusive market position. The development effort was the necessary step to obtain a product and service to sell.

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

[98] See Jewkes, *et al.*, *The Sources of Invention* (1958), p. 248.

[99] *Id.* p. 321; Friedman, *History of Color Photography* (1944), pp. 108-11.

The Ansco efforts with monopack after 1945 were based on the large-molecule coupler concept originally developed by the German related company. Ansco undertook its 35mm. motion picture film development in a clear effort to increase its share of a market in which it was then participating only to a very small degree. Polacolor arose from the efforts of a company previously outside the motion picture field. Here the process offered an opportunity to enter the field. It also illustrates a venture by a company with an impressive record of successful development in other fields. The Eastmancolor films were offered by the company already enjoying a major proportion of the business. In the form introduced, these films employed recent developments in the still-film field. Introduction of Eastmancolor was dictated by the prospect of increased dollar volume, especially from the release print film, and in some measure reflected the state of competitive development (Ansco, Polacolor, du Pont) by 1950. Du Pont offered the monopack release print film in an apparent effort to retain its position in the 35mm. film market and to exploit a novel approach when the use of monopack release print film seemed imminent. The du Pont effort illustrates a costly product development effort by an organization with ample resources and abilities that was displaced by an intervening competitive development. Finally, the Technicolor research on the imbibition process improvements in recent years represents development dictated by the need to prevent loss of existing processing volume.

Competitive manufacture of products modeled after existing products has been a relatively unimportant form of activity in the film manufacturing and processing industry. Kodachrome film has been outstandingly successful. For at least the last decade patent rights have not been an obstacle either to the manufacture or to the processing of such film. The Dynachrome experience illustrates this fact. Yet there is still no line of films modeled after Kodachrome. The recently introduced Ansco Moviechrome 8mm. film is the only known currently manufactured Kodachrome-type film. Similarly, there appears to be no inherent reason why Ansco could not manufacture a film using colored couplers.[100] Yet this has not been done. The history suggests that the industry displays some of the "no trespass" attitude that has been attributed to the chemical industry generally.[101] To the extent of this attitude, the importance of new products and processes is further emphasized.

The following comments from a recent study of the chemical industry appear to apply to the photographic industry:[102]

> The real competition in the chemical industry goes beyond the manufacture of the same chemical from the same raw material by the same process—although this, too, exists. . . . Competition is more characteristically found in the search for different raw materials and processes to make the same product, for different chemicals to perform the same function, for new chemicals to perform altogether new functions, and for new uses for established chemicals. . . .

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[100] In view of the interference settlement with Eastman, Ansco appears to have a royalty-free license under the basic Hanson patent. In any event, any needed license appears to be available on a reasonable royalty basis.

[101] See, e.g., Whitney, *op. cit.*, p. 236.

[102] *Ibid.*, pp. 238-9.

> This is the famous "test-tube competition," or continual struggle of competing laboratories to find new products. . . . The effect of test-tube competition is expressed by a statement, which can be supported by examples, "that there are no 'gentlemen's agreements' protecting the position of the unprogressive chemical firm."
>
> Besides product competition—including, as in other industries, competition in improving the quality of a given product—chemical companies compete in the technical assistance they offer to customers. Their "technical sales service" departments are of great importance. . . .
>
> Price competition on identical products plays a relatively small role in the thinking of the companies. It is said that in a discussion of competition lasting several hours the representative of one large company never mentioned the word "price." The effort of the industry to avoid competition in various trade practices was reflected, as one observer has pointed out, in the content of the National Recovery Administration codes of fair competition. These included:
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> > prohibition against concealed allowances, against excessive rebates on containers, against unearned discounts, free distribution services, espionage by competitors, enticement of employees, unjustified claims of adjustments, contingent sales, dumping, and, of course, sales below cost.

The same writer points out, however, that price fixing or other monopolistic efforts are not proof against new processes, products, types of equipment, and competitors.

It seems clear that the dominant aim of public policy in a field such as professional color motion pictures should be that of providing the most fertile climate for the development and introduction of new products and processes. Business decisions here—as in other respects—reflect the combined effects of many considerations. They may reflect antitrust law prohibitions against unreasonable restraint of trade, monopolization, or attempt to monopolize. They may reflect the incentive of a protected market arising from anticipated patent rights or trade secrets. At least in the case of Eastman, business decisions may reflect the risk that some market will be lost to a patented new product or process. Other law relating to business activity, especially the tax law, bears on the availability of risk capital and hence the activity in the industry with respect to new products and processes.

It is a mistake to single out any one of these factors and look to it either as the sole cause of lack of progress or the sole reason for the introduction of new products and processes. The antitrust law, for example, certainly has a place in preventing anti-competitive agreement, tying arrangements, and the coercive use of market position. In the writers' opinion the consent decree provisions respecting the tying of Kodachrome film sales to the processing are thoroughly sound. But neither this nor any other antitrust relief can bring about competitive manufacture of existing products when the market situation really rests on other considerations. The same applies as to the compulsory licensing provisions of the various antitrust decrees. In this respect the present study is consistent with results obtained from earlier similar studies.[103]

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[103] Frost, Oppenheim, and Twomey, "The Concrete Block Making Machine Industry," *PTC J. Res. & Ed.*, 2, No. 1 (March 1958), pp. 61, 111-15. Frost, Oppenheim, and Twomey, "The Parking Meter Industry," *PTC J. Res. & Ed.*, 2, No. 3 (September 1958), pp. 376, 401-5.

The experience with the antitrust case here studied brings out some of the limitations inherent in an effort to alter competitive effort in a highly complex and rapidly changing technical field by antitrust action and decree. The government filed a complaint based in large measure on the theory that Technicolor forced Eastman to withhold an existing competitive monopack professional film. The present study casts grave doubt on the validity of this premise. Perhaps more important, the major result of the decrees is believed to have been as the first step in an unrelated matter—Kodachrome processing by others than Eastman. In every other respect the industry has been altered more by the march of technical development—particularly the introduction of Eastmancolor materials—than by anything in the antitrust decrees. The experience supports a view that practical antitrust law enforcement in a field of this kind must be keyed to the prohibition of clearly anti-competitive agreements and monopolization, and attempts to monopolize, and that competition—not antitrust decrees—is the most likely source of the new products and processes that have the major effects on the industry.[104]

The patent law is likewise more effective and important in connection with some competitive activities than with respect to other competitive action. In the case of Polaroid, patents have been and still are a matter of emphasis. The importance of this concern to the industry is clear. Similarly, patents were of general importance in the early days of Technicolor and are now important to such Technicolor ventures as the TV Bandwidth Reduction System. Here again we have a concern of clear importance to the industry. Eastman presents a somewhat different situation. Patent rights are primarily important to Eastman in minimizing the risk of having to pay royalties (as occurred in the case of the Troland patent) or being excluded from an important market (as in the case of Polaroid). They have a less important role to Eastman as a source of royalty income. In the case of Ansco, patent rights do not appear to have been especially important to date, although the origins of the company can be traced to such rights and the company continues to look upon patents as important to its technical progress.[105] In the case of du Pont it is doubtful that patent rights offer much incentive for product development insofar as exclusion of competitors is concerned. Rather,

[104] Dissatisfaction with compulsory patent licensing as an antitrust relief measure is expressed in a somewhat different context in the report of the Senate Subcommittee on Patents, Trademarks, and Copyrights, summarized in *Report No. 1202,* 86th Cong., 2d Sess. (1960), pp. 10-12. Although statistical in character rather than a study of case histories, the report suggests that too much reliance has been placed by the Department of Justice on compulsory licensing as antitrust relief and criticizes reciprocal licensing provisions. The latter criticism implicitly rests on the importance of competitive research and development in giving rise to market competition.

[105] In the pamphlet "Progress Through Patents At Ansco," distributed in 1959, Ansco emphasized its origins as the first photographic manufacturer in the United States and especially to Goodwin patent 610,861 to the flexible nitrocellulose film base. The pamphlet concludes with the following statements:

> "Ansco stands today as it has always been, a leader in the manufacture of photographic products. The many years of photographic experience promise in the future as in the past . . . . Ansco will be the first with the finest.
>
> "Only through the United States Patent System will this progress be assured."

like Eastman, patents appear to be of principal importance for defensive reasons and because of the opportunity they provide to recoup some part of the research costs in patent royalties.[106]

The patent system has another role in the film industry. There are trade secrets —and they can be kept. One example is found in the preparation of the Polaroid positive sheet.[107] A more general example is found in emulsion manufacture.[108] To the extent secrets of this kind exist, interchange of scientific information is obstructed. An important ingredient to the most effective development of improved products and processes is thereby cut off. It is doubtful that any practical system could bring out disclosure of all information of this kind. The history does bring out the importance of offsetting a very real tendency toward undue secrecy. An unduly critical standard of patentability or of patent enforcement works against this desirable objective.

The industry also shows how factors of many kinds can influence the development of new products and processes. Ownership of 98% of the General Aniline and Film stock by the Alien Property Custodian and controversies involving rights of minority stockholders certainly have not stimulated the activity of Ansco. This is not to suggest that the government had any real alternative to the action taken or that the Attorney General has interfered unnecessarily in the affairs of the company. But the experience does indicate how extraneous factors can influence competitive endeavor.

To be sure, these observations do not offer any single ingredient for a public policy conducive to competition in color film development and processing. Indeed, they do not offer any assurance that future instances of apparent arbitrary delay in introducing new products will not recur. It is a mistake, however, to look for such assurance in a free enterprise society. Rather, long-term policy must be geared to incentives and goals that, on the average, provide a competitive industry and an early end to the non-competitive conditions when they exist. It means that antitrust decrees cannot and should not be expected to do the impossible, that the patent laws must not be regarded as a cure-all, and that other considerations affecting incentives for research and development should not be ignored. So considered, the present study of the 35mm. color motion picture film industry illustrates an industry going through a period of change. To be sure, in an industry-structured sense, the situation reflected a lack of adequate competition, at least prior to 1950. Yet, the situation was not as adverse as would be assumed from attention only to industry structure. One can even assume that Eastman really was forced by Technicolor to forego manufacturing an adequate product—as the government contended—but the competition of Ansco, du Pont, and Polaroid was ever present. The matter was drastically changed by the introduction of Eastmancolor. Not only this, but it seems clear that within a comparatively short

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[106] The current litigation on the linear polyethylene patent dispels any notion that du Pont is indifferent to the potentiality of patent rights as a source of income. See E. I. du Pont de Nemours v. Phillips Petroleum, 123 USPQ 124 (D. Del., 1959).

[107] Bello, "The Magic That Made Polaroid," p. 158.

[108] "Discussion of Current Issues," *PTC J. Res. & Ed.*, 3 (Conference Number 1959), p. 79.

time Ansco, du Pont, Polaroid, or some other competitor would have brought forth a commercially competitive technique if Eastman or Technicolor had not pursued the opportunities.

Finally, there is every reason to believe that important developments lie ahead. One of these is the possibility of couplers—especially for the red recording and green recording emulsions—that are sufficiently selective to render masking unnecessary. Another possibility—perhaps remote but nonetheless interesting—lies in the application of technique from the field of color television. Here, the transmission adopted as standard does not attempt to achieve equal detail for all colors, but rather accommodates the eye characteristics. Still another possibility was recently demonstrated by Edwin H. Land, of Polaroid. He has apparently succeeded in bringing out full color response by the use of light of only two colors.[109] Here we have a sharp departure from existing technique and scientific theory. It could revolutionize the entire industry. Just as practical monopack release printing has formed the principal competition to Technicolor imbibition printing, it seems likely that development along the lines of the above or other theories will eventually lead to a new line of camera and release print materials competing with those presently existing. With respect to such developments, there are present indications of competitive effort based on the prospect of patent and trade secret rights as well as defensive research activity motivated by a desire to have access to whatever does become practical. These efforts should lead to continued progress toward improved techniques.

[109] *Scientific American*, March 1959, pp. 62-3; Land, "Experiments in Color Vision," *Scientific American*, May 1959, pp. 84-99; Bello, "An Astonishing New Theory of Color," *Fortune*, May 1959, p. 144 *et seq.*

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CONTRIBUTED ARTICLE

Foreign Licensing and Investment in U. S. Foreign Economic Policy

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INTRODUCTION AND SUMMARY

THE VARIOUS STUDIES BY THE FOUNDATION of foreign licensing of U. S.-owned foreign patents, trademarks, and know-how have concentrated on the problems faced by U. S. licensors and the practices they have employed in licensing abroad.[1] This paper is directed at placing foreign licensing and its complement, direct investment, in the setting of overall U. S. foreign economic policy. We may justify this examination on the ground that all international business operations are strongly affected by the national interests which they serve as well as by the private interests which originally motivate them.

In this examination, I proceed from the general to the particular. The relation between the "national interest" and "private interests" is examined; then, some of the more important "challenges" faced by the United States in its foreign relations are analyzed. Third, the contributions which foreign licensing and direct investment can make in meeting these challenges are presented, and the problems which will probably arise as a result of the outflow of capital and know-how are depicted. Finally, policy measures are proposed for the U. S. Government to make these contributions more effective.

The argument could as easily be reversed. There is a growing outflow of capital and know-how from the United States through private operations abroad. This outflow is consistent with the objective of advancing the growth of the less developed countries and strengthening the West, but it also gives rise to economic and financial problems requiring new policies in U. S. foreign economic policy. Since the activities which are being carried out by private interests also serve the

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[1] See *PTC J. Res. & Ed.*, 1, No. 1 (June 1957), pp. 145-158; No. 2 (December 1957), pp. 220-243; Conference Supplement (1957), pp. 128-30. 2, No. 1 (March 1958), pp. 137-58; No. 2 (June 1958), pp. 181-277; Conference Supplement (1958), pp. 131-55. 3, No. 1 (Spring 1959), pp. 1-20; No. 3 (Fall 1959), pp. 272-302; No. 4 (Winter 1959), pp. 357-88; Conference Number (1959), pp. 23-35.

broad national interest, it behooves us to examine ways to reconcile any divergence in these interests.

DOMINANCE OF THE "NATIONAL INTEREST"

A primary motivation for foreign licensing and investment since World War II has been the interference by national governments in the flow of trade and payments, making local manufacture more desirable than exporting. Governmental interference is directed at pursuing goals seen as more clearly in the national interest than ones which would be gained through freer markets. The "national interest" is paramount, and private interests must serve that end also. These countries are trying to find an accommodation between the demands on the public sector for growth and the necessary and desirable reliance on the private sector. Although several have called themselves "socialist governments" (India, Indonesia, Egypt) and are dedicated to planning for national growth, they have, in fact, left a sizable area to the private sector and rely on it for development. For example, India's economy is only about 10% to 15% "planned," which is less than the proportion of GNP channeled through the U. S. Government.

The problem of reconciling the national and private interests has been solved somewhat differently in the United States, but the role of the government in U. S. economic growth cannot be discounted. Despite the instances in history in which the private interest seemed dominant, there never was a time in our own history in which the national interest was not recognized as predominant—if not always by the people, at least by their leaders. It was dominant even in the days when decisions as to economic growth and specific developments were left completely to private persons, for it was generally considered that what was in the private interest was *ipso facto* in the public interest. Also, the entrepreneurial, or subsidizing, or "controlling" role of state and local governments has been significant—not only in the past but at present.[2]

There are, of course, conflicts which arise between the public and private interests. It is not always to the benefit of any given private group to accept dictation from the government; nor can the government rely on private interests for the fulfillment of "national goals." Where there is a divergence, it is the responsibility of the government to bring the two sets of interest into reconciliation. Since democratic capitalism is a system under which the government's goals must, in large part, be achieved *through* actions of private business, the government must formulate its policy objectives and direct or induce action consistent with these goals. Private business, on its part, should seek its own interest in the most economic fashion; business cannot be expected to "second-guess" what the national interest is or should be and pursue it regardless of the costs to the company.

On the other hand, when the national interest is clearly demonstrated, it is no "sacrifice" to the private enterprise to make its actions consistent with that interest. It can be shown, I think, that in the long run it is to the advantage of the private sector that the national interest be served. For example, the prosperity of all U. S. business depends on the strength and welfare of the economy as a

[2] See, e.g., Committee for Economic Development, *Developing the "Little" Economies*, 1960.

whole; while the converse is also true in the aggregate, it is not true in each particular case; that is, the national welfare depends on prosperity of *all* business but not on *each* enterprise. This dominance of the national interest is widely accepted, as shown by the fact that many groups and corporations have "willingly" (i.e., without revolution) accepted judgments by the government against them in the belief that it was in their interest to maintain a *system* of government and regulation, which is in the interest of all. That is, "playing by the rules" is better than winning. In the parlance of the political scientist, this agreement establishes a "community of interest," which is basic to the rule of law and to political stability.

Given the dominance of the national interest—however defined— it is perfectly appropriate for the governmental authorities to examine what role the foreign operations of U. S. businesses should play in pursuit of overall economic and political policies. Since businessmen themselves have an important stake in the formulation and implementation of these policies, it is necessary to establish considerably greater cooperation between the U. S. Government and private businesses on the many facets of international operations than has existed in the recent past. From the numerous interviews I have conducted over the past three years, I have concluded that there is still a large cloud of suspicion on the part of many corporate and government officials of the motives of the other. There is on the part of some, however, a growing recognition of the necessity to cooperate in the pursuit of common goals. This paper is an examination of these goals and the means at hand to obtain them as they relate to foreign licensing and direct investment.

CHALLENGES TO U. S. FOREIGN ECONOMIC POLICY

There are two major challenges which face the United States today. One is the short run challenge stemming from the growth of Russia. The other is a long run challenge arising from the recent nationalism in a number of newly independent and less developed areas of the world.

Soviet Challenge

The challenge from Russia is three-fold: first from Russia's technological and economic growth, second from the demand of other countries for a higher standard of living, and third from the supposed solution to economic problems offered by Soviet-type government planning. The rapid rise of Russian technology requires no review. It has been phenomenal and constitutes a serious challenge to the economic leadership of the United States.

Of even greater importance, however, is the fact that the industrialized countries of the West have not adequately demonstrated to the less advanced countries how they may rapidly raise their standards of living. The Russian system has provided a simple "solution" which appeals to these people. I do not question here the realism of the desires of these peoples for *rapid* improvement. The reality of *their* objectives is not really the question; rather, it is the reality of *our* objectives, for we can control only our own policy. However, a more realistic policy on our part might well include ways of encouraging more realistic objectives on the part of others.

These countries are caught in a "revolution of rising expectations," and they will seek almost any means of achieving those expectations. The solution which Russia has offered them in government planning is not the anathema to these people that it is to us in the United States. The short run challenge to the United States, therefore, is that of leadership in the world.

Any consideration of our economic responsibilities as a great power is complicated by the fact that our relative power position is changing rapidly. Our military, political, and economic capabilities supporting world leadership were at their highest when we assumed this role in the late 1940's. At that time, we had a monopoly on the atomic bomb; we were the only source of supply for numerous commodities required for recovery and growth in the rest of the world; and politically we were still in the post-war honeymoon. We are now challenged; first, in the *military* arena, by an equal or superior striking power in nuclear missiles; second, in the *economic* arena, by the same countries whose post-war recoveries we have guided and financed and by rapid rate of growth in Russia, which threatens to equal our living standards in 20-25 years; and third, in the *political* arena, by efforts of the Sino-Soviet bloc to penetrate the new nations. These challenges are related, as seen from the fact that the growing economic and political unity of Western Europe and its waning dependence on United States economic and military assistance will inevitably weaken our leadership in the NATO alliance. And, the decline in power and influence of the North Atlantic countries over their recent colonies and territories weakens further the power of NATO.

As a result of these shifts in the relative power position of the United States and our basic desire to resolve international conflicts peacefully, we have altered our apparent attitude toward world economic problems. The principle of competitive co-existence has been accepted, behind which there continues a struggle for world domination by the Soviet Union. This apparent "cooperation" for peace complicates the problem of leadership on the military, political, and economic fronts. Close association by others with the Soviet bloc cannot now be objected to, and Asian and Latin American countries now feel freer to accept aid or to negotiate bilateral trade agreements with bloc countries. They have been accepting a large volume of aid from Russia—not so large as the combined grants and loans from the United States; but Russia's efforts are concentrated in a few selected nations.

Russia is already implementing her policy of economic expansion (and penetration) through bilateral trade deals and credits averaging about $200 million per year ($300 million in 1958). She has extended loans totaling some $2 billion worth of equipment, technicians, raw materials, and goods to countries such as India, Egypt, Burma, Indonesia, Afghanistan, and Yugoslavia, and has recently promised several hundred million more to these and others. These credits have usually been for 12 years at low interest rates mostly to be repaid in commodities or services. They have usually been for projects, such as steel mills, sports arenas, city streets, and plants or construction which would make good propaganda in the newspapers.

Besides these credits, which are still small compared to the loans and gifts ex-

tended by the United States to the underdeveloped countries, the Sino-Soviet bloc has served political ends by purchasing "surplus" commodities from the underdeveloped countries—such as Egyptian wheat, Burmese rice, Indian nuts and shoes, and Ceylonese rubber—at times when the world market was sagging with large supplies. As a result of these barter deals, Russia has been able to tie sizable amounts of trade to her economy and thus invade traditional Western markets—all the while claiming to be in support of "independence" and national freedom for these new countries.

Khrushchev has stated that "We value trade least for economic reasons and most for political purposes." He has also offered the United States a "challenge" that they will "out-trade" us in the rest of the world. Russia has claimed that she will be able to serve the needs of the developing countries better than the United States will be, and that she will win the cold war through economic efficiency rather than by a trial of arms. She has made it quite clear that her economic power is subservient to her political objectives—an approach which makes her policies suspect as imperialist, but so far she has been able to pin this label on the West because of historical relationships. And as her domestic economy grows, she will have greater capacity to trade and "invest" abroad, thus expanding her influence in the "uncommitted" nations of the world.

There is no need for the United States to try to prevent or substitute for Soviet aid. The Russians have not yet been so successful as to cause us to shy from their competition; and, if they contribute to growth abroad, they serve our objectives also. Where we must act positively is in providing a reasonable alternative to Soviet overtures so that a country can easily refuse a bargain which it feels will impinge on its freedom. What we must avoid is the risk of letting the resources of the rest of the world fall into Russian hands for exploitation. The United States interest is not so much in going *into* these countries or in keeping Russia *out*, as in keeping them out of Russian control.

These short run developments alter significantly the nature of our position as a great power and the economic responsibilities that accompany it. The United States faces a greater necessity than previously of having to lead from within an alliance of similarly dedicated countries. Its economic policy must, therefore, lead to a greater "community of interest" *among* nations so that disputes may be settled by peaceful means and in the interest of the *general* welfare.

Challenge of Economic Development in New Nations

While these more immediate forces have shifted our international economic political posture, longer run developments portend more fundamental alterations. I refer to the rising nationalism in Asia, Africa, and Latin America—areas where over the next generation or two the relative increase in population, coupled with industrial and technological advance, will probably shift the world's economic and political balance at the expense of both the NATO powers and the Soviet Union.

Rise and Costs of Nationalism

The dissolution of empire in Asia and Africa and the resulting drives to na-

tionalism are already creating a host of problems affecting both the national interests of the United States and the role of international business—and will continue to do so for some time. These nations are striving for the freedom to determine the solution to their own problems in their own way. But nationalism and the freedom which goes with it provide no panaceas for growth. Freedom does not itself breed progress; rather it frequently leads to the finding of a scapegoat for its difficulties and will generally turn to the solution of pressing internal problems at the cost of damage to international relations, as in Cuba and Egypt. The feeling of being "held back" by the West makes some of them more eager to accelerate growth by use of the Soviet planning model *and* to turn to regional cooperation as a means of gaining strength and independence. On both counts, the encouragement of nationalism tends to reduce the influence of the United States—at least in the short run. Our problem is to make certain that their newly gained freedom leads to governments and economies not incompatible with Western ideals and values.

The problem we face arises from the fact that a nation which gets its freedom from foreign rule gains *only* that freedom. This freedom may have little or no relevance to its real economic and social problems except possibly to make them worse. The price of this freedom may be very high; it may include poverty, disorder, and dissension which could encourage communism—a price which some of them can ill afford. A recent newspaper quoted the Puerto Rican Congress as saying "independence would be cruel," and several new nations have suffered from achieving their independence too soon (i.e., without adequate preparation). Yet, it is certainly a political truth of today that once the nationalist bug bites a group of human beings they cannot be cured except by national freedom with all the possible social and economic disadvantages which it may bring. Where these are the prices of national freedom in the new states, the costs may have to be borne largely by the United States and the industrialized nations of the West in an effort to widen their influence.

On the positive side, however, it must be recognized that the great gain of freedom is that thought and effort can then be devoted to something more immediately relevant than merely freedom. It does not follow, of course, that the effort will be so directed. Effort has historically been aimed, even after independence, towards condemning the former master for continuing ills. To get freedom is to lose such a grievance, and some nations have firmly refused to give up their scapegoat. (This position of the scapegoat should not irk or bewilder us if we review our own history which includes the election of a Chicago Mayor on an anti-British ticket in the 1870's.) Thus, attacks on "Yanqui" imperialism by the Argentine Republic were substituted for rational thought as to the cause of the serious, but quite curable, economic difficulties. The problems of Cuba would be greatly relieved by more energies being directed to solve their own problems than to blaming the United States for imagined ills.

Some time may need to be spent in blaming outsiders in order to mobilize national sentiment and energies and to conjure up nationally acceptable solutions. But such a need can be met fairly promptly and attentions turned to finding "na-

tional solutions." The ability to attain a solution which is "independently" determined may have some disadvantages in the necessity to bear full responsibility, but it has the advantage of encouraging greater local efforts. For example, the problems of India, which are admittedly exceedingly great, can now be solved in an "Indian" fashion. We can expect the government of India to make mistakes, but it can at least preach to the Indians that it is up to them and failure cannot be laid on the British.

The problems of bringing these new and weak governments into the Western sphere require that the United States show more understanding and patience than it has previously; and it will have to enter into long-run arrangements which dedicate men, time, and money to prop up rickity economies—economies which can easily be carried under by the efforts of a demagogue to maintain his personal position, *or,* by well-meaning politicians who cannot as yet see the longer-run effects of their policies. In the process, the United States will have to maintain self-control, in the face of charges of exploitation and imperialism made by leaders abroad seeking means of consolidating internal power. It may help if we recognize that the old order of empire formerly relieved us of problems which we must now face.

The decline of empires means the loss of a crude solution to a real problem which may be posed in the words of George Orwell: "all nations are equal, but some are more equal than others." It means that nations have very different resources, levels of wealth and power, are in very different stages of historical development, but want to be at the *same* stage. There is a general recognition that economic wealth and military power are prerequisites to political prestige and position, but all nations have been encouraged by pronouncements in support of democracy to expect an equal voice in the community of nations. In defiance of all objective assessments, they are ready to *assert* that this stage of real equality has been reached (or should be disregarded) and demand equal representation. Nigeria wishes to say that it is a republic in the same sense as the United States; Ceylon wishes to state that it is a nation in the same sense as France.

The outmoded imperial order denied this. Under it, nations were unequal; they were at different stages of development and power; the advanced nations had the right and the duty to command the actions and guide the growth of colonial areas. The forms of the guidance extended and the repayments exacted were different in each colonial area depending on the political power achieved and the degree of economic stagnation. Thus, India was ruled directly and payments collected through privileged companies. China was forced to extend special privileges to the Europeans. Japan was frightened into accepting European methods of industry and trade. The expanding technical superiority of the "conqueror" which destroyed the stagnation of the colonial areas led to desires for material advance and scattered the empire. The scattering has led to the next step in social, economic, and political growth, which is a concentration of power in the *national* government. It is this nationalism that is creating the economic and political problems of today and which constitutes the long-run challenge facing the United States.

The world is faced with new states with inadequate economic resources, rapidly rising populations, desperately low living standards, and weak and oft-times corrupt governments with delusions of grandeur. The problems would be frightening enough if national governments were strong and rational and there were no competition between the East and West. Unfortunately, we are not faced with so simple a task. The magnitude of the problem is seen by the struggle which India faces during the next 5-year plan to raise the average income per capita by 10%—from $55 to $60 per year! Most of these developing countries cannot aspire to give their peoples in the next generation even as good a government and as adequate standard of life as the most backward European nation or American state now possess. Without assistance from the more industrialized countries, it is conceivable that the less advanced countries will find the disparities increasing and, though "all nations are equal," some will be getting progressively *less* equal.

This brief review indicates that the long-run challenge of nationalism is in a sense inevitable. We cannot avoid it, nor can we solve the resulting problems by attempting to prevent the rise of new nations. Before we can react sensibly, however, we need to examine the specific characteristics of the challenge of nationalism.

Specific Accompaniments of Nationalism

There are several specific results of nationalism which affect the broad objectives of U. S. policy and the operations of U. S. businesses abroad. They include, at least, an emotional attack on "imperialists," the downgrading of the role of the private businessman, and the eagerness to advance in prestigeous areas too rapidly. These attitudes produce several "fictions" in the views and policies of the new nations which make it difficult to live with them.

Attack on "Imperialists"

The emotional attack on the colonial-imperialists has seemed of late to be waning. But it is revived periodically as suits local political interests. The cry against imperialism diverts attention from real problems to fictitious one. The fictitious charge of imperialism directly affects the willingness of U. S. business to enter, but the U. S. attitude should be to ignore and outflank these tirades as much as possible. There is the danger, of course, that fictitious issues will conceal from the long-suppressed nation that its misfortunes are largely its own fault. What these new nations do not realize is that the fact of subjection in the past itself suggests weaknesses which mere freedom does not necessarily cure. Freedom is probably the necessary preliminary to curing a weakness, but the weaknesses of resources, traditions, social habits are there to be cured. Waving the new national flag makes the people feel good, but that is about all. It solves no problems. U. S. policy must be directed to a solution of real problems and toward wakening the new nations to what the important problems are, including the role which private (non-imperialist) business may play in the more rapid growth of the economy.

Role of Private Business

One impact of the charge of "imperialism" is that the role of the businessman is played down in the developing countries. In a large part of the world, the views

of poets and philosophers, of orators, and legendmakers are more important than the views of the businessman or scientist or economist, and consequently, the prestige of the latter's position is not high. For example, the Arabs are dazzled by their culture and their past; many in Latin America are more concerned with their culture than with their economic progress. Answers to the pressing problems of economic growth must somehow reflect the glorious past of these peoples as they see it, yet provide rapid advances. Solutions which ignore the "values" of these cultures will not be readily implemented; yet, for American-style business to be accommodated, some of these "values" must change, and they will, as witnessed by the impacts of our attempt to build around totally anachronistic social structures as in Yemen and Saudi Arabia. But the change is neither rapid nor always smooth.

An important role of the U. S. business operating overseas, therefore, is that of relating the techniques of management and production to the environment abroad, and especially to show how the U. S. business approach to high-volume, low-profit-margin operations is a service to mankind (equally as the "professions") and thus to up-grade the prestige level of the entrepreneur.

Eagerness for Rapid Advance

A third consequence of nationalism is that many nations are insisting that they run before they can walk; many of them will likely fall. Their failures may have to be "made good" by the West. We cannot stop all such failures, and it will take a high degree of wisdom for successful "receivership" or to prevent incipient failures. The applicable methods are *not* necessarily those we employ *within* the United States. Few nations will be willing or even able to imitate all or most of the American way of life—social, political, or economic. We will have to learn to help the rest of the world by somewhat un-American techniques; to employ un-American qualities such as patience and accept reversals without "washing our hands of the whole deal." These techniques are difficult to employ when the recipients of such help are themselves impatient for results and are acting in ways to cause reversals. The United States has, however, stood against colonialism and has stated during the Suez debacle and after that it adjures *force.* Thus, it has the alternatives *only* of not helping or of helping in ways acceptable to the recipient—a recipient "feeling his nationalistic oats."

While nationalism brings these problems, it is not all bad. It is one of our greatest allies against communism. Nationalism in a free nation is itself the most effective, probably the *only* effective, force against international communism. For us to rely on its use against communism does not require that each country stand up and be counted against the Soviet or for the West—only that national feeling be employed to maintain independence and to achieve locally acceptable solutions to the pressing problems of economic growth and political stability.

Challenge of Regional Economic Integration

A second long-run challenge which faces the United States is the trend toward economic and political integration in various regions of the world. Although prog-

ress is slow in Latin America and the Middle East and merely incipient in the Far East, there is a feeling that the real equality sought by the developing nations can be achieved only through widening their economic and political systems. Their success will create power centers outside of Europe and the United States. A forerunner of regionalism is to be found in the European Common Market and the European Free Trade Area, which will alter the power position of Europe and also of the United States within the NATO alliance.

The official policy of the U. S. Government is to support the formation of such groups as means of accelerating growth and strengthening the economies of the members through increased division of labor and specialization. While it is to be expected that such growth will come, it is also the nature of such groups that there is increased discrimination against outside countries; the United States is such an outside nation. The discrimination will take the form of the absence of barriers to trade within the regional unions and an "average" of former barriers to trade with outside countries.

Because of these expected results—larger markets and trade discrimination—U. S. companies are already responding by increasing their investment and licensing to such areas. The immediate and long-run problems have, therefore, affected the current response being made by business. These responses through investment and licensing abroad are discussed in the following section.

CONTRIBUTION AND PROBLEMS OF LICENSING AND DIRECT INVESTMENT ABROAD

The contribution of direct investment and licensing to the economic growth of the free world arises from the commitment of real resources abroad. The major impacts of U. S. direct investment abroad arise less from U. S. dollar flows than from capital formation by U. S. interests in the host country and from transfers of non-monetary assets such as managerial and technical skills under or outside of license agreements. On the importance of international transfers of know-how, the president of D.L.R. Plasticos do Brasil S.A. has recently stated that:

> Technological "know-how" is quickly becoming a kind of universal currency. It has contributed the most in speeding up the process of economic growth in less developed countries, and it is within the free world, promoting effectively the economic integration among nations . . . . the main tool of our industrial development has been the imported technological *know-how* from more industrialized nations. . . . This technological cooperation between private enterprises from different parts of the Free World has created a highly useful and profitable partnership and makes accessible to less developed areas the treasure of the best research and engineering resources. Thus it accelerates progress, improves living conditions and standards, increases employment, and ultimately, to a great extent, promotes the integration of economies through sound international understanding and partnership.[8]

Transfers of managerial and industrial know-how from the more advanced countries are an important means of meeting the previously discussed challenge of the economic needs of the less developed countries and their desire to advance as

[8] Speech before the Second Annual Meeting of the Board of Governors of the International Finance Corporation, New Delhi, October 8, 1958.

rapidly as possible. These transfers provide precisely the means (i.e., advances in technology and management) to meet a similar challenge which the United States has already conquered in its own country. The United States experience indicates that rising living standards can be obtained without reducing individuals to mere cogs in a bureaucratic machine run by the government. A similar fight for higher incomes must be fought in the rest of the world, and it should attract the energy of a large part of the United States. In the words of Eugene Black "a war against mass poverty in the less developed countries must now be waged if mankind is to preserve his faith in the worth of knowledge. If mass poverty is not the root of all evil in our world, it is so much at the root of discontent in our times, that it offers the one concrete problem on which we can focus our energies and test the worth of our knowledge. No other problem of comparable scope or importance exists." Technical and managerial knowledge which we have today indicates that a successful war against such poverty *can* be fought; whether and how it *will* be fought depends on many factors outside of business and the economic system. But a major contribution by private enterprise can be made in the form of foreign licensing arrangements and direct capital investments.

The Nature of the Contributions

The contribution of direct investment may be described in terms of (a) sources of funds used abroad; (b) the ownership relations, and (c) the location of U. S. affiliated enterprises abroad.

Sources of Funds

Recent studies of the capital expenditures procedures of U. S. companies abroad have indicated that the approach to expansion used within the United States has been employed abroad.[4] That is, primary reliance is placed on retained earnings abroad, on reserves, and on local borrowing. U. S. dollar contributions are kept to a minimum and are generally employed to the extent that foreign law requires or other sources of funds are not available. For example, in 1957 direct investment of U. S. funds in Europe amounted to $924 million. Out of this total, only $186 million were funds transferred from the United States, $351 million were funds obtained abroad, $132 million represented re-invested income, and $253 million constituted charges for depreciation. The corresponding figures for 1958 were $72 million, $425 million, $195 million, and $288 million, for a total invested of $818 million. This means that, for the two years in 1957 and 1958, about 40% of capital expenditures of U. S. firms in western Europe were obtained from local sources, 29% from depreciation, 18% from earnings, and only 13% from U. S. dollars sent from the parent country.

We may conclude that the main impact of the U. S. dollar flows from American companies to their affiliates abroad is a catalyzing one. That is, it generates savings within the company or outside and mobilizes local savings in joint enterprises. Recent estimates indicate that the equity (or market) value of U. S.

[4] See the author's "Promoting Free World Economic Development Through Direct Investment," *Proceedings of the American Economic Association*, May 1960; and, *Survey of Current Business*, October 1959, pp. 16-20.

investments abroad is well over three times the reported book value of investments of U. S. funds. In general, then, an investment of one U. S. dollar has led to an additional equity capital formation by U. S. investors of at least two dollars equivalent. To this must be added the capital set aside for depreciation and local resources which had been channeled into the enterprise.

In sum, the major financial impact of U. S. direct investment is small if only U. S. dollar flows are counted. Any discussion of U. S. direct investment, therefore, should take into account the much larger contribution made in terms of accelerating capital formation within the foreign country itself, which may be done through joint-ventures or a wholly-owned subsidiary.

Ownership Relations

The larger U. S. companies operating abroad have continued to show a strong preference for the wholly-owned situation. For example, according to data obtained by the U. S. Department of Commerce,[5] even in the Netherlands where skilled managers and entrepreneurs could apparently be found and local capital obtained, the number of U. S. wholly-owned subsidiaries increased between the end of 1954 and June 30, 1959 as follows for each year: from 47 to 54, to 64, to 69 and 92 at the end of 1958, and to 102 as of mid-1959. Partial participations, however, declined from 43 at the end of 1958 to 37 in mid-1959. (This was partly the result of the transformation of two such affiliates into wholly-owned subsidiaries of the U. S. firms). These partial participations included enterprises in which a U. S. firm has made a capital investment as well as licensees of U. S. firms. In Belgium, in mid-1959 there were 171 wholly-owned U. S. subsidiaries and only 35 partial participations by U. S. firms; there were, in addition, 113 firms having licensing arrangements or subcontracting agreements with Belgium firms. The Department of Commerce also reports a trend toward full ownership of subsidiaries of American firms in both France and Germany in the last few years.

Ownership relations have an important impact on another contribution of direct investment—the transfer and training of personnel. The wholly-owned subsidiary may be more closely bound to the parent for key personnel and be less interested in training local nationals for key positions. A joint-venture has, by nature, such an interest since local entrepreneurs are involved. Both the joint-venture and licensing arrangement tend to develop local individual initiative to a greater degree and thereby to increase the importance of the private sector in the economy.

Location of Investment

A third way of describing the contribution through foreign operations is that of geographic location—particularly between the already industrialized and the less developed countries. The characteristic of "location" cannot be adequately described merely in terms of dollar assets in a given country. If the growth of free world economies is accelerated by the development of private enterprises abroad, it is important that there be a number of "pockets of enterprise" undertaking various types of activities in each country. The mere fact that there is a

[5] *Foreign Commerce Weekly*, December 21, 1959, p. 19.

large capital investment in a given country in a certain broad field of activity does not tell us enough about the impact of the investments or the problems arising from it. We should know how many individual "training grounds" are provided by this investment throughout the free world.

A recent study was made of private investment by the 115 largest U. S. foreign investing corporations (having 90% of total outstanding foreign direct investment of the U. S. excluding Canada).[6] Latin America has attracted by far the largest number of U. S. affiliates, having 768 associates and branches of the 115 companies. Continental Europe had 479 U. S. associates and branches, and the British Commonwealth (excluding Canada) had 422 such enterprises.

The distribution according to types of activity shows that the number of foreign manufacturing affiliates of 115 U. S. corporations is greater in Latin America than in Europe or the British Commonwealth; only 9% of the total was in the less developed areas. Extractive enterprises were also heavily in Latin America but also in the less developed countries with the latter containing over 22% of total such affiliates. In comparison, the less advanced countries (outside of Latin America) held only 13% of the selling organizations, the majority being in Latin America and Europe. Thus, despite the sizable capital sums invested in extraction, vast areas of the less developed economies are unpenetrated by U. S. direct investment.

From the Foundation's studies,[7] Latin America was shown as considerably less favored as an area of licensing than were the industrialized regions. It has only 287 agreements reported by a different 155 U. S. corporations compared to 938 for the British Commonwealth and 697 for Europe. The less developed regions of the world are far below in number of associated companies and licensees.

We may conclude, therefore, that the less developed countries are not now the recipients of significant amounts of direct investment or licensing—save those in Latin America. And, if some of the major countries of Latin America are excluded, there is comparatively little in that region. If oil and extractive endeavors are excluded from the other underdeveloped countries, there is precious little private U. S. enterprise there. In fine, private U. S. investors and licensors are not meeting the challenge arising from the new nations of the world. But, the transfer of capital and techniques, which is taking place, to some of these countries and to Europe and Japan is going to give rise to problems in trade and payments requiring adjustments in the U. S. economy.

Problems of Adjustment

The rapid expansion and wider dispersal of U. S. direct investment and of foreign licenses are giving rise to problems of adjustment for the U. S. economy which will be difficult to handle. The above review of the long and short-run challenges which face the United States indicates that the economic expansion of new nations will take place inexorably. It will occur with or without our help. The real question which faces the United States is whether or not the growth abroad

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[6] See *Proceedings, op. cit.*

[7] See *PTC J. Res. & Ed.*, 3, No. 4 (Winter 1959), pp. 357-83.

will occur more rapidly and "appropriately" with our help or less rapidly and without our assistance. Without our positive assistance, the developing nations will turn to other sources of guidance. It is probably much to our advantage to have a foot in the door in the developments which occur abroad for political and military reasons, if *not* from economic ones. However, the economic adjustments can be made more easily if we have some foreknowledge of the changes which are occurring abroad and therefore have some way of anticipating the adjustments which are required.

What are the adjustments that are likely to be needed? They are closely related to the changes which will occur in the recipient country as the direct investment and licensing make their contributions to economic growth. These changes may be classified as (1) an increase in real and probably money *incomes,* with a rising demand for domestic and imported goods, (2) a shift in the structure of domestic *production* and resource use, (3) a change in the volume and composition of international *trade,* with a consequent shift in the balance of payments. Each of these has a direct or indirect effect on the U. S. economy, which will require adjustment through either the free market or government intervention.

Recipient Country Incomes, Production, and Trade

The transfer of patents, trademarks, know-how, and capital from the United States adds to the real resources of the recipient nation and enables it to consume more than it produces for a time (especially if the payments for these factors amount to less than their contribution to the national product, as is likely). This immediately adds to incomes, but the use of these resources also adds to productivity and thereby to greater output in the future. This result is, of course, quite desirable from the viewpoint of U. S. foreign economic policy and is the basic reason why investment and licensing are approved by both the U. S. and foreign governments.

But it can be expected that the rise in incomes will cause a rise in demand for consumer (and producer) goods both imports and domestic goods (those which are neither import-competing nor exports). The increased demand for domestic goods means a diversion of resources from import-competing goods *or* potential exports to domestic production. Which of these will lose resources depends on the industry receiving the resources from abroad and the nature of these resources. For example, if the receiving industry produces import substitutes, and if U. S. technology is being brought in, additional resources to utilize this technology will shift from exportable goods into import competition. Demand will therefore shift away from exportable items into the import-competing and domestic goods. The volume and composition of trade will alter, with the volume shrinking through the dropping out of particular imports and the inability to supply former exports.

Or, if the industry receiving the technology is a potential exporter, resources will be bid into it from the import-competing area. Trade will expand through the addition of new products to the export list and a shift of resources out of former import substitutes. The net results of a variety of such changes cannot, of course, be predicted. There will, however, be a net effect on the balance of payments of the recipient country which reflects all the individual shifts.

The balance of payments will initially be turned into a deficit as the transfers of capital and equipment are received from the United States in the form of imports. But once these have been received, the balance will *tend* to turn in the other direction as a result of the payments of royalties, fees, and dividends. To this surplus must be added the net changes as a result of trade shifts—the final net effect being unpredictable. However, whatever occurs will lead to an opposite pressure on the U. S. balance of payments.

U. S. Incomes, Production, and Trade

The reverse changes in the United States are not as readily received as in the foreign economy, for in the latter the changes are welcomed as means of achieving economic growth. In the U. S. economy, with a slower rate of growth and with some pockets of unemployment, the shifts required may be felt more pointedly. A higher rate of growth in the U. S. (and mobility of resources) would reduce the impacts from foreign investment and licensing—even though some particular companies or industries might be hard hit—for the flexibility in the economy would readily absorb the required shifts.

The direct effects on income of the U. S. arise from the returns of royalties on foreign assets (patents and trademarks) otherwise not used (or not fully used) and from dividends on capital more efficiently employed abroad (in terms of returns) than in the United States. Only if the capital transferred were less effectively employed abroad would U. S. income be adversely affected.

While this increase in income should occur for the economy as a whole, it is not true for any given factor of production. That is, the relative returns to labor and technical and managerial personnel will shift. The increased demand for capital, arising from opening of the foreign markets for capital, and for technicians and managers will shift the proportion of the total product in their favor. This shift will be accelerated by the fact that the rise of foreign production assisted by the transferred resources will most likely be accomplished with low-wage labor abroad. This competition will in turn press U. S. wage rates downward.

As a consequence of these pressures, there will probably be a rising sentiment from labor groups (coupled with specific industries hit by the competition) for protection. A recent issue of *U. S. News and World Report* quotes an astute political observer as saying that Democrats would be protectionists in the 1960's from the pressure of labor and agriculture. For those of us who have been studying international economics for some time, it has long been a question as to why labor in particular has not been more protectionist. It does not take a great deal of astuteness to see that in many instances protection would be to the relative advantage of labor. This is particularly true as expansion abroad occurs in the low wage countries. But, at least in the recent past, labor leadership has indicated that it feels that the broad national interest is of predominant importance and that labor is better served through raising national income by more liberal trade policies; that is, the same share of a larger pie is considered better than a larger share in the same pie. There is no doubt that particular companies and even industries will be under strong competitive pressure from abroad in the next few years and

some may actually fail under stress from foreign competition. Yet, it would be a tragedy for the richest country in the world to hide behind protection, particularly at a time when it is urging other countries to forego this particular technique.

There is likely to be a pressure for increased protection from another angle—that of U. S. producers sustaining greater competition from those countries which are industrializing to produce items previously imported. As the composition and volume of exports of the foreign countries changes with economic growth and as a result of the investment in their industries, a complementary shift will occur in U. S. trade. In addition, there will be a pressure to change the *direction* of trade. These shifts will require greater flexibility and technical efficiency in order to maintain our competitive position. In the longer run, it would also require decreases in prices, rather than increases in wages and profits, with rising productivity in the United States.

It is to the credit of U. S. industry that during the past several decades, while prices of industrial goods have on the world market been rising generally, there has been a faster rise in prices of British and European products than in the prices of American products. However, this situation is currently changing, and it may be necessary for U. S. industry to examine the possibility of selling abroad at prices different from those at home. While this may well raise the question of dumping, there is a considerable difference between selling abroad below prime cost and selling at competitive market prices abroad—prices which are set by market forces outside of the U. S. economy. This suggestion of differential pricing is one of "competition" rather than of "protection."

Effects of Regional Economic Integration

Also from the longer-run viewpoint, additional pressures for protection in the United States may well arise out of the movements toward regional economic integration in Europe and Latin America, and possibly in the Middle East. These groupings will direct trade away from the United States into intra-regional channels. They are inherently discriminatory against "outsiders" and therefore will press down on the U. S. exports. It is to be hoped that the desired result of greater economic growth for the group as a whole will bring an increase in trade with the outside countries, but this will be accomplished only if additional barriers are not imposed on such trade.

It is not now clear from the actions of the Common Market or the European Free Trade Area whether the net effect will be to destroy trade with the United States or lead to an expansion of its trade with either group. The most immediate impacts will probably be to reduce trade, however, as the preferential tariffs (or removal of all duties) encourage intra-regional trade and before the longer-run effects of rising income can have substantial impact on imports from outside.

It will take a fairly high degree of statesmanship on the part of the excluded countries (namely the United States and Canada) to avoid "retaliatory" action through higher duties or tariff quotas. United States policy is currently directed toward obtaining as much equality in treatment for the outside countries as it can, thus reducing the degree of discrimination and the changing of trade channels.

However, the very possibility of being excluded and the enticement of an expanding market within a region has caused an expansion of direct investment and licensing in both Europe and Latin America—much of it with a view to serving those markets from local production rather than exports. These moves point to the further *relative* decline in the volume of trade compared to total world production and probably to a considerable shift in its composition. For example, differentials in other costs become narrowed. The flow of capital and technology and the eventual upgrading of labor productivity and finally the increase of wage rates will bring a considerable degree of homogeneity in the distribution of factors of production throughout the industrialized and industrializing countries. The major differentials will arise in raw material supplies and the cost of transporting such materials and the finished products. Without efforts to reduce the current level of barriers, it is likely that there will be a progressive decline in the *relative* importance of trade though its absolute volume will increase and its composition change.

To reduce barriers requires the development of a wide "community of interest" among Western nations. With such a community of interest, specialization could be carried to its most efficient level in each industry in each country, and trade would arise on the principle of division of labor just as it does within each country or should within the regions to be economically integrated. In other words, only with much freer trade would the volume of trade likely increase relatively as the wealth of nations increases in the future. That such a community of interest may be developed is not beyond the realm of possibility, but it will probably not be soon unless there is a horribly undesirable alternative to "force" the choice.

In the absence of such a "community of interest," nationalism will be the rallying cry, and the tendency of each nation will be to achieve a high degree of self-sufficiency within itself *or* within its regional group. Though the drive to autarchy will probably be modified by regional integration and a considerable laxity toward foreign enterprises—not only permitting but encouraging them to enter—the result will be an increasing diversity of domestic production and a *relative* decline in trade among nations.

It can be seen from the discussion in this section that the U. S. economy faces some major decisions as to how it will pursue its own "national interest" in the area of foreign economic policy. Even if it adopts the more enlightened approach of seeking to reduce barriers to the movement of commodities, capital, men, and ideas, there are going to be some rather painful adjustments required in specific industries both here and abroad, consequent upon the shifts in production abroad and the volume and direction of trade. These burdens will arise in some degree even if we do not assist development abroad; we may profit privately and nationally by assisting them. But some costs of adjustment will have to be borne; they can be sustained more readily and means found to ease the impact on particular groups if the United States maintains a flexible and expanding economy of its own.

MEASURES FOR SUPPORT OF U. S. INTERNATIONAL BUSINESS

The stated policy of the U. S. Government toward U. S. direct private investment and licensing abroad is a favorable one; it not only approves, but it also

promotes such activities in various ways. With or without governmental encouragements, these activities are increasing, but the evidence indicates that they are not expanding in the areas where the challenges of nationalism and mass poverty are arising. Europe and Latin America continue to be the most attractive areas. Yet these are in less "need" from the standpoint of national interest; in fact, support of regionalism may be to the detriment of the U. S. economy. If private activities are to substitute for or complement governmental aid abroad, there must be some inducement to rechannel and expand the flow of direct investment and the transfer of know-how into the areas which are currently less developed. Since an increase of direct investment and licensing in the underdeveloped countries is to the benefit of the national interest of the United States, responsibility for promoting this flow of funds and know-how devolves upon the U. S. Government. But implementation of such a policy can be obtained only with the acquiesence of the business community, and it will act only when a direct benefit is seen. Since U. S. companies are taking more careful notice of opportunities abroad and are in many cases jumping into areas and operations before they are actually ready, we can conclude that some benefits do arise. We therefore have two sectors (public and private) formulating policy—but only one area of implementation—business.

In addition to its programs of investment guarantees against inconvertibility, expropriation, and war, the government should adopt other measures to induce U. S. direct investment and licensing abroad. These include tax relief, clarification of antitrust legislation, and efforts of joint private-government assistance.

Taxation

Tax aspects have been stressed extensively in the discussions concerning the Boggs Bill. Other than a complete removal of foreign taxes, the most effective tax incentives suggested have been (a) the extension of the privilege of formation of a base company, whereby foreign earnings could be retained in the United States tax free until paid out to the parent company, and (b) extension of a tax exemption certificate to U. S. companies investing in specific countries abroad for approved projects.

Foreign Business Corporation

The proposal to permit establishment of a Foreign Business Corporation in the United States is prompted partly by the fact that an increasing number of such companies are being established in "tax haven" countries. Panama, Venezuela, Switzerland, Lichtenstein, and others do not tax (or tax at very low rates) income earned in countries outside of their dominions. This permits the accumulation of considerably larger volumes of investible funds, which may be directed over the world to maximize the return on foreign investments. So long as income is held abroad in this fashion, not only does the U. S. Treasury lose tax revenue, but the government also has less knowledge of the extent and location of foreign investment and the movement of U. S.-owned capital.

A United States F.B.C. would be permitted under the recently proposed H.R. 5 allowing similar privileges of tax deferral on income earned abroad and not remitted to the parent. While such tax deferral does in fact provide some differential

treatment of foreign income, it is no more than is already available through the foreign base company. The only extra advantage provided the F.B.C. would be the tax-free receipt of foreign-owned property of the parent, such as patents, trademarks, equities, etc., on which it could earn income; presently any such transfers to a foreign base company are taxable at capital gains rates unless permission for tax-free transfer is extended by the Treasury (which is seldom done). This permission of tax free transfer of assets would tend to expand foreign operations. And, the ability to accumulate earnings from exports in the F.B.C. would tend to increase the funds available for further investment abroad. While there are considerable arguments as to the tax-loss to the Treasury of such an F.B.C., it will probably be only slightly more than will be the case through foreign base companies without an F.B.C. And, there is no doubt that it would encourage foreign investment and licensing.

The question in the minds of many, however, is whether any encouragement should be given to investment in countries other than the less developed areas. As stressed in a prior section, one of the major challenges facing the United States is the proper treatment of the developing areas; assistance in the promotion of private enterprise within their economies is directly compatible with the aims of overall U. S. foreign economic policy. There are strong reasons for expanding private financial and human capital transferred to these areas. The Treasury has suggested that tax deferral be extended only to those amounts actually re-invested in the less developed countries (presumably under approval of the State Department or Treasury). The argument is made, on the other hand, that no inducement is needed to cause investment to take place in Europe or Canada or Japan and that continued investment in these areas will only reduce U. S. exports, employment, and wages, slowing overall growth.

In reply to the last point, it is quite possible, as indicated above, that pressures on the U. S. balance of payments will arise, but the movement of capital into Europe is a result of the creation of the Common Market, and the possibility of using a foreign base company permits the same action as would arise under the F.B.C. The only possibility of stopping the flow of capital into Europe would be by *forcing* a return of foreign earnings to the United States and preventing an outflow of new capital; earnings from exports would also have to be repatriated by force; thus a full-fledged system of exchange restrictions would be required. It would not be possible merely to stop the use of foreign base companies, for earnings could be retained within the manufacturing subsidiary itself or deposited in local banks; this would not help either the Treasury or the U. S. balance of payments.

In a more positive vein, there are advantages to be gained from permitting further investment in Europe. First, being a low-cost area for some items of demand in the less developed countries, these needy areas can obtain equipment at lower prices than from the United States, hastening their growth. Second, assistance either in building plants or through transfers of technology may be more effective from European operations which are similar in scale or technique to those more likely to be needed in the smaller and less industrialized countries. Third, a freeing of trade and payments would bring sizable benefits to the U.S. economy as

growth occurred in both Europe and the less developed areas. The conclusion to be drawn, therefore, is not that we should recoil from investment elsewhere, but that we should make certain that we reap whatever benefits are available, both for ourselves and our Western allies.

Tax Exemption

The F.B.C. will not, however, bring a larger allocation of investment to the less developed countries *unless* some such discrimination as suggested above were made between uses of funds accumulated, *or* unless some other technique of promotion is adopted. Since it would be unwise to differentiate according to use, as argued above, another technique must be coupled with the F.B.C. What is proposed is the extension of tax-exemption certificates to U. S. companies which invest in approved areas for projects approved by both the U. S. government (State Department) and the foreign government. (Approval by most foreign governments is already required and most U. S. companies have no compunction about providing similar information to the State Department; an agency which might be assigned the job of obtaining such approvals is the new Office of Private Enterprise in the ICA.)

Any interested U. S. business could apply for certificates which, when applied to its tax bill in any given year, would raise its expected return from the investment to levels comparable to those available in other pursuits and thus remove the additional "risk" of investing in the less economically advanced and politically stable countries. Just what the differential return as measured by the tax exemption might be would have to be negotiated for the different investment conditions. But it might be accepted as a general rule of thumb that a total exemption of taxes should be provided so as to insure a return equal to the principle invested within a given (say 10 year) period. By way of illustration, if $100,000 were to be invested in a given project, ten tax exemption certificates at a face value of $5,200 would be extended, each good in a different year. The total sum would thus eliminate the tax on the return of dividends equal to the investment and would double the expected return after taxes—i.e., from 5% to 10%.

If this rate of return is not considered sufficient, the amount of the tax exemption could be raised. And, if it is considered necessary in order not to *require* return of earnings from abroad in order to use the certificate, they could be applied either against any foreign income or domestic income. In the latter case, the maximum foreign earnings could be retained abroad for further investment; also, it would not be necessary for there to *be* any foreign earnings in order to use the certificates, thus "subsidizing" the more risky investments.

Such a program is clearly discriminatory, but it obtains precisely the type of investment abroad which serves the objectives of U. S. foreign economic policy. The cost of the certificates in lost revenue might seem to be large; but, for there to be a "loss" at all, it would have been necessary for the funds to have been invested elsewhere in revenue-producing pursuits. Undoubtedly some productive use would be made of the funds, and some would be directed to the domestic economy; others would go into foreign investment in less risky areas and might or might not produce future taxable income, depending on the use of a foreign base

company. But also, the investment in the less developed countries will produce revenue-bearing income after the tax exemptions are used; and to the extent that the development of the less advanced areas is accelerated, the burden on foreign aid and thus on the U. S. Treasury and taxpayers is lessened. In sum, while there may be a short-term loss of tax revenue, there should be larger income in the future and less need for taxes in the long-run to achieve the same objective of strong Western partners.

Antitrust Clarification

The movement of U. S. business overseas has taken the form of erection of new manufacturing facilities, creation of new companies through joint-ventures, mergers with existing companies, acquisition of plants or companies abroad, and licensing of independent companies. Each of these involves actions which may be in violation of antitrust under some circumstances. While most U. S. companies operating abroad apparently do not now feel pressure from antitrust legislation, a more rapid expansion into wider areas (both commodity-wise and geographically) will increase the possibility of anticompetitive actions. Several representatives of U. S. business have, therefore, urged clarification of the antitrust laws as they apply to foreign commerce.

What is involved, however, is more than a mere "clarification" of existing law. It is apparent from a study of the current state of the law that the criteria of anti-competitive action are based on a rather "simpliste" economic theory as to the nature and benefits of competition. Fundamentally, the belief that "competition *per se* is good," which is stated and implied throughout the antitrust cases on foreign commerce, is based on the view that no advantage can accrue to the nation from actions which are less than competitive. There is a certain ambivalence in holding to this view and at the same time deploring the ability of the Soviet bloc to gain from its "monopoly" methods of state trading. There are, undoubtedly, national gains which can be achieved through discriminatory pricing, differential treatment of separate markets, and selling abroad at prices unequal to those offered at home. So long as there is not in fact a "world" market, to treat quite distinct markets in the *same* fashion is to discriminate.

What is needed, therefore, is a more adequate examination of the structure of the world market, compared to the separate national and regional markets, coupled with an application of welfare criteria to the benefits of foreign commerce. This analysis would demonstrate in all likelihood that a simple pursuit of "competition per se" does not redound to the benefit of the U. S. economy. We cannot jump to the opposite conclusion, however, that any type of monopoly restriction is beneficial. In fact, until we have the proper framework in which to recast the antitrust laws, we probably do less damage through preventing private monopoly than we would through permitting it unrestrained, since it is quite clear that the private interest is not necessarily equal to the national interest and competition prevents the private interest of any one individual or group from being wholly fulfilled.

Government Private Participation

The above two techniques are aimed at expanding the financial resources avail-

able to U. S. companies for investment abroad and at increasing the monetary incentive to the taking of risks in the less developed countries. A third means of accelerating private activities abroad would be through government private participation in the construction, operation, management, and eventual ownership of projects under foreign aid funds. For example, when the United States government approves a foreign project for financing with aid funds it would stipulate that a certain portion of the project would be financed by private enterprise in the United States or at least that the construction be done by a private company. This company would then have the opportunity to buy into the firm abroad once it was proven successful.

Where the foreign government is the dominant partner in the operation, means should be sought of encouraging private U. S. participation either through a management contract, licensing, or venture capital. The U. S. government has become sufficiently concerned with the proper role of private enterprises abroad that it has recently set up advisory councils within the Department of Commerce on problems of foreign trade and operations and has established within the International Cooperation Administration of the State Department an Office of Private Enterprise. It is the duty of this office to find private opportunities abroad and to call them to the attention of the private sector in the United States economy.

SUMMARY AND RECOMMENDATIONS

The purpose of this article has not been to review the particular problems facing the U. S. licensor; this has been done at some length in earlier publications of the Foundation. Rather, it has been to place the techniques of licensing in the broader settings of international business operations and of U. S. foreign economic policy, which must rely in large part on private business. I have attempted to show that licensing and direct investment have important roles to play in the pursuit of the overall objectives of U. S. foreign policy, which include meeting the special challenges of the growth of independent nations out of colonial territories and of the rapid rise of Russia. While the interests of the U. S. government do not necessarily coincide with those of the private sector, the government must rely for implementation of many of its policies on private business. To this end, some measures have been suggested which might be employed by the government to stimulate "appropriate" business activities, including tax incentives, clarification of antitrust legislation, and some means of private-government cooperation in foreign aid.

The private sector, however, can do some things on its own. First, there is need for a larger study of opportunities abroad. It has been found that, as U. S. companies study foreign opportunities, they find less and less need for governmental assistance or encouragement. That is, they discover that the opportunities are themselves sufficiently profitable to warrant their undertaking the projects. More study of opportunities could be done by independent operators such as banks or economic consultants. A consortium of banks or groups of economic consultants could form a private study group to search out foreign opportunities. Stanford Research Institute has found that such an enterprise would probably be very useful. On a small scale a company in Kansas called Private Enterprise, Incorporated is doing this very thing throughout the world.

Each company should also consider the question of whether or not it would be more advantageous to take minority positions in foreign enterprises so as to spread its risks, accelerate the education of foreign nationals, and activate savings abroad into local capital formation. Unless greater participation of foreign nationals in U. S. subsidiary operations is encouraged, there will be greater concern over the role of the "international corporation." There are several conflicts of interest that may arise from the activities of the international corporation which is largely wholly-owned. The foreign government may consider that decisions taken by such an international corporation would not always be in line with the interests of the host government. In addition, decisions of the wholly-owned corporations to centralize management, financial decisions, and research and development operations for the company might be considered against the interests of the host country. Obviously, it must be recognized that conflicts of interest may well arise among the private parties in any joint-venture. But these may be more easily resolved if the national government considers that the activities of the corporation are in general in line with national interests.

Wide-spread licensing of independent companies is a move in the direction of minority participations and eventually joint-ventures abroad. The result is a closer integration of U. S. private business with foreign private business to meet the complex problems of expansion abroad. The drive among Latin American and European countries toward various types of economic and political integration may be complicated, but it should be assisted by the spread of capital and technical know-how. If U. S. companies do not seek to take an active role in the development of less advanced countries, the competition from European and even Russian industries will force or bring solutions which may not be to the advantage of U. S. enterprise or the U. S. economy as a whole. U. S. business must, therefore, take a much more careful look at its international operations from the viewpoint not only of direct profits but also of the ways in which they can best advance the national interest.

STUDENT PAPER*

Certain Aspects of the Armstrong Regeneration, Superregeneration, and Superheterodyne Controversies

JAMES R. GAFFEY

SUMMARY

EDWIN H. ARMSTRONG OBTAINED PATENTS and reaped financial reward from them for his contribution of regenerative, superregenerative, and superheterodyne radio circuits. Claims in each of these patents were later held invalid on the ground of priority of invention by others. Armstrong has been honored by professional groups and shares the social and historical credit for his contributions in these fields.

INTRODUCTION

THE CONSTITUTION OF THE UNITED STATES PROVIDES that Congress has the power "To promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."[1] Unlike the laws of many foreign countries which grant patents to the first inventor who files an application, the American patent law requires that a patent be granted to the first who conceives an invention and is then diligent in reducing it to practice.[2]

Since conception is essentially a subjective matter, the tribunals charged with determining who is the first inventor have a very difficult task which may be complicated by extremely technical subject matter. The patent controversies of Edwin H. Armstrong, perhaps as none other, illustrate these problems.

Edwin H. Armstrong, born December 18, 1890, devoted his adult life to advanc-

* Among the objectives of the seminar and lecture series given by the Foundation in conjunction with The George Washington University Law School are the stimulation of student interest and the initiation of a source of publishable student material for the *Journal*. By making available the best papers, students receive an incentive and our readers will appreciate the evidence of scholarly development in the fields of interest. The Foundation invites educational and research institutions to submit informative student manuscripts on the patent, trademark, copyright, and related systems.

[1] U.S. Const., Art. 1, Sec. 8.

[2] 35 USC 102 (g).

ing the radio art as an inventor, author, and professor of electrical engineering at Columbia University. Forty-three patents [3] have been issued naming Armstrong as inventor. Much of his life, which ended in a tragic suicide on February 1, 1954, was spent in very involved, protracted and taxing litigation concerning among others, his patents on the regenerative circuit,[4] the superheterodyne radio receiver,[5] and the superregenerative circuit.[6] At the time of his death, Armstrong was engaged in sixteen separate infringement suits on a number of his frequency modulation patents. Four more were filed after his death.[7] Five of these suits were dismissed on stipulation and one was tried, the court finding Armstrong's patents valid and infringed.[8]

A biography on Armstrong was published in 1956;[9] the author, Lessing, boldly claims that Armstrong was the true inventor of the regenerative circuit, the superheterodyne radio, and the superregenerative circuit. This paper is devoted to a brief review of some aspects of the legal controversies involving Armstrong's patents on these circuits. Further, an analysis is made of claims that Armstrong is recognized as the true inventor of these circuits.

THE SUPERHETERODYNE CONTROVERSY

By 1917, the radio receiver art had progressed a long way from the day that Marconi first invented the radio. Pickard had devised a crystal detector, De Forest had invented the triode tube, and amplifiers using triode tubes were being used to amplify weak radio signals.

The heterodyne principle was being used to receive radio signals.[10] The principle can be observed and illustrated by causing two tuning forks, such as those used in piano tuning, to vibrate at the same time at different rates. A "beat" note, the difference between the rates of the individual tuning forks, can be heard. As used in the radio art, the heterodyne principle involved the reception of a high frequency radio signal which was "mixed" with another signal of frequency very close to that of the received signal in a non-linear device, such as the crystal rectifier. The result, analogous to that occurring when the outputs of two tuning forks are "mixed" in the human ear, was a beat frequency electrical signal, the difference between the two high frequency signals. The difference frequency signal was within the audio range and could be used to energize earphones or loudspeakers thus giving an audible indication of the presence of a received radio frequency signal.

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[3] See Appendix A.

[4] Patent No. 1,113,149, issued Oct. 6, 1914.

[5] Patent No. 1,342,885, issued June 8, 1920.

[6] Patent No. 1,424,065, issued July 25, 1922.

[7] See Appendix B for a listing of the suits filed on the frequency modulation patents.

[8] Armstrong v. Emerson Radio and Phonograph Corporation, 123 *USPQ* 133, 179 Fed. Supp. 95 (S.D.N.Y. 1959).

[9] Lessing, *Man of High Fidelity: Edwin Howard Armstrong* (Philadelphia and New York: J. B. Lippincott and Company, 1956).

[10] See Patent No. 1,544,081 filed Jan. 2, 1907, issued June 30, 1926.

One of the greatest problems in the radio art which existed at this time was the limitation of the triode tube in radio receivers as an amplifier of high frequency signals. As the frequency became higher, the tube became more and more inefficient. It was to this problem that Armstrong, who was then in France serving in the Army, addressed himself in March of 1918.

Armstrong, knowing that the triode tube could not effectively amplify high frequency radio signals, perceived that if means could be found to reduce the frequency of a radio signal in a receiver before amplification and detection, a greatly improved receiver would result. Using the heterodyne principle, Armstrong provided a non-linear device in which he "mixed" a received high frequency radio signal with a second high frequency signal which he generated in the receiver. The first and second signals when "mixed" provided a difference or "beat" signal, not of audio frequency as in known heterodyne receivers, but of a radio frequency lower than the frequency of either the first or second signals. The "beat" signal so produced was readily amplifiable in the triode tube. After amplification the signal was detected in a conventional detector, such as a crystal rectifier. The output of the detector was an audio frequency which could be used to drive earphones or a loudspeaker.

This invention, which came to be called the superheterodyne receiver, was destined to become one of the greatest advances in the radio art. Today, over forty years later, the superheterodyne principle is used in virtually all radio and television receivers, has wide use in radar, navigation equipment, and many military applications.

Armstrong filed an application on the superheterodyne circuit on February 8, 1919, and received a patent on June 8, 1920.[11] While Armstrong's application was pending, an application for a similar receiving system was filed by Lucien Levy, a French inventor whom Armstrong had met in France. After Armstrong's patent had been issued, Levy copied the claims.[12] The primary examiner refused to allow Levy to make the claims. The principal issue was a simple one. Figure 7 of the drawing in Levy's application included two possible modifications disclosed in dotted lines. One of the modifications disclosed the use of amplifiers for amplifying a heterodyne signal of inaudible frequency, the other a source of a second high frequency signal at a receiving station, rather than a source remote from the receiving station which was also disclosed. In order to make the claims both modifications must exist simultaneously, but Levy's specification lacked any explicit teaching that both could be used at the same time or that any advantage would result from such an arrangement. The Board of Appeals and the Commissioner affirmed; Levy appealed to the Court of Appeals for the District of Columbia, which reversed the Commissioner.[13]

Accordingly, an interference was declared; on opening the preliminary statements, it was found that the earliest date of conception alleged by Armstrong

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[11] Note 5, *supra.*

[12] Except for minor subcombination claims 4 and 5 which Armstrong lost in Interference No. 45,783 and appear respectively in Patent No. 1,508,151 and No. 1,734,132.

[13] In re Levy, 2 F.2d 939, 55 App. D.C. 138 (1924).

was March 1918, later than the French filing date of August 4, 1917, to which Levy was entitled. Armstrong made a motion to dissolve on the ground that Levy's specification did not support the counts, that is, the copied claims; it was denied. Levy filed a motion for judgment; Armstrong responded with a motion for leave to take testimony bearing on the right of Levy to modify his disclosure in order to make Armstrong's claims. The motion was denied and judgment entered for Levy; the Commissioner affirmed. Armstrong appealed; and the District Court of Appeals Affirmed.[14] In due course Levy's patent was issued.[15]

The Court quoted with approval from the decision of the Law Examiner ". . . it requires no inventive extension . . . to provide a basis for the simultaneous use of heterodyne reception and amplification . . ." It is likely that the court probably meant that it could be implied from the Levy disclosure that both modifications could be made at the same time.

While the result of the decision here was to deny Armstrong the distinction of being recognized legally as the first inventor of the superheterodyne receiver, he did not suffer financially for he had sold his superheterodyne and regeneration patents to the Westinghouse Electric Company on October 5, 1920, for $335,000.[16]

THE REGENERATION CONTROVERSY

By 1912, a mere six years from the time that De Forest had invented the triode vacuum tube, many inventors were working on devices which used his invention. De Forest was investigating the use of the new device in low frequency telephone circuits. Armstrong, then a young college student, was addressing himself to the problems of using the triode in high frequency radio receiving circuits.

During the fall of 1912, according to Armstrong, he developed an improved amplifier for high frequency radio signals. He filed a patent application on the device on October 29, 1913, and in due course was granted a patent.[17]

In August of 1912, De Forest, seeking to use triode tubes as a two way repeater for audio frequency signals, interconnected the input and output circuits of a triode and observed that the device would "sing"; that is, produce musical tones.

Armstrong, perceiving a new use for the regeneration phenomenon which he had observed in developing his improved amplifier, filed an application on December 18, 1913, for an oscillating circuit based on the regenerative principle. De Forest filed applications on aspects of the use of his vacuum tube in feedback arrangements on March 21, 1914, and on September 23, 1915. The three applications were placed in interference with others, which had been submitted by two other well known inventors, Langmuir and Meissner.

During the pendency of the interference proceeding, Armstrong sued, in the Southern District of New York, the De Forest Radio Telephone and Telegraph

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[14] Armstrong and Levy, 29 F.2d 953, 58 App. D.C. 293 (1929).

[15] Patent No. 1,734,038, issued November 5, 1929.

[16] Lessing, note 9, *supra*, p. 131.

[17] Note 4, *supra*.

Company for infringement of his amplifier patent. The defense of prior invention by De Forest was rejected and the Armstrong amplifier patent sustained.[18] The Circuit Court of Appeals affirmed [19] finding that De Forest had not understood the true nature of his experiments in 1912. The Supreme Court denied a petition for certiorari.[20] Final judgment was not entered in the infringement suit.[21] Had final judgment been entered, the doctrine of *res judicata* may have been applicable in later suits.

Meanwhile, the Commissioner of Patents, affirming the Interference Examiners and the Board, awarded priority to Armstrong in the four party interference on March 31, 1923. De Forest appealed to the Court of Appeals for the District of Columbia which reversed the Commissioner,[22] but observed in doing so that they were not passing on the invention involved in the New York infringement suit.[23] In due course two patents were issued to De Forest.[24] The interference battle continued in the District Court of Delaware where the three unsuccessful parties filed bills in equity under the provision of Section 4915, Revised Statues.[25]

De Forest, knowing that the decision in the New York infringement suit [26] was not *res judicata,* filed suit in the District Court of Pennsylvania under Section 4918, Revised Statutes [27] to have Armstrong's tuned regenerative amplifier patent [28] declared invalid. The court ruled in favor of De Forest.[29]

The result reached by the Pennsylvania court in declaring claims invalid in the Armstrong patent, which had been sustained in the infringements suit, was based largely on the doctrine of *Morgan* v. *Daniels,*[30] where the Court held that, as to priority of invention, the decision of the Patent Office in interparte cases must be controlling unless the contrary is established by testimony which in character carries thorough conviction. Thus the court considered that the Armstrong radio frequency detector-amplifier invention was the same as the invention claimed by De Forest. One could hardly expect a different result, since Westinghouse and Armstrong had insisted that only one invention was involved,[31] in spite of the fact that Armstrong's initial position in the Patent Office was that

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[18] Armstrong v. De Forest Radio Tel. and Tel., 279 Fed. 445 (S.D.N.Y. 1921).

[19] Armstrong v. De Forest Radio Tel. and Tel., 280 Fed. 584 (C.C.A. 2d Cir. 1922)

[20] De Forest Radio Tel. and Tel. v. Armstrong, 270 U.S. 663, 46 Sup. Ct. 471 (1925).

[21] Note 18, *supra.*

[22] De Forest v. Meissner, *et al.,* 298 Fed. 1006, 54 App. D.C. 391 (1924).

[23] Note 18, *supra.*

[24] Patents No. 1,507,016 and 1,507,017, issued Sept. 2, 1924.

[25] "Whenever a patent is refused . . . by the Court of Appeals for the District of Columbia . . . the applicant has a remedy by bill in equity; and the court . . . may adjudge that such an applicant is entitled . . . to a patent . . ."

[26] Note 18, *supra.*

[27] "Whenever there are interfering patents, any person . . . may have relief . . . by a suit in equity against the owners . . . and the court may declare either of the patents void . . ."

[28] Note 4, *supra.*

[29] De Forest Radio Co. v. Westinghouse, 13 F.2d 1014 (D.C. Penn. 1926).

[30] Morgan v. Daniels, 153 U.S. 120, 14 Sup. Ct. 34.

[31] *Air L. Rev.* 280.

there were two separate inventions, for he had filed separate applications on the radio frequency amplifier-detector and the oscillator.

The proceedings in the Delaware District Court were decided in favor of De Forest.[82]

Armstrong appealed the decision of both the Delaware and Pennsylvania District Courts. These cases, with another case of Langmuir, were argued together, and the Circuit Court, in a single opinion, affirmed in favor of De Forest.[83] In essence, the Circuit Court held that the presumption of validity which attached to the De Forest patents as a result of the proceedings in the Court of Appeals for the District of Columbia had not been overcome. The Circuit Court did not indicate that the Armstrong patent enjoyed any presumption of validity. The Supreme Court affirmed [84] on the authority of *Morgan* v. *Daniels*.[85]

One would think that the controversy was at last ended. As between Armstrong and De Forest and their respective assignees the doctrine of *res judicata* applied; however, the final episode was yet to be determined. It began when the American Telephone and Telegraph Company, the owner of the De Forest patents, sued Radio Engineering Laboratories, a small manufacturing company, for infringement of the two De Forest patents. Armstrong, determined to upset the De Forest patents, undertook to pay the expenses of the litigation. The infringement was admitted, and the defense of prior invention by Armstrong alleged. The District Court upheld the De Forest patents.[86]

The decision was reversed by the Court of Appeals.[87] The Court of Appeals took the view that the invention involved was the radio frequency regeneration circuit and that Armstrong was the first inventor of this particular circuit. The Supreme Court again granted a petition for certiorari, and after granting a petition for rehearing reversed the Court of Appeals.[88]

The evidence produced during the various phases of the regeneration controversy was essentially the same. In an effort to establish a date of conception Armstrong testified as follows:[89]

> Q. 16. Will you please fix as closely as you can the dates of these occurrences?
> A. I showed the apparatus to my father within a very few days after the invention was made; that was about the first of October, 1912. As nearly as I recollect I told Mr. Burgi of my work within a month of that date . . . The disclosure to my uncle occurred during the Christmas holidays of 1912.
> Q. 17. Please state whether or not you made a drawing of the connections and had it witnessed by a notary?
> A. I did. Shortly after receiving this advice I drew up a sketch of the best circuit

[82] Meissner, *et al.*, v. De Forest Radio Tel. and Tel. Co., 18 F.2d 338 (D.C.Del. 1927).
[83] Westinghouse v. De Forest Radio Tel. and Tel. Co., 21 F.2d 918 (C.C.A. 3d Cir. 1927).
[84] Langmuir, *et al.* v. De Forest, *et al.*, 278 U.S. 562, 49 Sup. Ct. 34 (1928).
[85] Note 30, *supra*.
[86] Radio Corporation of America, *et. al.* v. Radio Engineering Laboratories, Inc., 1 Fed. Sup. 65 (E.D.N.Y. 1932).
[87] Radio Corporation of America, *et. al.* v. Radio Engineering Laboratories, Inc., 66 F[2d] 768 (C.C.A. 2d Cir. 1933).
[88] Radio Corporation of America, *et. al.* v. Radio Engineering Laboratories, Inc., 293 U.S. 1, 55 Sup. Ct. 928 (1934).
[89] Transcripts of Records, U.S. Supreme Court Case No. 619, 1933, p. 833.

connections which I had used up to that time and had it witnessed by a notary . . . The date of this sketch was January 31st 1913.

A facsimile of the drawing[40] referred to appears as Figure 1. No written explanation of the operation or results of testing appeared on the drawing.

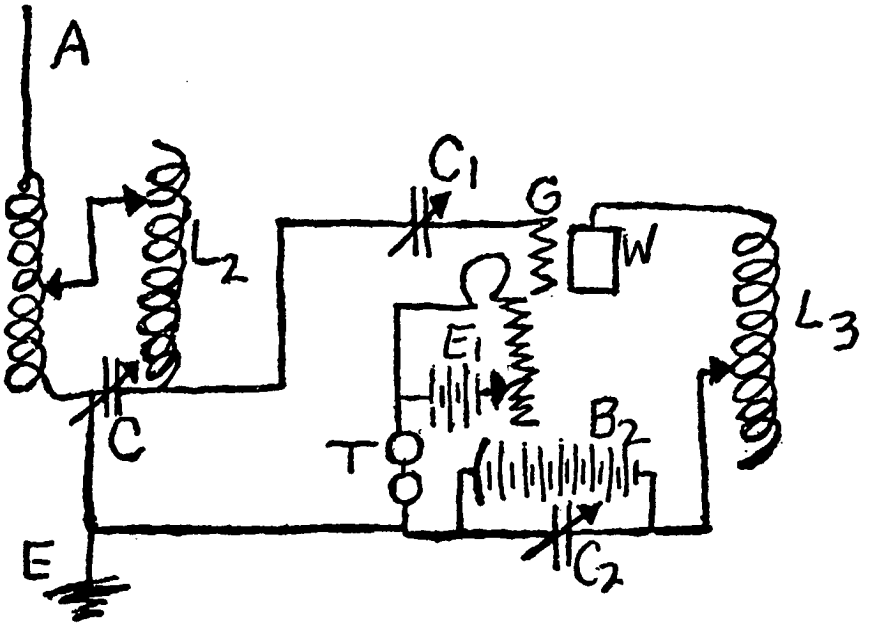

FIGURE 1. ARMSTRONG'S SKETCH OF JANUARY 31, 1913

The testimony of Armstrong relating to his drawing continued:[41]

Q. 19. Did you show the sketch to anyone else at or about this time?

A. To the best of my recollection the next man I showed it to was Mr. Frank Mason, an instructor of mine at Columbia University.

Q. 21. Please state whether or not any of these persons to whom you spoke of your work before you showed it to Mr. Mason had any knowledge of wireless, and whether you attempted to explain to any the nature of your invention?

A. None of these people had any knowledge of wireless phenomena. I did not explain except in a general way, the operation of the system to any of them.

As evidence of conception and reduction to practice by De Forest a number of notebook drawings and records of experiments were presented. On August 6, 1912, De Forest, seeking to use a dual triode tube as a repeater for audio frequency signals, interconnected the input and output circuits. A schematic drawing of this circuit was recorded in the notebook[42] of De Forest's laboratory assistant, Herbert Van Etten; see Figure 2.

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[40] *Id.* at 1419.
[41] *Id.* at 834.
[42] *Id.* at 1166.

The following text accompanied the drawing:

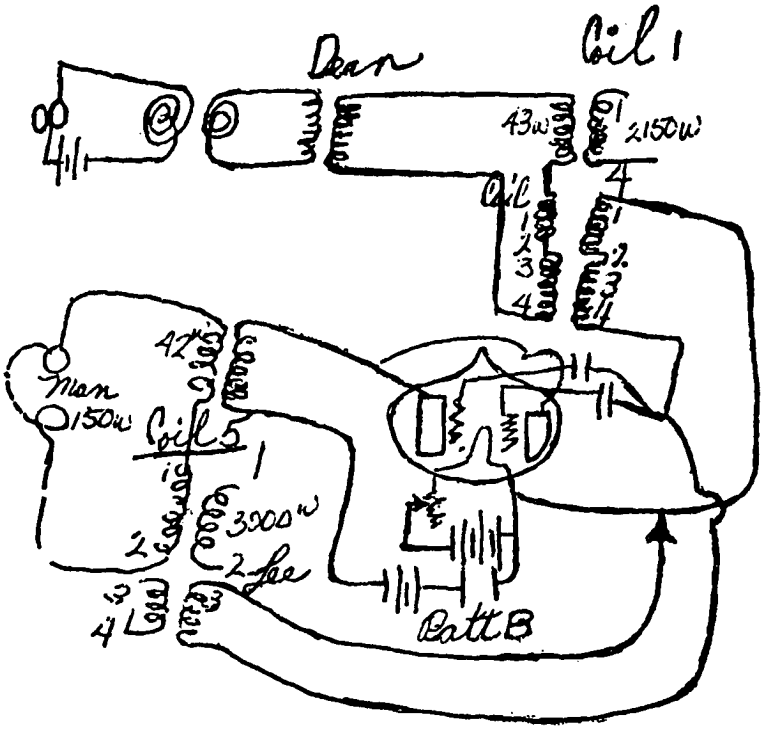

FIGURE 2. DRAWING FROM VAN ETTEN'S NOTEBOOK

> . . . tried the following circuit and found the watch ticks came thru altho they were not amplified . . . a slight loss probably. When 3-4 of coil 5 is connected as indicated to 1-4 of coil 4 get a beautiful clear tone in the phones.

On the following page of Van Etten's notebook[48] notes indicated the tone could be varied by varying the size of the B battery, and that the phenomenon was apparently similar to the howl produced in an ordinary telephone when the receiver was placed next to the transmitter.

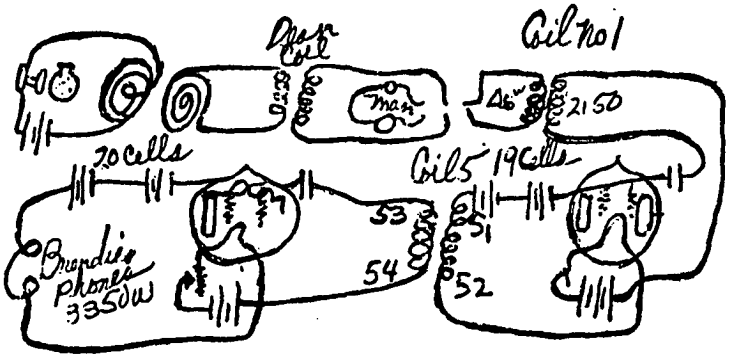

FIGURE 3. DRAWING FROM DE FOREST'S NOTEBOOK

[48] *Id.* at 1167.

A similar experiment was performed on August 29, 1912. A schematic drawing[44] of this circuit was recorded in De Forest's notebook; see Figure 3.

The following text accompanied this drawing:

> Reversing the connections to the secondary wdg. of coil #1 made all sorts of musical notes in the Brandes phones, then reversing the connections to one coil wdg. of coil 5 the musical notes are gone.

De Forest testified with respect to the events of August 1912 as follows:[45]

> Q. 17. The fundamental principle of the patent in suit state when you first became familiar with such a coupling whereby energy in the plate circuit is fed back into the grid filament circuit. With that understanding of what I mean by feed back coupling, will you please state when you first became familiar with such a coupling? [sic.]
>
> A. . . . in the summer of 1912. The first written description of work showing such a coupling occurs, so far as my notebook is concerned, under the date of August 29, 1912 . . . We observed at that time, as noted by Mr. Van Etten, that the pitch of the musical notes could be changed by putting on very small capacities, such as the capacities of one body between or by crossing either any or all of these points through small capacities.

Some questions relating to a demonstration by Armstrong of his regenerative circuit followed in which some similarities were pointed out by De Forest who continued:

> Q. 21. In other words, in the demonstration this morning, the Armstrong circuit was adjusted as described in the patent to a point below oscillations?
>
> A. Yes.
>
> Q. 22. Whereas in your circuit arrangement there described in the book, it was adjusted to obtain oscillations?
>
> A. To obtain oscillations and . . . to change the pitch of the oscillations . . .
>
> Q. 25. Was all of Van Etten's work in connection with the audion under your direction and instruction?
>
> A. Yes.
>
> Q. 42. Did you know at that time, August 6, 1912 why the audion was generating sustained electrical oscillations?
>
> A. We understood perfectly well the reason for this. The first discovery was accidental, but we at once arrived at the correct explanation of this. When the input and output circuits were associated, as I have described in connection with the August 29th sketch.
>
> Q. 45. Did you point out any specific uses to Van Etten and Logwood at that time . . .?
>
> A. On account of the small size of the output I pointed out at that time that it would be chiefly useful . . . as a generator of 500 cycle current, or as a driver where such character of variable current would be needed . . .

Some further questions were asked De Forest by the Court:[46]

> Q. 48. At that time there had been no impression on your mind as to the efficacy of this in connection with receivers?
>
> A. Not immediately at this time, but very shortly thereafter, not on the date of August 29, 1912.
>
> Q. 58. What were the next uses, or when did any other uses suggest themselves to you?
>
> A. I disclosed them to Mr. Stone in October, 1912 . . .

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[44] *Id.* at 1168.
[45] *Id.* at 727.
[46] *Id.* at 734 and 766.

Q. 68. What would be necessary to make, for example, the circuit in Van Etten's notebook generate radio frequencies rather than audio frequencies?

A. Merely the substitution of so-called radio frequency coils for the coils of high inductance . . .

Q. 156. At first, as I gather your testimony, your thought was that this was useful solely in connection with laboratory purposes.

A. That was the first thought that occurred to me after we had our demonstration in August, 1912, this oscillating audion for the production of musical notes.

Q. 167. When was it, if you can answer the question, that you are willing to say you first appreciated that the so-called feed back circuit would be useful for practical radio work?

A. Between the last of August and the last of October, 1912.

Q. 158. And was that your conviction continuously from that time on?

A. Absolutely, yes, sir.

Under cross examination De Forest testified as follows:[47]

X.Q. 176. Now what do you mean by "shortly thereafter?" I want you to say when you first realized that you could make the audion oscillate at any frequency you pleased by varying the inductance and capacity of circuits.

A. Within a few weeks thereafter.

X.Q. 177. Well before August 29th?

A. In less than two months thereafter.

X.Q. 178. Before August 29th?

A. I would not say before August 29, but I would say before October 30th.

With respect to the first use of the oscillating audion De Forest testified on cross examination as follows:[48]

X.Q. 121. When did you first successfully apply the oscillating audion to either one of the three purposes covered by this investigation?

A. In the spring of 1913 at Palo Alto, I connected the audion with a feed back circuit so as to detect by audio heterodyning the arc signals from Federal's telegraph station at South City, San Francisco . . .

X.Q. 140. This morning you testified that in the spring of 1913 at Palo Alto you first successfully applied the oscillating audion to either of the three purposes of your investigation; do you wish to correct that statement?

A. Yes . . . The production of alternating currents which were actually serviceable in radio signalling was the event I had in mind when I answered X.Q. 121.

By other testimony[49] De Forest fixed the date of this use in a radio as April 17, 1913.

It was not until March 21, 1914 that De Forest filed a patent application, after he had learned of Armstrong's work, as indicated by his own testimony:[50]

X.Q. 75. . . . In the interval between February 4th, 5th, 1914 you had learned, had you not, Dr. De Forest, that Mr. Armstrong had some sort of set-up for receiving signals at his home; that he had received signals from Honolulu . . .

A. During what interval?

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[47] *Id.* at 767.
[48] *Id.* at 163.
[49] *Id.* at 161.
[50] *Id.* at 168.

X.Q. 76. Prior to February 5, 1914?

A. I believe that is correct . . . but I knew nothing of the details. I did not know what he did at the time.

The testimony of De Forest was corroborated by Van Etten and Charles V. Logwood.[51] However, John Stone, to whom De Forest had disclosed his invention, testified as follows:[52]

Q. 16. At the time you were thoroughly conversant in the radio art and were conversant with the radio situation, were you not?

A. Yes, I think I was.

Q. 17. As an engineer appreciating these requirements, did it occur to you that this disclosure by De Forest embodied the idea of extreme or unusual value to the radio art?

A. No, I did not perceive any value.

After 14 years of litigation, we find that seven tribunals had ruled in favor of De Forest and six in favor of Armstrong. Having essentially the same evidence before them, equally competent tribunals reached different conclusions on the issue of priority of invention. All of the courts and, in particular, the two Circuit Courts seem to have been well apprised of the prior art. The major difficulty seemed to be in interpreting the complex technical subject matter in the light of the patent law, which compelled lay tribunals to make a determination of who was first to conceive the subject matter of the claims.

THE SUPERREGENERATIVE CONTROVERSY

The superheterodyne radio, as it had developed in 1920, was a very expensive and complex device. Many engineering problems needed to be solved before an inexpensive version could be developed. The regenerative receivers available were relatively inexpensive and simple, but had a tendency to "howl," that is, break into oscillations. What the radio industry appeared to need at the time was an inexpensive receiver which did not "howl."

Armstrong, while experimenting with a regenerative circuit, discovered that if means were provided to disable the regenerative circuit at a superaudible rate, it was possible to prevent the circuit from howling and still provide for amplification and detection.

A patent application on this new circuit was filed by Armstrong on June 27, 1921 and in due course a patent was granted on July 25, 1922.[53] Shortly thereafter broad claims in the patent were copied by Charles Logwood, and an interference declared by the Patent Office. Later a third party, Laurence B. Turner, was added. On opening the preliminary statements, it was found that Turner's filing date was prior to the earliest date of conception alleged by the other parties. Accordingly, priority was awarded to Turner with respect to the broad claims of Armstrong's patent.[54] In due course a patent was issued to Turner.[55]

[51] *Id.* at 223, 273, 458, 579, 1093.
[52] *Id.* at 675.
[53] Note 6, *supra.*
[54] 319 OG 705.
[55] Patent No. 1,642,861, issued Sept. 20, 1927.

Armstrong did not suffer any financial loss as a result of this interference, for he had sold his rights on the superregenerative circuit to R.C.A. in June, 1922, for $200,000 and 60,000 shares of R.C.A. stock.[56]

THE SOCIAL AND HISTORICAL CREDIT

In spite of Armstrong's failure to retain legal credit for being the first inventor of the regenerative, superregenerative, and superheterodyne circuits, he has been given a part of the social and historical credit which he shares with others. He has also been honored by professional societies for his contributions.

Armstrong is identified as an inventor of the regenerative circuit, the superheterodyne, and superregenerative circuit in *Who's Who in America*.[57] The same publication [58] credits De Forest as an inventor of the triode tube as a radio detector, radio and telephone amplifier, and oscillator. *International Who's Who* [59] similarly credits both inventors.

The Encyclopedia Americana [60] indicates that De Forest "discovered" the oscillating properties of the audion in 1912, and that Armstrong "perfected" the regenerative circuit in 1913. It goes on to state that the circuits were similar in operation, and that after years of litigation, the Supreme Court decided in favor of De Forest. *The Encyclopedia Britannica* [61] simply reports that between 1910 and 1915 Armstrong, De Forest, Meissner, and others found special advantages in a feedback circuit which produced either regeneration or self-oscillation.

Donald McNicol, past president of the Institute of Radio Engineers, mentions both Armstrong and Logwood as contributors of the superregenerative circuit,[62] both Armstrong and Levy as inventors of the superheterodyne,[63] and De Forest and Armstrong as contributors of feedback circuits.[64] Many other authors of historical accounts of the development of the radio industry credit both inventors in these instances of dual inventions.

Armstrong, who had been awarded the Medal of Honor by the Institute of Radio Engineers in 1917 [65] for his work on the feedback, or regenerative circuit, sought to return the Medal at the National Convention of the Institute in May of 1934 as a result of his defeat in the Supreme Court. The President of the Institute, Mr. Jansky, on behalf of the Board of Directors refused to accept the Medal and quoted the substance of the citation which accompanied it:[66]

That the Medal of Honor be awarded to Edwin Howard Armstrong for his engineering

[56] Lessing, Note 6, *supra* at p. 146.
[57] *Who's Who in America* (Chicago: Who's Who, Inc. [Marquis]), XXVIII, p. 84.
[58] *Id.*, XXX, p. 693.
[59] *The International Who's Who* (18th ed.; London: Europa Publications Ltd., 1958), p. 28 and (27th ed., 1958), p. 213.
[60] *Encyclopedia Americana* (New York: Americana Corporation, 1958), XXIII, 121d.
[61] *Encyclopedia Britannica* (Chicago: Encyclopedia Britannica, Inc., 1958) VIII, p. 340H
[62] McNicol, *Radio's Conquest of Space* (New York: Murray Hill Books, Inc., 1946), p. 280.
[63] *Id.* at p. 264.
[64] *Id.* at pp. 173-184.
[65] *Proceedings of the Institute of Radio Engineers* (April 1919), v. 7, p. 96.
[66] *Proceedings of the Institute of Radio Engineers* (June 1934), v. 22, p. 812.

and scientific achievements in relation to regeneration and the generation of oscillations by vacuum tubes.

In 1940 the American Society of Mechanical Engineers awarded Armstrong the Holley Medal "for his leadership in the field of radio communication."[67]

The renowned Franklin Institute presented him with the Franklin Medal for 1941 saying:[68]

> . . . in recognition of his pioneer work in regeneration and the oscillating vacuum tube circuits, in the invention of the superheterodyne circuit, the super-regenerator, and a system of wide swing frequency modulation, each an outstanding contribution to the communication art."

The Edison Medal, given annually by the American Institute of Electrical Engineers for meritorious achievement in the electrical field, was awarded to Armstrong for the year 1942. The medal was presented with these remarks:[69]

> . . . for distinguished contributions to the art of electric communication, notably the regenerative circuit, the superheterodyne circuit, and frequency modulation.

CONCLUSION

The claims of Lessing and others that Armstrong is recognized as the "true" inventor of the superheterodyne radio, the regenerative circuit, and the super-regenerative circuit are understandable. One can hardly expect the social and historical credit to be identical with the legal credit, especially when the legal credit is clouded by divergent findings. This lack of identity does not make a legally recognized inventor any less "true" than a socially and historically recognized contributor in the same subject area.

The superheterodyne and superregenerative controversies illustrate relatively easy applications of the patent law, which provides that only the first inventor be rewarded by the grant of a patent. The regenerative controversy, on the other hand, illustrates an instance where the application is very difficult because of overlapping dates and complex technical subject matter.

The outstanding problem in the De Forest-Armstrong controversy appears to be that of recognition. It is the opinion of the author that both of these men would have fought just as hard for priority regardless of whether or not money was involved.

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[67] *Mechanical Engineering* (January 1941), v. 63, p. 61.
[68] *Franklin Institute Journal* (September 1941), v. 232, p. 260.
[69] *Electrical Engineering* (January 1943), v. 62, p. 27.

APPENDIX A

PATENTS NAMING ARMSTRONG AS INVENTOR

1,113,149	Oct. 6, 1914
1,336,378	April 6, 1920
1,342,885	June 8, 1920
1,388,441	Aug. 23, 1921
1,416,061	May 16, 1922
1,424,065	July 25, 1922
1,502,875	July 29, 1924
1,539,820	June 2, 1925
1,539,821	June 2, 1925
1,539,822	June 2, 1925
1,541,780	June 2, 1925
1,545,724	July 14, 1925
1,611,848	Dec. 21, 1926
1,675,323	July 3, 1928
1,716,573	June 11, 1929
1,941,066	Dec. 26, 1933
1,941,067	Dec. 26, 1933
1,941,068	Dec. 26, 1933
1,941,069	Dec. 26, 1933
1,941,447	Dec. 26, 1933
2,024,138	Dec. 17, 1935
2,062,074	Dec. 8, 1936
2,082,935	June 8, 1937
2,085,940	July 6, 1937
2,098,698	Nov. 9, 1937
2,104,011	Jan. 4, 1938
2,104,012	Jan. 4, 1938
2,116,501	May 10, 1938
2,116,502	May 10, 1938
2,122,401	July 5, 1938
2,130,172	Sept. 13, 1938
2,169,212	Aug. 15, 1939
2,203,712	June 11, 1940
2,215,284	Sept. 17, 1940
Re 21,660	Dec. 17, 1940
2,264,608	Dec. 2, 1941
2,275,486	Mar. 10, 1942
2,276,008	Mar. 10, 1942
2,290,159	July 21, 1942
2,295,323	Sept. 8, 1942
2,315,308	Mar. 30, 1943
2,318,137	May 4, 1943
2,323,698	July 6, 1943

APPENDIX B

SUITS FILED ON ARMSTRONG'S FREQUENCY MODULATION PATENTS

	DEFENDANT	DATE	PROCEEDING NO.	COURT
1.	Radio Corp. of America & The National Broadcasting Co.	July 22, 1948	1139 C.A.	(D.C. Del.)
2.	Allen B. Dumont Laboratories, Inc.	Dec. 17, 1953	1580 C.A.	(D. C.Del.)
3.	Philco Corporation	Dec. 17, 1953	16170 C.A.	(E.D. Penn.)
4.	Emerson Radio & Phonograph Corporation	Dec. 21, 1953	90–142 Civ.	(S.D. N.Y.)
	(Consent Judgment, Jan. 28, 1960)			
5.	Radio and Television, Inc.	Jan. 4, 1954	90–212 Civ.	(S.D. N.Y.)
	(Dismissed on Stipulation Sept. 5, 1956)			
6.	Sylvania Electric Products, Inc.	Jan. 6, 1954	54–6–S	(D.C. Mass.)
7.	Motorola, Inc.	Jan. 6, 1954	54C19	(N.D. Ill.)
8.	The Radio Craftsmen, Inc.	Jan. 6, 1954	54C20	(N.D. Ill.)
	(Dismissed on Stipulation Sept. 14, 1955)			
9.	Sentinel Radio Corporation	Jan. 6, 1954	54C21	(N.D. Ill.)
	(Dismissed on Stipulation April 2, 1956)			
10.	Wells-Gardner & Co.	Jan. 6, 1954	54C22	(N.D. Ill.)
	(Dismissed on Stipulation July 20, 1955)			
11.	Gilfellan Bros., Inc.	Jan. 7, 1954	16, 169T	(S.D. Cal.)
12.	Admiral Corporation	Jan. 7, 1954	1586 C.A.	(D.C. Del.)
13.	Avco Manufacturing Corporation	Jan. 7, 1954	1587 C.A.	(D.C. Del.)
14.	Arvin Industries, Inc.	Jan. 12, 1954	3635 Civ.	(S.D. Ind.)
	(Dismissed on Stipulation April 23, 1956)			
15.	Hoffman Radio Corporation	Jan. 7, 1954	16, 170T	(S.D. Cal.)
16.	Packard-Bell Company	Jan. 7, 1954	16, 171T	(S.D. Cal.)
17.	Philharmonic Radio and Television Corporation	Aug. 5, 1955	102–294	(S.D. N.Y.)
18.	Bendix Aviation Corporation	Aug. 8, 1955	1741	(D.C. Del.)
19.	International Telephone & Telegraph Corporation	Aug. 9, 1955	8427 Civ.	(D.C. Md.)
20.	Fada Radio & Electric Co., Inc.	Aug. 11, 1955	102–343 Civ.	(S.D. N.Y.)

BOOK REVIEW

DYNAMICS OF THE PATENT SYSTEM. Discussions of the Ten Critical Areas of Contemporary Patent Law, The Patent Law Seminar, Villanova University School of Law, Villanova, Pennsylvania. Edited by William B. Ball, Professor of Law, Villanova University Law School. Central Book Company, Inc., 850 DeKalb Avenue, Brooklyn 21, New York. 448 pp. $12.50.

Reviewed by JOSEPH ROSSMAN*

THIS VOLUME CONTAINS THE PROVOCATIVE PAPERS and discussions presented during a seminar of ten sessions in the fall of 1957 at the School of Law of Villanova University. These sessions were arranged with the cooperation of Mr. Virgil E. Woodcock and Mr. Joseph Gray Jackson, well-known attorneys of the Philadelphia Patent Bar, which has held for many years so-called "Junto" patent law meetings. The meetings are patterned on Benjamin Franklin's "The Junto" which he started in 1727 as a club of bright young men who met in the warmest of good fellowship to discuss topics of the day. Franklin describes the rules of the club in his *Autobiography*. Each member was to present a paper once in three months that was to be discussed. "Our debates were to be under the direction of a president, and to be conducted in the sincere spirit of inquiry after truth, without fondness for dispute, or desire of victory; and, to prevent warmth, all expressions of positiveness in opinion, or direct contradiction, were after some time made contraband, and prohibited under small pecuniary penalties."

There is a brief foreword by Federal Judge John Biggs, Jr., who states that he hopes the papers will be the starting point for constructive action and the formulation of needed changes in patent law and procedure.

The first paper (pages 1-33) by Mr. Edwin L. Reynolds, Chief Technical Advisor, U. S. Court of Customs and Patent Appeals, discusses the standard of invention followed by the Patent Office. He concludes that the overall standard of invention applied by the Patent Office is now substantially lower than that applied by the courts which pass upon the validity of patents and steps should be taken to reduce this discrepancy. Mr. Reynolds gives no statistical data to support his conclusions. The available statistics of court decisions do show a high percentage of decisions invalidating patents in litigation. But since only a tiny fraction of all issued patents is ever litigated, it is this reviewer's opinion that such

* Dr. Rossman is a member of the Research Staff.

court statistics do not necessarily reflect the same proportion of invalidity of all issued patents. It is usually the borderline patent that gets into court and no statistics are presently available on the total number of patents which are recognized as being valid and are therefore never contested. Also, who is to judge at the outset whether a gadget invention is not worthy of a patent? The telephone, telegraph, movie, radio and television were regarded as mere "gadgets" in their early stages. In fact, nearly all basic inventions must necessarily go through the "gadget" stage. The Patent Office policy of resolving doubts in favor of the inventor is thus sound. It encourages investment which promotes industrial progress. As expected, a lively discussion followed, led by Mr. Arvid Lyden, Patent Department, Pennsalt Chemicals Corporation, and nine other attorneys, which touched on various possible remedies, such as opposition proceedings, spot checks on the work of examiners, additional supervisory examiners, rigorous proof in pharmaceutical and chemical cases, etc.

Mr. Thomas Cooch, of the Wilmington, Delaware Bar, presents a paper (pages 34-72) on the standard of invention in the courts, which is a refreshingly frank discussion by an experienced trial lawyer. He believes that the question of "invention" is a question of "fact" even though it cannot be proven by an eye-witness. He discusses the methodology which should be followed in court to establish "invention." He also points out why patent statistics of court decisions do not shock him, since the sample is too small and there are good reasons for invalidity holdings not always attributable to Patent Office procedures. Mr. C. Marshall Dann, Assistant Manager, Patent Division of E. I. du Pont de Nemours & Company, led the discussion of this paper. He presented patent statistics to show how patents fared in the courts during the last 30 years. Discussions by Mr. George L. Church, Patent Department, Sun Oil Company, and Mr. W. Wycliff Walton contributed further light on the subject of whether invention is a question of fact and not of law.

Mr. Joseph Gray Jackson's scholarly paper "Patent Claims Before The Patent Office" (pages 73-127) covers many problems which frequently arise in prosecution of patent applications and includes valuable pointers to practicing attorneys. The paper is profusely annotated with recent decisions. Mr. Jackson gives a very concise statement of the function of claims and then goes on to give an excellent analysis of process claims. He then discusses the problems of claiming new uses under Section 100 of the 1952 Patent Act. Other topics covered are introductory clauses in claims, mathematical expressions in claims, completeness of definition, definiteness, and "means" claims. An interesting discussion follows, led by Mr. Francis J. Bouda, Patent Counsel of Scott Paper Company, which includes current experiences with claim problems.

A paper "Patent Claims and Infringement" by Mr. Floyd H. Crews of the New York Bar (pages 128-154), after reviewing a few court decisions, concludes that it is the attorney's job "to sell the judge a bill of goods" on the merits of the invention covered by the patent and "the court will find the rules of law to fit your case." The paper presents a pragmatic approach to litigation problems. For example, Mr. Crews points out that in appeal cases it is better to appeal on ques-

tions of law rather than on the findings to get a reversal. The floor discussion of this paper was led by Mr. Robert B. Frailey of the Philadelphia Bar.

The paper by Mr. Zachary T. Wobensmith, II, of the Philadelphia Bar, "Who Is The First Inventor?" (pages 155-187), discusses some special problems in patent interferences. He discusses the *Mason* v. *Hepburn* doctrine, the abandoned experiment, corroboration, and estoppel in interferences. Mr. Wobensmith cites numerous decisions and gives some sound practical advice based on his own rich experience as a practicing attorney. A lively discussion of the paper led by Mr. Robert J. Mawhinney, Houdry Process Corporation, is included.

Dr. Howard I. Forman, Patent Attorney, Rohm & Haas Company, contributes a paper entitled "Inventors and Their Relations With Others" (pages 188-237). He discusses the problems of employee agreements to assign inventions; the problems of the individual inventor in exploiting his patent rights; confidential disclosures; types of patent licensing, royalty provisions and methods of arriving at suitable royalty rates; and foreign patents. Dr. Forman presents a very clear and concise review of these widely ranging topics in his usual scholarly manner with numerous supporting authorities which should be valuable to the practitioner. A discussion led by Mr. H. Gordon Dyke, Manager of Patent Department, International Latex Corporation, adds to the value of this paper.

A paper on design patents by Mr. Henry N. Paul, Jr., (pages 238-262) and discussion led by Mr. Kennard N. Ware, both of the Philadelphia Bar, covers questions of patentability of designs and infringement. The current severity of the courts in regard to design patents is touched upon and proposed design legislation is discussed.

Mr. Virgil E. Woodcock, of the Philadelphia Bar, in a paper entitled "What Is Prior Art?" (pages 263-332) gives a very comprehensive and scholarly discussion of current problems of assessing prior art as a statutory bar under the present Patent Act and court decisions. He discusses the effect of prior inventions of another; prior knowledge and use; prior patenting; prior description in a printed publication; Alien Custodian publications; published abstracts of U. S. applications; manuals and instruction books; prior filing by another; publication, public use, and sale under Section 102; prior public use and experimental use; experimental use: field trials, durability tests, in secret or in public; changes made during experimental use; abandonment; propriety of combining patents issued after applicant's filing date. This paper is virtually a treatise in miniature and is one of the best surveys which has yet appeared in print on this important and complex topic. The numerous citations make it valuable reference material for patent attorneys. A discussion led by Mr. Robert I. Staples, Patent Attorney, The Electric Storage Battery Company, touches on a number of interesting questions relating to prior art. A short memorandum by Mr. Jacob C. Kellem, of the Wilmington, Delaware Bar, is included entitled: "Can Damages Be Collected For Infringement Occurring Upon the Last Day Before the Patent Expires?" and "Can A Patent Be Sued Upon The Day It Issues?"

Judge Giles S. Rich, U. S. Court of Customs and Patent Appeals, presents a paper "Contributory Infringement," (pages 333-364) which gives a lucid discus-

sion of the doctrine of contributory infringement, its historical development by court adjudication, a history of proposed legislation efforts and final codification of the doctrine in Section 271 of the present Patent Act for which Judge Rich deserves much of the credit in drafting same and having it enacted by Congress. Judge Rich has previously published several articles on this topic. The present paper represents his current thinking five years after Section 271 was enacted, in the light of recent cases. He believes that Section 271 has restored balance in the relation between the patent system and the antitrust laws. A discussion of the paper was led by Maurice A. Crews, Assistant Commissioner of Patents, U. S. Patent Office. Mr. P. J. Federico, Member of the Board of Appeals of the Patent Office, also participated in this discussion.

Mr. John Hoxie, of the New York Bar, presents a paper on "Misuse of Patents" (page 365-392) followed by a discussion led by Mr. William P. Cole, of the Philadelphia Bar. The development of the doctrine of misuse is traced and practical problems of meeting such situations are discussed.

The volume contains a very detailed subject index which serves to locate the topics discussed. A table of cases is also included.

The patent profession should be greatly indebted to Professor William B. Ball, of the Villanova University School of Law, for his creative efforts in sponsoring this unique symposium and also for his arduous work in editing the papers and discussions and getting them into print in a very handsome volume.

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NOTES

Foundation Accomplishments Reviewed and DIGEST Introduced

For the benefit of our readers who are not members of the Foundation and do not receive the *Report to Members,* we are reprinting below an editorial entitled, "Looking Ahead On Our Birthday," which appeared in the *9th Report.* This editorial reviews our accomplishments since establishment of the Foundation in 1954, and introduces the *Digest,* a new publication devoted to the presentation of non-technical summaries of the results of Foundation research and news of its educational activities. The *Digest* is intended for the use of executives, government officials, educators, and laymen generally, as well as for those with a professional interest in the patent and related fields.

The advent of our sixth birthday on February 11 prompted not only the change in the format of *Report to Members,* but also the inauguration of a supplement to the *Report to Members* to be called, *Digest.* This *Digest* will be beamed, in addition to members, at selected professional men, business and government executives, and educators interested in the patent and related systems and the contributions made under the Foundation's auspices. It will not have the great variety of information about the people and events of the Foundation which is included in the *Report to Members.* The *Digest* will be devoted solely to our research and educational programs and non-technical summaries of our findings and will be issued more frequently than the *Report To Members.* As we establish a broader and more effective communication base, we expect the Foundation to benefit as well as the broader audience being contacted. A larger group will be made aware of the Foundation's work and its meaning and the Foundation may eventually increase the sources of its support.

Over the years a wider and wider audience has become interested in the research and educational programs and findings of the Foundation. The need for an organization like the Foundation has been increasingly recognized. The Foundation is dedicated to disinterested inquiry into the nature and value of the patent and related systems and the dissemination of the findings to specialists and the public at large. The significant function performed by the Foundation is indicated by the increase in the number and variety of members, the increasing press references to Foundation reports, and the growing frequency of citation of the various reports of the Foundation in the literature. It is also shown by the increasing number of inquiries by government officials for information relating to the

Foundation's fields of interest. We have been pleased to be asked to undertake studies for the National Inventors Council on "Attitudes of American Inventors Toward Defense Invention," and the General Services Administration of "Federal Patent Policies in Research and Development Contracts." Area Committees have also sought our assistance and advice with respect to subjects of local interest such as educational curricula, etc. In turn, we have been enriched by the growing communication with practicing patent attorneys, educators, business men, and research workers.

It has been our custom to consult with informed people in the field intimately concerned and competent in the aspects of subject matter under study. Included are practicing patent attorneys, educators, engineers, physical scientists, business and government executives, economists, statisticians, psychologists, and other social scientists. It is our purpose that the spectrum of our information sources will be very broad in scope. In like manner our audience is becoming more and more diversified and our efforts to communicate with them must be rendered more effective.

Among our achievements during the past six years are:

(1) Establishment of a journal and putting it on a quarterly basis.

(2) Establishment of an annual public conference and publication of proceedings; and the "Charles F. Kettering Award for Meritorious Work in Patent, Trademark, and Copyright Research and Education."

(3) Expansion and diversification of research topics and publication of the results in the *Journal.*

(4) Establishment of diversified educational program with such media of communication as a section of the *Journal* devoted to education; a pamphlet series for young people; guides to Foundation research; and a Seminar and Lecture series; and a student assistance award in the name of the Patent Office Society.

(5) Establishment of Area Committees to maintain grass-roots contact and spread the information and guidance to school systems and local organizations; a *Report To Members* of the Foundation; and an annual *Bulletin,* including information on the organization, personnel, membership, and programs of the Foundation.

(6) Maintenance and establishment of liaison with other organizations in bringing to bear the special contribution of the Foundation in these coordinating activities.

For our six years of existence we feel we should list at least six accomplishments. There is a seventh and more subtle accomplishment which we must continue to elaborate throughout the future life of the Foundation. This is the establishment of a school of attorneys and social scientists from different specialties and fields of learning dedicated to a dispassionate inquiry into and reporting of the facts concerning the patent, trademark, copyright, and related systems. On these important matters there has often been more heat generated than

light cast. We go forward in confidence that the torch they will hold high will illuminate the path for new students and our democratic society at large. The need for unbiased research findings becomes ever more pressing in a democratic society in which the general public and their representatives and agents are required to make decisions effecting our institutions.

Looking ahead, we may expect the unique role of the Foundation to become increasingly appreciated by the busy executive, the professional person and the intelligent lay audience through the medium of the *Digest* as well as through the other publications of the Foundation.

Student Assistance Award

Readers will recall an announcement in the Fall 1959 issue of the *Journal* (pages 330-31) that the Patent Office Society had established, within the Foundation, a student assistance award to "provide financial assistance to those scholars, practitioners and other students who may potentially contribute to original research in the patent and trademark systems and the patent and trademark law." In order that all prospective beneficiaries be given the same consideration, the Affiliation Committee of the Society requests that all names be sent directly to the Committee at the Patent Office Society, Post Office Box 685, Washington 4, D. C. Each applicant should include a statement of his academic background. Those who appear to be best qualified for the award will receive a further screening by a Selection Board of the Foundation, and the recipient thus determined.

Forum Section New Journal Feature

Some readers may have noted the new "Forum" section in the Winter 1959 and Spring 1960 issues of the *Journal*. We have devised this section to round out the *Journal's* educational function and we would like to call this particular aspect of that function to the attention of interested persons. We hope to publish as frequently as possible in this section consistent with maintaining balance and the fulfillment of our total objective.

We invite submission of manuscripts to be considered for inclusion in this section.

Meeting on Inventive Activity

A conference on *The Economic and Social Factors Determining the Rate and Direction of Inventive Activity* was held May 12-14, 1960, at the Center for Continuation Study, The University of Minnesota. The meeting was sponsored jointly by the Universities-National Bureau Committee for Economic Research and the Committee on Economic Growth of the Social Science Research Council. The program is reprinted below:

I. *The Overall Rate of Inventive Activity:* 9:00 a.m., May 12

Chairman: Walter Heller, Department of Economics, The University of Minnesota

1. "Inventive Activity: Problems of Definition and Measurement"
   Simon Kuznets, Department of Political Economy, Johns Hopkins University
2. "Psychology of Creativity and the Supply of Inventors"
   Donald W. MacKinnon, Institute of Personality Assessment and Research, University of California, Berkeley

3. "The Supply of Inventors and Inventions"
   Fritz Machlup, Department of Political Economy, Johns Hopkins University
4. "Scientific Discovery and the Rate of Invention"
   *Irving H. Siegel Council of Economic Advisors, Washington, D. C.
5. "Historical Trends in the Rate of Inventive Activity"
   *Barkev S. Sanders, The Patent, Trademark, and Copyright Foundation, The George Washington University

Discussants:
Jacob Schmookler, University of Minnesota (1,3,5)
Thomas Kuhn, University of California, Berkeley (2,4)

II. *The Direction of Inventive Activity:* 1:30 p.m., May 12

Chairman: Harold Barnett, Department of Economics, Wayne State University

1. "Does the Market Direct the Relative Factor-Saving Effects of Technological Progress?"
   William Fellner, Department of Economics, Yale University
2. "Changes in Industry and in the State of Knowledge as Determinants of Inventive Activity"
   Jacob Schmookler, Department of Economics, University of Minnesota
3. "The Changing Direction of Research and Development Employment Among Firms"
   *James Worley, Department of Economics, Vanderbilt University
4. "Locational Differences in Inventive Effort and Their Determinants"
   Wilbur Thompson, Department of Economics, Wayne State University
5. "The Future of Industrial Research and Development"
   Yale Brozen, The School of Business, The University of Chicago

Discussants:
Edwin Mansfield, Carnegie Institute of Technology (1,5)
Sidney Winter, The RAND Corporation (2,3,4)

III. *Case Studies of Research and Development:* 9:00 a.m., May 13

Chairman: Simon Kuznets, Department of Political Economy, Johns Hopkins University

1. "Invention and Innovation in the Petroleum Refining Industry"
   John Enos, School of Industrial Management, Massachusetts Institute of Technology
2. "Inventions in the Post-War American Aluminum Industry"
   Merton Peck, The Graduate School of Business, Harvard University
3. "The Origins of the Basic Inventions Underlying Du Pont's Major Product and Process Innovations, 1920 to 1950"
   Willard Mueller, Department of Economics, The University of Wisconsin
4. "Research and Development and Profitability in the Chemical Industry"
   Jora Minasian, Industrial Relations Center, The University of Chicago
5. "The Nature of Military Research and Development"
   Burton Klein, The RAND Corporation, Santa Monica, California
6. "The Link Between Science and Invention: The Case of the Transistor"
   Richard Nelson, The RAND Corporation, Santa Monica, California
7. "Predictability of the Costs, Time, and Success of Development"
   Andrew Marshall and William Meckling, The RAND Corporation, Santa Monica, California

Discussants:
Zvi Griliches, National Bureau of Economic Research, Inc.
Kenneth Arrow, Stanford University

IV. *Organization and Research and Development Decision-Making:* 1:30 p.m., May 13

Chairman: Solomon Fabricant, National Bureau of Economic Research, Inc.

1. "Organization and Research and Development Decision-Making Within the Firm"
   Albert Rubenstein, Department of Industrial Engineering, Northwestern University
2. "Strategy and Organization in a System Development Project"
   Thomas Marschak, The School of Business Administration, University of California, Berkeley
3. "Organization and Research and Development Decision-Making Within a Government Department"
   Paul Cherington, Graduate School of Business, Harvard University
4. "Organization and Research and Development Decision-Making Within a Society"
   Robert Merrill, Department of Anthropology, The University of Minnesota

Discussants:
Harrison White, The University of Chicago (1,2,3)
Joseph Spengler, Duke University (4)

V. *Normative Aspects:* 9:00 a.m., May 14

Chairman: Charles Hitch, The RAND Corporation

1. "Inventive Activity: Government Controls and the Legal Environment"
   *Jesse W. Markham, Department of Economics and Sociology, Princeton University
2. "Economic Welfare and the Allocation of Resources for Invention"
   Kenneth Arrow, Department of Economics, Stanford University
3. "Optimum Research and Development Expenditure for a Firm"
   Burton Dean, Operations Research Group, Case Institute of Technology

Discussants:
Leo Hurwicz, The University of Minnesota (3)
George Stigler, The University of Chicago (1,2)

1960 Conference Number To Be Published

The proceedings of the fourth Annual Public Conference will be published in the fall of 1960. Members of the Foundation and subscribers to the *Journal* will receive a copy as part of their membership or subscription. Others interested in obtaining a copy may order it from the Foundation office at a cost of $3.00.

Conference Session Broadcast Nationally

Arrangements have been made to tape-record one of the highlights of the Conference, the "Special Session Devoted to Discussion of Current Issues." This is another dimension of our many-sided educational program. The tape will be edited, condensed to one hour, and broadcast over a national radio network.

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* Dr. Siegel, Dr. Sanders, and Dr. Markham are members of the Foundation's Research Staff. Mr. Worley is a former member of the Research Staff. A revised version of Dr. Siegel's paper will be published in the Fall 1960 issue of the *Journal.*

Analysis of 203 Transistor Patents*

EDGAR WEINBERG, Research Associate
IRVING H. SIEGEL, Project Consultant

NATURE AND SCOPE OF STUDY

THIS REPORT, THE SECOND OF A SERIES ON TRANSISTORS and related devices,[1] is based on an examination of the 203 original patents (*i.e.*, exclusive of cross references) included in the U. S. Patent Office file for Subclasses 12 through 40 of Class 330. The data were transcribed by the authors in May-June 1960, at which time the entire Class contained over 2,500 original patents.

Class 330 embraces amplifiers of all kinds, while the Subclasses of special interest are restricted to "amplifiers with semiconductor amplifying device (*e.g.*, transistor)". The Class as a whole is thus concerned with such transducer devices as vacuum tubes, controlled gas tubes, saturable reactors (magnetic type), masers, and variable resistance elements, in addition to transistors. The amplifying devices of interest here are constructed of natural semiconductor materials, such as germanium, silicon, or selenium; or of modified insulating materials to which similar electric properties have been imparted. The transistor, which has attracted considerable attention since its invention in 1948, is made of a semiconductor material and has three or more electrodes (for signal input, power supply, and signal output). Because of its economic importance and in accordance with common practice, its name is used here to characterize the varied group that is actually comprised by the 203 patents.

Even as they do not exhaust the field of amplifier technology, the 203 patents do not cover the entire range of semiconductor or transistor technology. Thus, pertinent patents, other than cross references, may also be found in Subclass 253 (manufacture of barrier layer devices) of Class 29 (metalworking); Subclass 200 (coating processes used in making barrier devices) of Class 117 (coating); Subclass 88.5 (nonlinear conductor devices, such as transistor circuits) of Class 307 (electrical transmission); and Subclasses 148.5 (transistor circuit with electric relay or electromagnetic load) and 234-236 (structure of semiconductor devices, including transistors) of Class 317 (electricity). At the time this study was made, these additional subclasses contained about 1,450 original patents.

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* Interim Report on *Project 3b*, which is concerned with the "Role of Patents in the Evolution of Established Companies".

[1] Edgar Weinberg and Irving H. Siegel, "Development and Implications of the First Transistor Patents", *PTC J. Res. & Ed.*, Vol. 3, No. 4 (Winter 1959), pp. 392-397.

TIME REQUIRED FOR PATENT PROCESSING

Table 1 presents a frequency distribution, for each year of patent application, of the 203 transistor patents according to the time interval between date of filing and date of grant. From this table, it may be seen that:

1. Applications made in the 4 years 1953-1956 led to 105 patent grants, more than half of the total.
2. Almost two-thirds of the patents (132) were issued 3 to 5 years after the applications were filed.
3. The median interval between filing and issue dates falls in the frequency class of 3.5-4 years.
4. The median interval for patents based on applications made in 1954-1959 is shorter (3-3.5 years) than the median interval for those based on applications made in 1948-1953; but, since some of the applications filed in the later period remain to be approved, the difference between these medians does not yet conclusively indicate a significant reduction in processing time.

COMPANY PATENTING ACTIVITY

In Table 2, the 203 patents are grouped by company of assignment as well as year of application. The following points stand out:

1. Eight companies account for three-quarters of the patents, while 32 others are named as assignees for fewer than one-fifth.
2. Unassigned patents comprise fewer than 4% of the total number, and assignments to the government comprise only 2%.
3. Bell Telephone Laboratories (B.T.L.), which fostered the invention and early development of the transistor, is named assignee on one-fourth of the patents (51).
4. Radio Corporation of America (R.C.A.), which made its first applications shortly after B.T.L., is assignee of almost as many patents (48).
5. The next two companies, General Electric (G.E.) and North American Phillips (N.A.P.), have the same number of patents (15 each), but they trail far behind B.T.L. and R.C.A. and made their first successful applications several years after the leaders got underway.

CLAIMS PER PATENT

Table 3 was designed to show whether fewer claims were made or allowed through time as the "space" of transistor technology became more "crowded". This hypothesis does not seem to be strongly supported by the table even though the maximum ratio of claims per patent granted is shown for filings of 1948, the year the transistor was invented, and the minimum ratio is recorded for 1959. The ratios computed for 1957-1959 are, of course, still subject to significant change as additional patents are granted.

Table 4 shows that companies having the largest number of assignments also have the largest ratios of claims per patent. The support for this proposition is still strong if N.A.P. is excluded, despite its 15 patents. This company represents a special case: all of its assigned patents are of foreign origin.

Another striking point in Table 4 is the standing of unassigned patents. For these, the average number of claims (9.3) is comparable to the average for B.T.L. (9.5) and much higher than the ratios shown for most other companies. Apparently, "independent" inventors have striven for broad coverage.

SINGLE INVENTORS AND MULTIPLE PATENTS

According to Table 5, single inventors dominate, even though most of the 203 transistor patents were assigned to corporations and were presumably made by employees. Almost four-fifths of these patents carry the name of only one inventor, and less than a handful carry the names of three. B.T.L. shows the same proportion for single inventors, and the ratio is even higher for R.C.A. (nine-tenths). N.A.P. again stands out as an exception, with paired inventors predominant; its United States transistor patents, however, may well differ from its whole portfolio of assigned patents with respect to average number of inventors.

Another analysis of the basic data, not summarized here in tabular form, shows that the 203 patents are the work of 168 inventors. Almost one-fifth of the inventors (38) contributed to more than one patent. Most of the relatively prolific transistor inventors, however, contributed to only 2 patents. The name of William Shockley, co-inventor of the first transistor and a co-winner of the Nobel Prize, leads all the rest, appearing on 14 patents.

As in other fields of invention, foreign-born persons have made important contributions to transistor technology. In addition to Shockley and others who were born abroad but did their work in the United States, we must mention the 27 inventors listed on our patents as residents of other countries—especially the Netherlands, but also England, France, India, and the Union of South Africa.

TABLE 1

REQUIRED PROCESSING TIME FOR 203
TRANSISTOR PATENTS
DISTRIBUTED BY YEAR OF APPLICATION *

Year of Patent Application	No. of Patents Granted by May-June 1960	Months Elapsed Between Date of Filing and Date of Grant												
		less than 12	12–17	18–23	24–29	30–35	36–41	42–47	48–53	54–59	60–65	66–71	72–77	78–83
All years	203	2	5	3	11	21	47	30	27	27	14	8	3	5
1959	1	1												
1958	1	1												
1957	11		2		2	4	3							
1956	31		2	1	3	5	11	7	2					
1955	26		1			3	6	3	8	3	2			
1954	32						9	2	7	7	4	3		
1953	27					1	6	4	5	3	2	3	2	1
1952	12							5	1	2	2	1		1
1951	17				2	2	2	2		4	3	1		1
1950	12					1	4	1	3	2			1	
1949	12				1		2	1	1	4	1			2
1948	15			2	2	4	3	3		1				
1947	1							1						
1941	1					1								
1938	1				1									
1928	2							1		1				
1926	1						1							

* Compiled from U.S. Patent Office records as of May-June 1960, for Class 330, Subclasses 18–40: "Amplifiers with semiconductor amplifying device (*e.g.*, transistor)." Refers to original patents only (*i.e.*, excludes cross references).

TABLE 2

ASSIGNMENTS OF 203 TRANSISTOR PATENTS
DISTRIBUTED BY YEAR OF APPLICATION *

YEAR OF PATENT APPLICATION	NO. OF PATENTS GRANTED BY MAY-JUNE 1960	B.T.L.*	R.C.A.*	G.E.*	N.A.P.*	M.H.*	MOTOROLA	PHILCO	I.S.E.*	U.S. DEFENSE DEPARTMENT	32 OTHER COMPANIES	UNASSIGNED
All Years.....	203	51	48	15	15	9	6	4	4	4	39	8
1959.....	1										1	
1958.....	1										1	
1957.....	11	1		1		1				1	6	1
1956.....	31	3	5	4	2	3				2	11	1
1955.....	26		8	1	5	3	1	3	1		4	
1954.....	32	1	10	2	6	2	1			1	8	1
1953.....	27	2	8	4	2		4	1			5	1
1952.....	12	5	5	2								
1951.....	17	11	4						2			
1950.....	12	6	3						1		2	
1949.....	12	6	4	1								1
1948.....	15	13	1								1	
1947.....	1	1										
1941.....	1	1										
1938.....	1	1										
1928.....	2											2
1926.....	1											1

* See asterisked footnote in Table 1.
* Initials stand for Bell Telephone Laboratories, Radio Corporation of America, General Electric, North American Phillips, Minneapolis-Honeywell, and International Standard Electric.

TABLE 3

CLAIMS ALLOWED IN 203 TRANSISTOR PATENTS
DISTRIBUTED BY YEAR OF PATENT APPLICATION *

Year of Patent Application	Number of Patents Granted by May-June 1960	Number of Claims	
		Total	Per Patent
All Years	203	1,374	6.8
1959	1	3	3.0
1958	1	6	6
1957	11	97	8.8
1956	31	185	6.0
1955	26	133	5.1
1954	32	172	5.4
1953	27	144	5.3
1952	12	76	6.3
1951	17	84	4.9
1950	12	58	4.6
1949	12	89	7.4
1948	15	255	17.0
1947	1	5	5.0
Before 1947	5	67	13.4

* See asterisked footnote in Table 1.

TABLE 4

CLAIMS ALLOWED IN 203 TRANSISTOR PATENTS
DISTRIBUTED BY ASSIGNEE *

Assignee ▪	Number of Patents Granted by May-June 1960	Number of Claims	
		Total	Per Patent
Total	203	1,374	6.8
B. T. L.	51	485	9.5
R. C. A.	48	293	6.1
G. E.	15	123	8.2
N. A. P.	15	71	4.7
M. H.	9	70	7.8
Motorola	6	21	3.5
Philco	4	11	2.8
I. S. E.	4	14	3.5
U. S. Defense Department	4	19	4.8
32 Other Companies	39	193	4.9
Unassigned	8	74	9.3

* See asterisked footnote in Table 1.
▪ See footnote ▪ in Table 2.

TABLE 5

SINGLE AND MULTIPLE INVENTORS ON 203 TRANSISTOR PATENTS DISTRIBUTED BY ASSIGNEE *

ASSIGNEE*	NUMBER OF PATENTS GRANTED BY MAY-JUNE 1960	PATENTS NAMING—		
		1 inventor	2 inventors	3 inventors
Total	203	160	39	4
B.T.L	51	41	10	
R.C.A.	48	43	4	1
G.E.	15	13	2	
N.A.P.	15	6	8	1
M.H.	9	8	1	
Motorola	6	4	2	
Philco	4	3	1	
I.S.E.	4	1	3	
U. S. Defense Department	4	3	1	
32 Other Companies	39	30	7	2
Unassigned	8	8		

* See asterisked footnote in Table 1.
* See footnote * in Table 2.

Patent Information in Annual Reports: Potential Contributor to Corporate Image*

IRVING H. SIEGEL, Project Consultant

THIS INTERIM REPORT carries forward a discussion initiated in a note published two years ago.[1] The original note was based on a quick survey of the annual reports of manufacturing corporations for 1957. The present paper takes account of the 1958 and 1959 corporate reports and looks forward to possible future changes. The new review generally confirms the earlier findings and provides a broader base for making recommendations to the companies.

The survey of 1957 corporate reports disclosed that only occasional and limited references were being made to patents (and trademarks, too). It indicated that industrial firms were failing to exploit systematically the opportunities afforded by an exclusive proprietary channel of communication to achieve a major objective that many of them were pursuing in other ways (*e.g.*, by advertising) and through other media. This objective is the creation and wide public acceptance of a favorable corporate image of technological progressiveness.

Like the original note, the present paper suggests that more deliberate, fuller, and more functional use can be made of patent information in the annual reports. In particular, such information can contribute effectively to the shaping of a company image of technical vigor. If this aim were explicitly and generally adopted for annual reports, the incidental educational value of these documents would also be enhanced. Thus, shareowners and other readers would be made more aware of the relation of patents to corporate research, invention, and innovation; and students of the patent system would acquire a new handy source of primary material.

Treatment of Patent and Related Information in Recent Reports

An examination of hundreds of corporate reports for 1958 and 1959 reveals that remarks on patents (and trademarks) are still uncommon and that their informativeness, moreover, is greatly qualified by the absence of needed detail.

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* Interim report on *Project 3c*, which is concerned, among other things, with "Corporate Patent and Research Activities As Revealed in Reports to Stockholders."

[1] I. H. Siegel, "Corporate Annual Reports as Sources of Patent Information," *PTC J. Res. & Ed.*, 2, No. 3 (September 1958), pp. 444-45. The reader of the present paper should also refer to the comments on 1959 corporate reports in the paper on "Scientific Discovery, Invention, and the Cultural Environment," pp. 233-248 of this issue.

In addition to limitations regarding quantity and intelligibility, there are shortcomings from the standpoints of representativeness, continuity, and comparability. Thus, the great variation in kind and form of material selected for publication by the different companies frustrates significant intercompany comparison or aggregation; and, even for one company, the change in content and form from one year to the next may not only prevent valid interperiod comparison but also, in some instances, represent retrogression rather than improvement.

In too few of the reports is the reader given some idea of the nature, scope, and significance of a company's recent or historical patent experience.[2] The glimpses are not only infrequent but also brief and fleeting. Here or there in the text, the reader is treated to rationed comments on such topics as patent filings or grants during the year in the United States or abroad, the size of the company's patent portfolio, licensing arrangements, or litigation.[3] But no rounded picture, embracing all pertinent topics, is presented and, as a rule, no special effort seems to be made to achieve a definable total effect.

A limited role is accorded to patents in the income statement and balance sheet as well as in the text. Royalty income is rarely mentioned or shown separately. Most companies make no explicit reference to patents in the listing of assets. In roughly half of the remaining minor fraction, patents are listed, often with goodwill and trademarks, at a value of $1; and, in the other half of the residue, value is shown at cost less amortization for acquired patents and other intangible property. The capitalized value of the entire patent portfolio, including patents emerging from company research as well as purchased patents, is not estimated.[4]

Although it has become fashionable for companies to stress research and development activities and product innovation, the costs annually incurred in experimentation are seldom reported in the text or separately noted in the statement on operations. The practice of companies with respect to expensing or capitalizing research outlays is usually left obscure. Thus, research is often not mentioned as an operating cost or a deduction from income before taxes, nor, alternatively, is it shown as a deferred charge on the balance sheet.[5]

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[2] It is recognized that many companies supply patent information through other media. See, for example, International Business Machines Corporation's recent report on *New Methods for Knowing* and the listing of "Recent IBM Patents" by month at the end of each issue of the quarterly *IBM Journal of Research and Development.*

[3] Useful patent information is included, for example, in the 1958 report of Babcock and Wilcox and in the 1959 reports of American Can, American Machine and Foundry, Farm Machinery and Chemicals, General Aniline and Film, Monsanto, Polaroid. References to licensing may be found, for example, in the 1958 reports of American Chain and Cable, Budd, and Texas Company; and in the 1959 reports of Armco, Kaiser Industries, Koppers, and Otis.

[4] S. Cottle and T. Whitman, "Twenty Years of Corporate Earnings," *Harvard Business Review,* May-June 1958, pp. 100-114, mention the difficulty of obtaining uniform annual research figures and capitalizing them among the other problems encountered in intercorporate and interperiod comparisons (102).

[5] Lockheed's report for 1959 has an interesting discussion of "deferred development costs" for its JetStar and supersonic transports and its Super Hercules turboprop cargo plane. More recently, the company has decided to write off these costs during the year instead of carrying them on the balance sheet. See *Wall Street Journal,* August 11, 1960.

As companies pay increasing attention to new products, they do seem, however, to give more notice to trademarks than formerly in the annual reports. The trademarks are typographically distinguished by solid capitals, italics, or the registry symbol suffix.[6]

Suggested Improvements in Reporting

The foregoing comments point out lines along which companies could improve their annual reports as vehicles for promoting an image of technological progressiveness. As has already been said, the greater the number of companies making the suggested improvements and the greater the degree of detail or separate identification of the indicated accounting data, the greater will be the incidental value of the reports to all classes of readers and patent and trademark students. Company officials should recognize in particular that the general public has a high degree of tolerance of, and even a positive interest in, anecdotal and descriptive literature relating to patents as well as other aspects of technology.

Specifically, the corporate utility and incidental educational value of the reports may be enhanced if the texts:

1. Discuss patents (and trademarks) as integrally related to company research and development activity, product and process innovation, and marketing efforts.
2. Present statistics on the year's patenting and licensing activities and on the annual change in the size of the company patent portfolio.
3. Provide "human interest" case studies of new company patents, including information on names and backgrounds of the inventors.[7]
4. Show annual company expenditures on research and development programs, distinguish corporate from government financing of these programs, and note whether company outlays are treated as expenses or investments.
5. List trademarks with dates of registry.
6. Illuminate technical relations with "small business."[8]

The accounting statements included in the reports could be improved considerably if they:

1. Show annual revenues and costs relating to patent and trademark transactions (*e.g.*, royalties received and license fees paid).
2. Explicitly list patents on the balance sheet, even if they are assigned only a nominal value.
3. Separately tag the annual research outlay, and, if appropriate, the annual research amortization charge.
4. Note the annual revenue derived from public and private contract (or subcontract) research.

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[6] Among the 1959 reports showing an interest in trademarks are those for Harshaw Chemical, Koppers, Sherwin-Williams, Mead Johnson, Upjohn, and Westinghouse Air Brake.

[7] The 1959 Pfizer report is one of the few referring to individual achievement.

[8] See, for example, the 1959 report of North American Aviation.

Factors Favoring Improvement in Reports

Rapid progress in the reorientation of annual reports along the lines just mentioned should not be expected, but certain developments of the past two years and some longer-range tendencies surely increase the chances for gradual revision in the indicated directions.

First of all, annual reports have recently come under heavy criticism from many quarters—shareowners, security analysts, accountants, and other specialists—with respect to style, content, and professional quality.[9] Such criticism delays the freezing of report molds and encourages further experimentation with regard to ingredients and methods of presentation.

Second, companies show ever-increasing interest in prospects for growth through expansion into promising new fields of production.[10] This interest has been spurred by intensified foreign competition, which threatens some of the established markets of our nation's producers; and by the broadening of opportunities for product diversification through the participation of firms in government research and procurement programs.

Third, company reports are devoting greater space to efforts to develop needed managerial and technical personnel. The prolonged shortage—or "sense of shortage"—[11] with respect to scientists and engineers will encourage public acknowledgment of individual achievement, one dimension of which is the creation of patentable inventions.

Fourth, improvement of the corporate image has become an outstanding aim of rising public relations expenditures.[12] Since firms are placing special emphasis on leadership in particular precincts or provinces of technology, information on patents becomes increasingly relevant to their annual story. Although companies may understandably wish to avoid complete publicity regarding patent (and trademark) transactions, they certainly would find it advantageous to tell much more and more clearly than they now do about the role of their intangible technical assets. Reference to these assets would reinforce the impression that they already seek to make through extensive discussions of research, development, and marketing programs.

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[9] See, for example, K. Hayes, "Readers Evaluate Annual Reports," *The Exchange,* March 1960, pp. 1-5; A. G. Erpf, "The Trouble With Today's Annual Reports," *Investor's Future,* July 1960, pp. 18-20; and L. V. Seawell, "Corporate Annual Reports: Financial Fantasy," *Business Horizons,* Fall 1959, pp. 92-101.

[10] "An affinity for growth products or fields" is cited as one of the characteristics of "companies with high rates of sales growth" by N. R. Maines, "Why Companies Grow," *Stanford Research Institute Journal,* Number One, 1958, pp. 18-23.

[11] See I. H. Siegel, "The Influence of Government on the Demand for Scientists and Engineers", in *Scientific Manpower: 1958,* National Science Foundation, 1959, pp. 54-59.

[12] See L. H. Bristol, Jr., ed., *Developing the Corporate Image,* Scribner's, New York, 1960, especially the article by P. Boyer, "The Image Via Annual Reports and Publications," pp. 188-193.

CONTRIBUTED ARTICLES

The Coordinated Soviet Effort to Promote And Apply Major Inventions

HERSCHEL F. CLESNER*

SUMMARY

THE ACHIEVEMENT OF HIGHER LEVELS of labor productivity than those realized in Western nations is an important element in the Marxist theory of inevitable triumph of "communism" over "capitalism". Accordingly, all echelons of Soviet leadership seek, with vigor and determination, the promotion and extensive application of significant inventions. The campaign makes use of "capitalistic" incentives as well as legislation and decrees, social pressure, and propaganda.

TECHNOLOGICAL IMPROVEMENT AS A MAJOR STATE AIM

THE PURPOSE OF THIS PAPER is to explore briefly some of the policies and mechanisms through which the Soviet Union expects to encourage flow, adoption, and effective use of significant inventions in support of her domestic and international objectives. Khrushchev and his predecessors have promised to lead the people of the Soviet Union, through technical progress, to full communism, a stage of economic and political development in which the levels of material well-being would be far above those now enjoyed in Western Europe and America. The Communist party and Soviet labor union leaders stress invention as an especially important means by which workers, technicians, and engineers may directly participate in the needed technical advance. Accordingly, psychological and material stimuli are provided and institutional arrangements are made to foster invention and technical improvement for greater industrial efficiency and higher labor productivity.

The Soviet ambition and the determination to enlist the whole society in programs to achieve it are well expressed in a resolution adopted on October 19, 1956 by the

* Staff member, Subcommittee on Patents, Trademarks, and Copyrights, U. S. Senate Committee on the Judiciary. Since this paper was not prepared in the course of the author's duties with the Subcommittee, the views expressed herein should be attributed to him alone.

All-Union Conference of Inventors, Production Innovators, and Suggesters of Ways to Increase Efficiency:

> We, the participants in the All-Union Conference of Inventors, Production Innovators, and Suggesters of Ways to Increase Efficiency, ardently call upon all workers, engineers, technicians, employees, scientists, suggesters of ways to increase efficiency, and inventors to increase their creative work and to fight with all their efforts for the creation of new technology, the improvement and modernization of existing equipment, and the search for new materials and methods of production. We call upon the workers and the technical intelligentsia to increase the rate of introducing into production scientific discoveries, technical achievements, inventions, improvements, suggestions of ways to increase efficiency, and everything valuable and advanced that has been created by labor innovators. It is necessary to accelerate the solution of the practical tasks of the complex mechanization and automatization of production. The acceleration of technical progress will guarantee a new, major increase in labor productivity, which, as the great Lenin taught, constitutes in the final analysis the most important and principal factor in the victory of the new social order, in the victory of communism.

Many implementing measures concerning science, invention, and technology have been introduced in the Soviet Union in the four years since the All-Union Conference. Characteristically, the regime leaves very little to chance and local initiative; everything has to be organized. Futhermore, there is no indication that the Soviet leadership is satisfied as yet with the whole complex of statutes, stimuli, and institutional arrangements for guaranteeing victory through technical superiority.

Since this paper seeks to show in a general way how the ramified Soviet apparatus of persuasion and communication is enlisted in the promotion and application of basic inventions, it does not present the details, for example, of the Soviet counterpart of our patent system or Soviet practice regarding incentives and rewards. It will be apparent to the reader, however, that Soviet leaders recognize the importance of providing "capitalistic" stimuli that appeal to self-interest—of using such stimuli as alternatives to, or as supplements of, political and social pressure.

STATE AND PARTY LEADERSHIP

In the Soviet Union the creation and effective application of new technology is a matter of highest national importance and priority, and the very top leadership of the Communist Party gives considerable thought and attention to methods of attainment. Numerous policy directives and decrees—resolutions of the Central Committee of the Communist Party—are issued in behalf of the improvement of techniques. These resolutions, which also carry the seal of approval of the Council of Ministers, are the law of the land, subject only to explanation and interpretation by the Presidium, Secretariat, and executive staff of the Central Committee. They are futher supplemented by administrative actions of governmental and party organs. The executive organs—ministries and state committees—carry out the tasks assigned to them by resolutions of the Central Committee, the Council of Ministers, or both. The Council of Ministers also issues decrees which represent decisions on basic problems of governmental activity. An example is the Statute Concerning Discoveries, Inventions, and Suggestions for Rationalization of Procedures,

which was approved by Resolution No. 435 of the Council of Ministers on April 24, 1959. The Council of Ministers also issues decisions on questions of current operational administration—instructions or orders. An example is the Instruction Regarding Remuneration for Discoveries, Inventions, and Suggestions for Rationalization Procedures, which was approved by Resolution No. 43 of the Council of Ministers of the U.S.S.R. on April 24, 1959. The decrees, instructions, and orders of the Council of Ministers of the U.S.S.R. have the full force of law throughout the Soviet Union.

The Communist Party's influence, power, and organization pervade all phases of Soviet life, including the application of science to industry; and under Khrushchev this infiltration has been tremendously strengthened. Indeed, scientifically and technically trained personnel are being rapidly moved into key positions, such as the first secretaries of local, regional, and even the national Party organizations. Indicative of Party interest in fostering new technology is the existence of the following committees of the Council of Ministers: State Scientific and Technical Committee, State Committee on Inventions and Discoveries, State Committee on Aviation Technology, State Committee on Defense Technology, State Committee on Radioelectronics, State Committee on Shipbuilding, State Committee on Chemistry, State Committee on Construction Affairs, State Committee on Automation and Machine Building, and State Planning Committee (Gosplan). The Academy of Sciences and the existing ministries also carry on extensive work relating to new technology—for example, the Ministries of Railways, Medium Machine Building (which includes the Soviet Atomic Energy Administration), Construction of Electric Power Stations, Transport Construction, Communications, Health, Higher and Specialized Secondary Education, Geology and Conservation, Agriculture, and Ocean Fisheries and Oceanography. The State Committees are equal to Ministries in rank. They coordinate and carry out assigned tasks that cut across the different ministries, industries, and disciplines.

The State Scientific and Technical Committee was first created in 1948 as the State Committee on New Technology, which in turn was an offshoot of Gosplan. The present significance of this committee is reflected in the fact that Malyshev, the successful administrator of the Soviet atomic energy program and the Minister of Medium Machine Building, became its chairman when it was revived in May 1955. From the start, the Committee's purpose has been to help maintain the technical up-to-dateness of Soviet industry through the application of both domestic and foreign inventions. The Committee functions as an advisory group on technological policy and makes studies for the Central Committee. Recently, it has been assigned even greater tasks and responsibilities.

The State Committees on Aviation Technology, Defense Technology, Radioelectronics, Shipbuilding, Chemistry, Construction Affairs, and Automation and Machine Building have comparable functions in their respective fields. They are principally responsible for executing research and development programs, operating pilot plants, planning the introduction of new processes in industrial plants, monitoring the use of materials, and distributing scientific-technical literature. The State Committee on Automation and Machine Building was created last March

by the directive of the Central Committee to speed and coordinate all Soviet research and development programs looking toward mechanization and automation of production lines. By July 1960, this Committee directed the operation of 57 research institutes, 25 design offices, 7 design institutes, and 26 experimental plants. Together with the State Committee on Radioelectronics, it is also responsible for developing new models of household machines and appliances, conducting contests to stimulate design of such consumer goods, and providing technical assistance to enterprises producing them.

KEY TECHNOLOGICAL ROLE OF PRESIDIUM

The basic Soviet policies regarding science and technology come from the Presidium of the Central Committee. It consists of twenty-four members and candidate-members chosen from the Central Committee. It is chaired by, and receives its cues from, Khrushchev, who at one time or other sponsored most of the present members. At least half of these members have a technological background. They are kept abreast of the current scientific and technical problems by the executive staff of the Central Committee. For example, a Department of Science and Technology within the executive staff is headed by a Corresponding Member of the Academy of Sciences and a winner of the Lenin Prize in Engineering.

The scope of the Presidium's actions and interests respecting science and technology is very broad, in sharp contrast with the functions of the highest governmental policy-making bodies of the United States and Western Europe. The Presidium, with the aid of the Secretariat and executive staff, schedules meetings specifically to consider scientific and technical policies and operations. Prominent scientists and technical experts advise the staff and sometimes are called to give their opinions to the Presidium. At one time, the decisions of the Presidium were limited to general organization problems and the establishment of economic priorities, which in turn determined the priorities of technological implementation and scientific research. Now, the decisions even concern specific scientific and technical problems. They may relate, for example, to the initiation, acceleration, or coordination of research and development activity and the provision of funds, manpower, equipment, and facilities to advance automation.

They may lead to plenary sessions of the Central Committee which provide opportunities for thrashing out problems and publicizing Party directives and programs concerning the introduction and utilization of truly *new* technology—truly novel techniques and products as distinguished from mere routine improvement innovations. These plenums help to enlist public opinion in behalf of legislation and policies designed to counteract the strong deterrents to path-breaking technical advance that are built into the Soviet system.

TRANSLATION OF TOP-LEVEL TECHNOLOGICAL DECISIONS INTO ACTION

Since July 1955 there have been fifteen or more plenary sessions of the Central Committee and two Congresses of the Communist Party. Organization for advancement of new technology has received considerable attention in practically

every one of these important conventions. Many new major Party policy decisions regarding new technology have been issued. Efforts have been made either to counterbalance or to overcome the built-in deterrents and antagonisms to the introduction of genuine novelty in the Soviet economic system. Responsibilities and tasks have been redistributed and reorganized. In some instances, only the facade is changed; but, in other instances, the changes are far-reaching and significant.

The published notes of the Central Committee plenum of July 1955 reported that a "technological lag existed in important areas of Soviet industry" and that lower Party organs were directed to convene more scientific and technical conferences—meetings of scientists, inventors, and rationalizers—to arouse interest in new technology and presumably prevent recurrence of the kind of misfortune experienced by the inventor-hero, Lopatkin, of Dudintsev's novel, *Not by Bread Alone*. Accordingly, from 1956 through 1958, such meetings were held widely in the Soviet Union.

Starting in the middle of 1957, draft measures of various statutes and instructions on legal rights, remuneration, and promotion relating to discoveries, inventions, and suggestions were published; and a directive went out calling for nationwide discussion and criticism of these drafts. As a result, organizational and administrative changes were promulgated; and it appears that the discussion had some effect, for the final measures do differ from the draft measures.

Other developments include the enlargement of fund allocations for awards and bonuses for creation, or assistance in the introduction of, significant new inventions. In the field of technology, the Soviets clearly allow—or, more accurately, organize —public opinion to serve as an instrument for modifying the law and even Party Policy in desired directions.

The 20th Communist Party Congress, held on February 14-25, 1956, decided that the Party must give more active attention and direction to the introduction of new technology. This decision was followed by decrees aimed at increasing the production of new equipment, introducing mass production techniques into the construction industry, improving the collection and dissemination of technical information, and propagating know-how and experience more broadly. Funds and material resources were channeled in these directions by Gosplan.

Soon after the 1956 Congress, the Academy of Science Institute of Scientific Information became the All-Union Institute of Scientific and Technical Information. The work of the Institute has since grown rapidly. Its *Abstract Journal* is now published regularly, covering many different areas of technology and based on the worldwide literature and patents. The issues follow the publication of the original articles by three months to a year. The *Express Information,* a weekly summary fact sheet, has subdivisions for specific technologies. The Institute also provides translations of the pertinent articles and reproductions of foreign technical publications. On the whole, the Institute is regarded as successful, and its scale of operation has been expanded.

Another constructive action following the 20th Congress is the conversion of the *Industrial-Economic Gazette* from a weekly newspaper to one published three days a week at first and now published daily. This newspaper propagates information

on the best in domestic and worldwide technology, inventors' experiences, new products, know-how, new projects, and new equipment.

On June 1, 1960 the Party took over the responsibility of publishing the newspaper, renamed it, and expanded the coverage of foreign technology. Accordingly, the executive staff of the Central Committee of the Party is now actively involved in keeping abreast of foreign and domestic science and technology on a day-to-day basis, for the practical business of forcing industrial application.

The 21st Communist Party Congress, held January 27 to February 5, 1959, outlined ways to speed technological improvement in all economic areas. It ordered integrated mechanization of operations in industry, construction, transportation, and agriculture; replacement and modernization of out-dated equipment; accelerated development of the electric power system; automation and further specialization of production; and effective utilization of scientific discoveries and inventions, with special emphasis on radioelectronics, radioactive isotopes, semiconductors, nuclear energy, and construction. The Congress also gave orders for the rapid development of the chemical industry and for concentration of the Party, the Soviets, the trade unions, and Young Communist organizations on elimination of deterrents within the system to technological improvement.

On June 24-29, 1959, a Plenum of the Central Committee heard reports on the 21st Party Congress decisions relating to mechanization and automation. The convening of the Plenum and its agenda were proposed on the initiative of (*i.e.*, ordered by) Khrushchev. Among other things, the resolution of the Plenum adopted on June 29 stated:

> At the same time it must be admitted that in the practice of our economic buildup the principle of material stimulus is still insufficiently used with regard to the workers, engineers, and technicians of enterprises and buildings, specialists in research, designing, and planning organizations in the creation of new technology and its rapid introduction into production. Not infrequently, workers in enterprises in the process of mastering new technology find themselves worse off regarding payment for their work than the workers of enterprises producing by out-dated methods. Experts in research, designing, and planning organizations who are successfully engaging in the further improvement of machines and technology in practice have no material advantage in payment compared with those who have produced nothing new for years.

This conclusion clearly acknowledges that the Soviet system fails to use available material incentives adequately for stimulating basic and primary inventions and for rapidly adapting such inventions to use. The paid creative Soviet inventor apparently receives an insufficient differential, if any, over the reward of his unoriginal colleague. The income, derived from the basic wage, bonus, and incentive award, is geared to achievement of greater quantity output along established lines rather than to major innovation.

It is clear that the constant driving force of the Party is essential to the introduction of new technology. Without Party initiative to counter the shortcomings of the system, Soviet industry would only continue to make slight increases in production by outdated methods. Great reliance has to be placed on the Party to achieve the fuller utilization of foreign inventions and developments, to upset the

routine pursuit by management as well as the workers of higher incomes through performance of familiar operations.

Obviously, recognizing these factors, the Central Committee has recently enacted a decree stating that:

> The State Committee on Labor and Wages, the State Planning Committee, the Ministry of Finance, the All-Union Central Council of Trade Unions, the State Scientific and Technical Committee are instructed to prepare, jointly with Union Republic Councils of Ministers and the State Committee on Branches of Industry and Construction, and submit to the Central Committee and the Council of Ministers proposals on the establishment of economic stimuli to enterprises and building organization for the introduction of new machinery and technology, integrated mechanization in industry and construction, and automation of production; and on raising the material incentives of workers in industry, construction, transportation, and research and development organizations engaged in the technical improvement of production.

The language indicates that policy and statutory changes will be made relating to material and economic incentives for invention, discovery, and innovation and to the scale of income payments for the utilization of new technology.

The 1959 Statute and Instruction on Remuneration relating to Discoveries, Inventions, and Suggestions had been in effect for only two months when the decree was issued. It will, of course, be taken into account when the new proposals are issued. However, the Soviet custom is not to amend an existing statute but to issue an entirely new one incorporating the desired changes. Accordingly, a brand new statute and instruction as to compensation relating to discoveries, inventions, and suggestions may well be forthcoming.[1]

Another plenary session of the Central Committee was held on July 13-16, 1960 to discuss progress in introducing the latest advances in science and technology into production. Kosygin, a member of the Presidium and First Deputy Chairman of the Council of Ministers, laid down the line: Measures will have to be taken to insure further rapid economic development through technological progress. The commission appointed to elaborate the decisions of the Plenum is headed by Khrushchev. And it is well known, from his many public statements and Party addresses, that Khrushchev assigns the utmost importance to accelerating technical advance.

As already suggested, the public airing of issues at the plenums of Central Committee is a means by which the Soviet regime seeks to maintain popular interest in a technological orientation that has starved consumer industries for over 30 years. The present Seven Year Plan, adopted by the 21st Party Congress, continues to stress heavy industry, including chemical production. Paradoxically, the tempo of scientific and technological progress throughout the world encourages continued neglect of the Soviet consumer in the interest of his government's international and longer-range objectives.[2]

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[1] According to information made available while this paper was in process, a new statute and instruction providing for additional bonuses was issued in the summer of 1960.

[2] This statement may be substantiated despite the impression that may have been created abroad by the increasing publicity given in the Soviet Union to the needs of consumers.

SUPPORT THROUGH COMMUNICATIONS

The plenums are supported by the media of mass communication in their efforts to stimulate futher development of industry and technology. The discussions and decisions of the Central Committee and the Party Congresses are lead stories in the press. They are publicized throughout the country by radio, television, and all sorts of publications. The Soviet state possesses a monopoly over all communications, and the Party, in turn, maintains supervisory control over all public information. Control of all commentary and analysis of party decisions is exercised by the Party to aid in carrying out its program. Prior to, or as soon as, a decree is published, the propaganda and agitation departments of the executive staff of the Central Committee issue to the lower Party committees detailed instructions for creating a receptive public attitude. When the Party desires maximum public support of subjects considered of prime importance, such as the adoption of new technology, professional propagandists and agitators move in at all levels of Soviet society to create the desired impact by saturation.

CONCLUDING COMMENT

There is no doubt that the foremost part of the program of the Communist Party is to achieve world economic superiority for the Soviet Union through industrial might derived from technological forwardness, the adaptation of novel methods, the acceleration of automation and mechanization, and the achievement of significantly higher industrial efficiency. The Communist Party has entwined the hope of the people of the Soviet Union for an eventual higher standard of living around this program, which continues to give highest priority to the development of heavy industry. The chemical industry is currently a prime object of intensive development. In all probability, other industries, in turn, will also receive special attention. It is this continuing Soviet development program—pressed vigorously, ruthlessly, and with single-minded determination by the highest echelons of the Party hierarchy, and buttressed by promises of a better life while living standards lag far behind—which offers a stern challenge to the scientific and technical capacities of the Western nations, particularly those of the United States.

The U.S.S.R. Patent System*

M. HOSEH**

SUMMARY

THE REVISED SOVIET PATENT LAW concentrates the examination of applications and issuance of patents in a Patent Commission. The Commission is charged also with aiding inventors, promoting inventiveness, and expediting the adoption of inventions in industry. The revised law introduces a new category—discovery, which, although not strictly speaking patentable, is recorded and acknowledged by the state.

THE SOVIET PATENT LAW DATES TO the early years of the regime. A decree on patents appeared in 1919. The first Soviet patent—Furnace for continuous production of sodium sulfide—was granted to A. M. and K. I. Nastyukov on September 15, 1924. The law was changed frequently. It was finally stabilized by the statute of March 5, 1941 and the appended instruction of November 27, 1942.

A Council of Ministers' decree of April 30, 1951 directed the filing of applications for certification of inventions with the ministries and departments in whose field the inventions belonged. The validity and merits were determined by special examining sections within the respective ministries, departments, or other administrative units of the national economy, and, if approved, the Commission on Standards, Measures, and Measuring Devices was duly informed of it and issued the requisite certificate.

Here certificate and certification were used in places where patent and patenting should have been. The reason for it is that the Soviet law recognizes several kinds of certification of an invention, while patent designates only one of them. To avoid misunderstanding I eschew the use of patent as a generic name until its specific meaning is defined later on.

The practice of examining applications and deciding their merit by a body or bodies, and certification being done by another body was terminated by the Council of Ministers' statute of February 23, 1956 *number 274* which establishes the *Komitet po delam izobretenii i otkrytii pri Sovete Ministrov SSSR* (Commission on Inventions and Discoveries attached to the Council of Ministers of the USSR). The old order was allowed to run until April 1, 1956.

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* Presented at the "Institute on Patents as Sources of Information" at Columbia University, School of Library Service, New York, June 29th, 1960.

** Dr. M. Hoseh is in Charge of Washington Branch Office of Chemical Abstracts Service.

The statute chartering the Commission comprises 10 articles. *Article 2* states:

The main tasks of the Inventions and Discoveries Commission of the Council of Ministers, USSR are:

a. Guiding the development of inventions and the incorporation of inventions and discoveries in the national economy.

b. Supervision of the activities of ministries and departments in the area of incorporation of inventions and discoveries in the national economy.

c. Protecting the interests of the state in the area of inventions and discoveries belonging to the USSR.

d. Collaboration with inventors and protection of the inventors' rights.

e. Organize an expertise of material dealing with inventions.

f. Issue authors' certificates and patents.

In order to carry out its task, the Commission is charged in *Article 3*:

To prepare and present before the Council of Ministers, USSR suggestions . . . on the necessary changes in and amendments to the existing law on inventions

. . . . . .

on patenting Soviet inventions abroad and on exchange of patent material with other countries, as well as the acquisition of specifications of foreign patents and other technical literature on inventions . . .

Further on, in *Article 3,* the Commission is charged with:

e. Organizing a service to inform ministries and departments about new inventions and discoveries, both domestic and foreign, and provide for an inter-industry flow of information.

f. Accept notices of inventions and discoveries (applications), examine inventions and discoveries for novelty, and evaluate them in view of the information presented by the ministries and departments on the utility of the invention and its acceptance in industry, and decide on granting authors' certificates and patents.

g. Maintain the state registry of inventions and discoveries, formulate the issuance of authors' certificates and patents to inventors, as well as diplomas to authors of discoveries.

h. To protect the state's and the authors' priority, the Commission is to register on the basis of information furnished by ministries and departments scientific, research, development, and experimental work carried on in industrial research institutes, Academy of Science institutes, Academies of Federated Republics, schools of higher learning, construction bureaus, laboratories, and enterprises of industry, building, transport, agriculture, forestry, and medicine.

i. Consider complaints against decisions of ministries and departments in matters of incorporation of inventions and discoveries and the payment of authors' remuneration.

j. Organize consultations on the law of inventions.

k. Maintain and systematically enlarge the patent holdings of the All-Union Patent and Technical Library and assist in the utilization of these holdings by ministries and departments.

Article 5 of the statute entitles the Commission to:

c. Assign inventions to ministries and departments for examination as to their utility . . .

d. Call upon experts from ministries and departments (with their consent) to examine inventions and discoveries as to utility and novelty, or in connection with inventors' appeal.

f. Publish *Byulleten' Izobretenii*, the journal *Izobretatel'stvo SSSR*, pamphlets describing inventions, bibliographic information on foreign patents, indices to domestic inventions, and other literature related to inventions.

g. Participate in (accordance with) established procedure in international organizations, meetings, and conferences of problems of inventions.

Article 8 states that the Commission consist of:

. . . A chairman, a deputy chairman, and members—(all) appointed by the Council of Ministers.

Finally *Article 9* provides that the Commission have:

. . . an "Ekspertnyi Sovet" (Board of Experts) for examining the most important inventions and discoveries, to deliberate on questions of methodology and practice of inventions, and in exceptional cases, consider inventors' appeals.

It is apparent from the aforesaid that the Commission on Inventions and Discoveries which bears a strong family resemblance to our Patent Office has duties which are rather unorthodox for a patent office. It is expected to disseminate information to industry about approved inventions, it is bound to see to it that inventions are incorporated in industry, and it is charged with the task of promoting inventiveness and encouraging inventors. In addition, it must protect inventor's rights to just and prompt remuneration.

The Commission enjoys prerogatives rather uncommon for such a body. It may call on industry to examine the usefulness of an invention. In the Soviet economy such practice would not involve conflict of interests.

The Commission drafted a law which was later approved by the Council of Ministers and is now known as *Polozhenie ob otkrytiyakh, izobreteniyakh i ratisionalizatorshikh predlozheniyakh, 24 Aprelya, 1959, number 435.* (Statute on discoveries, inventions and suggestions for rationalization, 24 April, 1959, number 435).[1]

This statute supersedes the one of March 5, 1941 as well as the directive of November 27, 1942. To the new statute is appended:

Instruktsiya o voznagrazhdenii za otkrytiya, izobreteniya i ratsionalizatorskie predlozheniya, 24 Aprelya, 1959, number 435.
Directive on remuneration for discoveries, inventions and for suggestions of rationalization.

The new statute is not a radical departure from the one it replaces. It is rather a modification of the old statute in a manner to stimulate inventiveness and encourage as many people as possible to search for new products, new processes, and new methods.

The new statute simplifies the filing of applications, eases somewhat the requirements of patentability, provides for greater efficiency in arbitration of inventors' complaints, and liberalizes the reward of inventors. The new law is not designed solely for the benefit of the inventor; the assignee too profits from it.

[1] In writing this paper, I used the Russian text of the statute and the directive. An English translation of the Russian text can be found in: *Soviet Patent and Trademark Law*. London, 1960. Her Majesty's Stationery Office. 33pp.

The assignee, of course, is the state which also controls the national economy. The greatest inventions, most striking discoveries, and most useful suggestions avail but little unless they are realized in the national economy. The incentive of profit being absent from the Soviet economy, the only stimuli for exchanging of the tried and known for something new remain the alertness of the managers and the compulsion of law. This latter is provided for in the new statute and particularly in articles 23-24 and 62-66.

What is patentable.—The Soviet law recognizes three patentable categories, accordingly protected by three kinds of patent letters.

1. Discovery (*otkrytie*)—defined as formulation of previously unknown but independently existing laws, properties, or phenomena of the physical world.

2. Invention (*izobretenie*)—defined as a substantially novel solution of a technical problem in any field of the national economy, culture, public health, or national defense, giving positive results.

3. Suggestion for rationalization, respectively improvement (*ratsionalizatorskoe predlozhenie*)—defined as suggestions for improving the utilization of existing technology (machines, instruments, devices, apparatus, etc.), suggestions for perfecting the produced goods, production technology, control and research, industrial safety and hygiene, and suggestions for increasing productivity and more effective utilization of industrial power, equipment and supplies.

In order to qualify, an invention must be substantially novel and must give positive results, *i.e.*, be useful. Novelty is established by searching Soviet, pre-Soviet, and foreign patents, applications for patents, scientific and industrial reports, dissertations, and printed literature in general, both foreign and domestic. The usefulness is determined by the respective department of Inventions and Discoveries Commission (*Komitet po Delam Izobreteniĭ i Otkrytiĭ*) which may refer the invention for testing and appraisal of its usefulness to any unit of the national economy. The usefulness of an invention need not be immediate. If, because of existing technological, economic, or other circumstances, an invention cannot be utilized immediately, or even in the near future, but holds a potential use, it is judged to be valid. For instance, a new kind of synthetic fiber was developed and its production is demonstrably feasible. However, the production of this fiber cannot be undertaken with existing equipment, or the production of this fiber is economically not desirable because, say, existing stocks and facilities would be rendered obsolete. Under such circumstances the invention has potential merit and is declared useful.

An inventor is granted either a patent (*patent*) or an author's certificate (*avtorskoe svidetel'stvo*). In the former case the inventor retains property rights of his invention and can license its use on his terms. A certificate of authorship assigns the legal rights of the invention to the State, and the inventor is granted an honorarium fixed by the State. (See Figure 1.)

It is the inventor's right to request a patent or an author's certificate. There are certain exceptions to this rule. No patents are granted for medicinals, foods, and condiments; certificates of authorship are issued for these substances.

For new methods of treating disease, provided they were tested and approved by proper authorities, author's certificates are granted but not patents. If an invention covered by a patent is of special interest to the state and no agreement can be reached between the interested state organ and the patentee—the Council of Ministers may order a mandatory alienation of the patent and fix the remuneration to be paid to the holder of the patent.

While the inventor is allowed a free choice between patent and author's certificate, the benefits of an author's certificate outweigh those of a patent to an extent that it is simply imprudent to request a patent. What are some of the advantages of an author's certificate?

1. An applicant for an author's certificate pays no filing fee nor any other expenses connected with preparing and filing of the required forms.
2. In the case where the application for an author's certificate is refused, the applicant is entitled to request documentary evidence on which the refusal is based and file a rebuttal, all without cost to him.
3. The remuneration of up to 10,000 rubles for an invention covered by an author's certificate is tax exempt. Anything above this sum is taxable after deduction of the first 10,000 rubles.
4. The holder of an author's certificate is entitled to quicker promotions.
5. He enjoys certain housing privileges.

A patentee enjoys none of these and his tenancy of the patent may be abrogated.

The compensation for an invention covered by an author's certificate is fixed by law. In its essence it is based on the return resulting from industrial realization of the invention. The minimum and the maximum are also fixed by law, but considerable latitude is allowed in applying the maximum 200,000 rubles.

A suggestion for improvement was defined before. It is meant to stimulate employees' interest in their jobs, to induce them to share their ingenuity with management, and to move then to participate in the development and progress of their occupation. The great designer, the top engineer, the director of the enterprise are unaware that the reverse lever, the port handle, or the control switch are located awkwardly, while men who operate these components are apt to notice it. Valid suggestions for rationalization are rewarded with a certificate (perhaps attestation would be a better rendition of *udostoverenie*) and a bonus of up to 50,000 rubles. Rapid promotions and other benefits are accorded successful proponents of rationalizing suggestions. (See Figure 2.)

The new patent law of the Soviet Union is called *"Polozhenie ob otkrytiyakh, izobreteniyakh i ratsionalizatorskikh predlozheniyakh."* In English rendition it would read "statute on discoveries, inventions, and suggestions for rationalization." This was stated before and it is repeated here to emphasize the first of the three categories, *i.e.*, discoveries.

The second and third categories, *i.e.*, inventions and suggestions are catholic subjects of letter patents to be found in one form or another in the patent law of any country. To find "discoveries" as defined by the Soviet patent law (formulation of previously unknown, independently existing laws, properties, or phenomena of the physical world) among patentable categories is rather unique. True, the

law does not recognize ownership, either personal or transferred, of a discovery and grants neither certificate of authorship nor a patent on a discovery, but it does enter the discovery in the "State Register" in the name of the discoverer. The discoverer is rewarded with a diploma (*diplom*) and up to 50,000 rubles.

Geographical, archeological, paleontological, and prospecting discoveries are excluded from this category and so are discoveries in the field of social sciences. This is interesting; while Heraclitus, Newton, Maxwell, Einstein, and Bohr qualify under this law, Marco Polo, Amerigo Vespucci, Sir Henry Rawlinson, Hammurabi, and Karl Marx are disqualified.

Applications for attestation of suggestions are filed with the administration of the enterprise concerned with its utilization. If the object of the suggestion is applicable to more than one enterprise, the application can be filed with the Discoveries and Inventions Commission.

Requests for authors' certificates and patents are filed with the Commission. There they are examined for novelty and merit, and either approved or declined.

Application for diplomas for discoveries are also submitted to the Commission. The Commission in turn refers the discovery, depending on its nature, to the USSR Academy of Sciences, to Academies of constituent republics, to the USSR Academy of Medicine, to the All-Union Academy of Agriculture, to the USSR Academy of Building and Architecture, or to a leading scientific institute, for examination of claims and supporting evidence. The diploma is granted or denied by the Commission on the basis of the opinion submitted by the learned bodies.

The time from the date of filing to granting a diploma, certificate, patent, or attestation or, in the case of denial, to settling the appeal is set forth in the law and must be adhered to by the officials concerned.

The application for a diploma, certificate, or patent must be approved or denied within four months and for an attestation within six weeks. Further, the law provides for appealing denial of diploma, certificate, etc. by the Commission.

Discoveries, inventions, and suggestions are protected from day of filing. The granting of diplomas, certificates, and patents is announced in "*Byulleten' Izobretenii*"—the official organ of the Commission comparable to our *Official Gazette*. Within one year of announcing their grant or of their registry, discoveries and inventions may be contested by corporate bodies and individuals on grounds of novelty or authorship. The life of a patent extends for fifteen years, and it can be contested any time during its life. Where the validity of a discovery or invention is contested the question of novelty is decided by the Commission, while the question of authorship is decided in court. Patents are subject to a prior use clause which is to say that if the subject of a patent is already used by some enterprise at the time the patent is granted, then the enterprise may continue using it without paying licensing fees.

Inventions in the field of plant and animal breeding are legitimate subjects of authorship certificates. Certificates for such inventions are granted not by the Commission but by the Ministry of Agriculture.

Класс 12о, 14 № 128383

СССР

ОПИСАНИЕ ИЗОБРЕТЕНИЯ

К ПАТЕНТУ

Заявитель

Иностранная фирма Химические фабрики ВИТТЕН,
Общество с ограниченной ответственностью
(Федеративная Республика Германии)

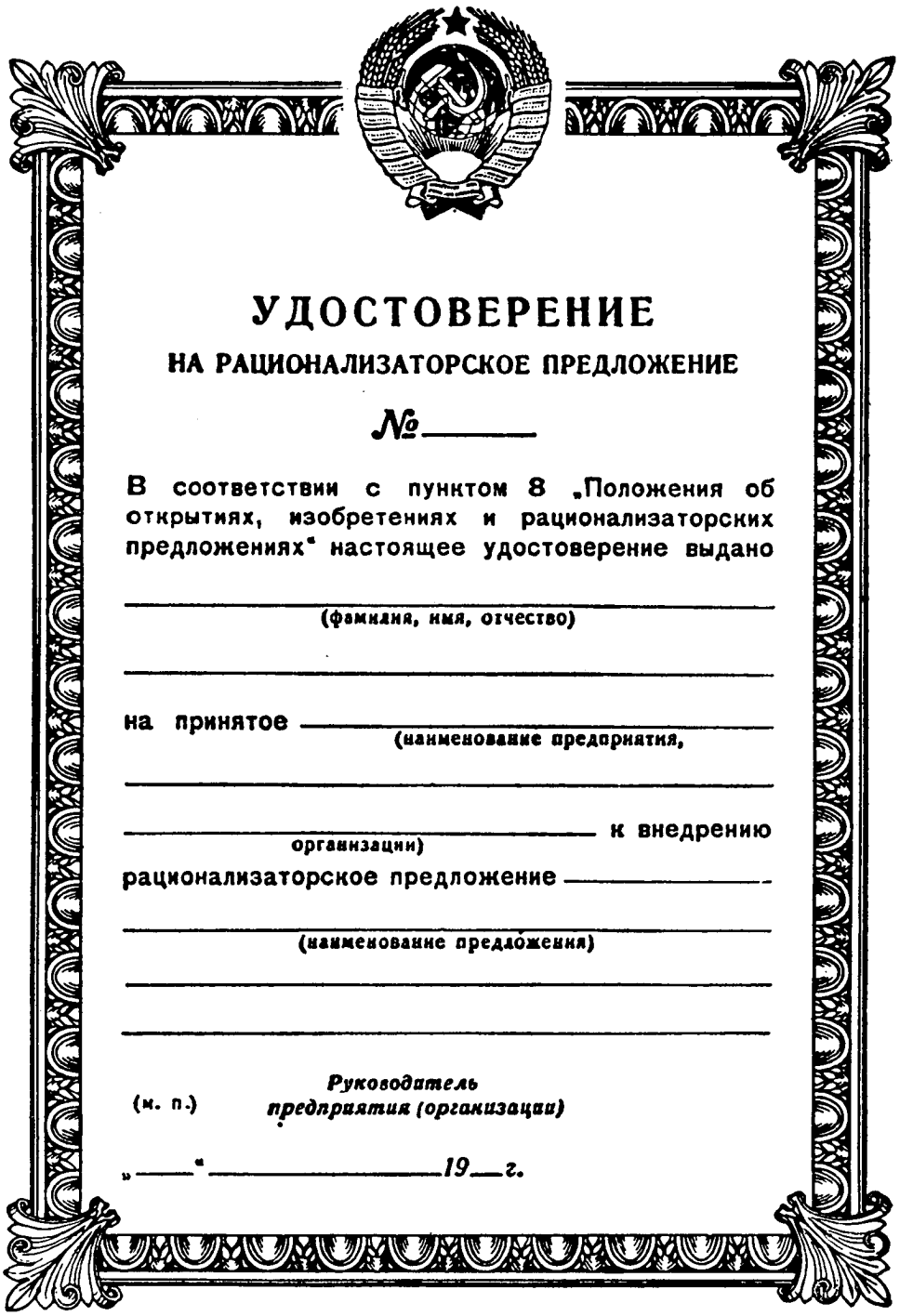
Действительный изобретатель
Иностранец Эвальд Качман

СПОСОБ ПОЛУЧЕНИЯ β-ОКСИМОНОЭТИЛОВОГО ЭФИРА ТЕРЕФТАЛЕВОЙ КИСЛОТЫ

Заявлено 24 апреля 1958 г. за № 597833/23 в Комитет по делам изобретений и открытий при Совете Министров СССР

Опубликовано в «Бюллетене изобретений» № 9 за 1960 г.

FIGURE 1. USSR PATENT NO. 128,383 GRANTED TO: "FOREIGN FIRM CHEMICAL PLANTS VITTEN, LTD. (FEDERAL REPUBLIC OF GERMANY), INVENTOR, FOREIGNER EVALD KATSCHMAN. METHOD FOR PRODUCTION OF β-HYDROXYMONOETHYLTEREPHTHALATE."



УДОСТОВЕРЕНИЕ

НА РАЦИОНАЛИЗАТОРСКОЕ ПРЕДЛОЖЕНИЕ

№_____

В соответствии с пунктом 8 „Положения об открытиях, изобретениях и рационализаторских предложениях" настоящее удостоверение выдано

_____
(фамилия, имя, отчество)

_____

на принятое _____
(наименование предприятия,

_____

_____ к внедрению
организации)

рационализаторское предложение _____

_____
(наименование предложения)

_____

_____

(м. п.) *Руководитель предприятия (организации)*

„_____" _____ *19__ г.*

FIGURE 2. CERTIFICATE GRANTED FOR A SUGGESTION FOR RATIONALIZATION.

Discoveries, inventions, and suggestions for rationalization related to national defense are considered secret. If it is deemed necessary in the interest of the State, other inventions too may be declared secret. Inventions related to armament, combat, and logistics are considered top secret. Applications for certificates on secret inventions are filed with and examined by the Commission. The Commission is charged by the law to take due precautions for safeguarding the secrecy of such inventions. Applications for certificates on top secret inventions are filed with and examined by the Ministry of Defense. If granting of a certificate is approved, the Ministry of Defense notifies the Commission which issues the certificate without examining the application.

Refusals to grant certificates on secret inventions are appealed to the Commission on Discoveries and Inventions, while refusals of certificates on top secret inventions are appealed to the Ministry of Defense.

Soviet citizens may take out patents abroad provided they obtain permission of the Commission to do so. Foreign citizens may take out patents and diplomas for discoveries in the Soviet Union. Section 14 of the statute states:

> 1. Authors of discoveries, inventions, or suggestions for rationalization who are aliens shall enjoy the rights provided for by the present statute on equal footing with nationals of USSR on a reciprocity basis.

The compensation for discoveries, inventions, and suggestions for improvement are fixed by law embodied in the previously mentioned *Instruktsiya o voznagrazhdenii za otkrytiya, izobreteniya i ratsionalizatorskie predlozheniya.* The compensation is based on the savings accrued by incorporating the invention or suggestion in the national economy. The method of computing the inventor's or innovator's remuneration is specified in the Directive. Where the invention or suggestion is utilized in more than one industrial unit all the users contribute to the inventor's fee in a manner specified by the law.

Monies paid inventors and innovators come from specific funds provided in the budget of all industrial, agricultural, and other units of the national economy.

The law pertaining to the remuneration of inventors and innovators requires that they be paid justly and promptly. If an invention or improvement is used in more than one enterprise the inventor is paid *in toto* by the enterprise first designated to incorporate the innovation and the payer may collect from the others later. Where the inventor or innovator is dissatisfied with the rating of his invention or tardiness in its realization he may call the management to account before higher authority.

The Soviet government appreciates the importance of inventions and innovations in the development of the country's economy and is doing everything to stimulate inventiveness. The law requires that:

> . . . the ministries, departments, regional administrative councils (*Sovnarkhoz*), and individual enterprises shall establish sections or bureaus for inventions and improvements

and that they

> . . . shall be obliged to establish, for the purpose of carrying on work in connection with invention and innovation activities, experimentation centers and provide them with funds, materials, and instruments.

The inventor may use his employer's time and facilities to work on his invention and still retain his right to full compensation. The employer is expected to provide the inventor with materials, instruments, apparatus, and equipment needed in the work on the invention and to assist him in the preparation of graphs, drawings, illustrations, models, etc. required for filing the application.

The inventor or innovator in his turn is obligated to cooperate when called upon with the Commission and with the enterprise entrusted with testing his invention. If this happens to be at a distance from the place of his regular employment he is paid his full salary and any travel expenses it may entail. If the examination or the testing of the invention takes place after regular working hours, the inventor is paid an extra fee.

Inventions and good suggestions are of little use unless they are utilized. An extensive section of the Soviet patent law is devoted to provisions for incorporation of inventions in production, and the failure to do so must be accounted for, but managers are managers whether they wear fur caps or homburgs and red tape is a great impediment whether red or any other color. So, the best provisions of the law notwithstanding, the utilization of inventions is often delayed and Soviet inventors are frequently shortchanged by sharp accounting practices. Aleksandr F. Garmashev, chairman of the Discoveries and Inventions Commission, complains about the frequent underrating of some inventions, which results in monetary losses to the inventors; too often also the very payments are delayed and too much time lapses before new inventions and suggestions are put in operation in plants, shops, trades, etc.

Up to this point we were dealing with the circumstances surrounding the nascency of a Soviet patent. By this is understood here a diploma, certificate of authorship, patent and attestation, all as previously defined. We shall take up now the patent literature and specifically the printed document.

We shall consider two kinds of documents, the *Byulleten' Izobretenii* and the *diplom, avtorskoe svidetel'stvo,* and *patent.*

The *Byulleten' Izobretenii*—the Bulletin of Inventions, is the official publication of the *Komitet po Delam Izobretenii i Otkrytii.* In its content and purpose the *Byulleten'* is analogous to our *Official Gazette of the United States Patent Office.* From the time of its inception in 1924 the *Byulleten' Izobretenii* has changed its name and periodicity a number of times. Currently it appears in 24 issues per year under the above name.

The *Byulleten'* carries the "formulae" of the patents. The "formula" of a patent is best defined as the essence of a Soviet patent. The "formula" is written by the Patent Office (to use our terminology) and should be accepted by the applicant. In case of disagreement, a compromise between the Patent Office and the inventor must be arrived at before the application is approved. The formulae often include mathematical or chemical equations and occasionally drawings.

In the *Byulleten' Izobretenii* the formulae are published in numerical order. Patents are numbered consecutively with certificates of authorship, and their

formulae appear in the proper sequence. The numbers included in an issue are indicated in the heading above the text of the "formulae."

Soviet certificates and patents use a classification scheme similar to that of Germany, Switzerland, and other European countries. The classes run from 1 to 91—from ore beneficiation to medication. The classes are further subdivided into subclasses, divisions, and subdivisions.

Besides the "formulae" the *Byulleten' Izobretenii* publishes notices of cancellation, changes in the text of formulae, court decisions, and other official notices.

Soviet certificates and patents are brief, concise documents readily understandable by laymen. It is usually one, occasionally two, pages accompanied by drawings where needed and one or more examples of composition and process.

On the left, top side of a Soviet specification appears the classification and on the right the number. Then follows:

Description of the Invention to Author's Certificate

Next come the author or authors and the name of the invention. Then the date of filing, the number of the application, and where filed. Then "Published in *Byulleten' Izobretenii* no. and year." This is followed by the text. At the bottom of the last page appears the colophon. (See Figure 1.)

An example of a Soviet patent, or rather the translation of it follows:

Class 39c, 30 No. 127023
12m, 7

B. V. Korshak, A. S. Sultanov, and A. A. Abduvaliev.

Catalysts.

Filed 16 June 1959, No. 631,176/23 with the Discoveries and Inventions Commission, Council of Ministers USSR. Published in *Byulleten' Izobretenii* No. 6, 1960

It is known that furan and its derivatives are polymerized in the presence of zinc chloride used as catalyst. However, this procedure uses a large quantity of catalyst and the polymerization process is slow.

The described catalyst enables the acceleration of the polymerization process of furan and its derivatives, and at the same time reduces the required quantity of catalyst. This is attained by adding silicon tetrachloride or its methyl derivatives to the zinc chloride.

Example: 16g. of toluene, 15.9g. of sylvan, 0.77g. of dimethyldichlorosilane, and 0.16g. of zinc chloride are mixed for 3 hrs. at 50°. After polymerization is completed the product is neutralized with 3 ml. of 25% ammonium hydroxide. The viscous mass is washed twice with water, the aq. layer is decanted, and the toluol is driven off with steam. The polymer is filtered and dried at 35-40° in a vacuum desiccator to constant weight. The yield of the product is 16g. molecular weight of polysylvan 8700-9000.

For analysis the product is reprecipitated with water.

Yield 6.07 mg. of substance contg.: 14.960 mg. CO_2, 4.260 mg. H_2O, and 0.440 mg. SiO_2.

Found, percent: C 67.28; H 7.85; Cl 3.13; Si 3.39.

Subject of the Invention

A catalyst consisting of zinc chloride and used in polymerization processes, of, *e.g.* furan and its derivatives, distinguished by the fact that in order to accelerate the process and lower the quantity of catalyst, silicon tetrachloride or its methyl derivatives are added to it.

In patent work, the chronology is quite important and therefore an examination of this matter as it appears in Soviet patents is of interest.

In the *Byulleten' Izobretenĭ* the last sentence of the heading just before the "formulae" there appears a statement:

> Authors' certificates are considered published on *day, month, year.*

This means that certificates and patents of which the "formulae" are printed in this issue are considered published on the date indicated in the caption.

Thus, the date in *Byulleten' Izobretenĭ* no. 8 of 1960 is 12 April, 1960. However, the colophons on the specifications recorded in this particular issue indicate that these were printed anytime between 3 February and 28 March. Whether the specifications were available for inspection I do not know, but they were printed before their official date of publication.

The sole purpose of a Soviet patent or certificate is to stimulate inventiveness and the results to be incorporated in the national economy. The author's certificates are tokens of recognition and are devoid of any restrictive intent. They are, therefore, written in a clear language and are illustrated with actual examples.

The number of certificates and patents issued by the Commission, although modest in comparison with other major industrial countries, is growing steadily.

In 1957 were issued 4997 certificates and 3 patents.

In 1958 were issued 7183 certificates and 18 patents.

In 1959 were issued 8569 certificates and 109 patents.

Judging by the 3176 certificates and patents issued in the first four months of 1960, the total for the year will exceed 12,000.

The availability of Soviet patents in this country is not as good as one may wish. Partly it is not our fault, but we are not entirely blameless in this matter.

In the nineteen forties the *Byulleten'* was received sporadically in this country and then only by two or perhaps three institutions.

Between 1946 and 1955 this situation continued with few issues received here and there. From 1956 the *Byulleten'* has arrived quite regularly. Its subscription is open to anyone who cares.

Full specifications of Soviet patents were not printed between 1950 and 1955. Afterwards, the Commission started publishing the formulae and the specifications of the missing years with the intention of completing the task in the next few years.

Soviet specifications were unknown here until the 1959 issues started arriving in our Patent Office. Beginning with 1960 *Chemical Abstracts* also is receiving full specifications of the classes included in the wide scope of its subject matter.

The coverage of Soviet authors' certificates and patents in secondary publications will be examined in three abstract journals only: *Chemical Abstracts, Chemisches Zentralblatt,* and *Referativnyĭ Zhurnal.*

Over the years *Chemical Abstracts* published complete translations of the "formulae" as given in *Byulleten' Izobretenĭ* to the extent that they fall within the scope of its interests. Complete translation is perhaps not strictly true. A small fraction of the "formulae" was published by title only. Thus were treated inventions which are purely mechanical and yet of interest to *Chemical Abstracts, e.g.,*

filter presses, concentration tables, furnaces, reactors, and chemical apparatus for which the "formulae" were too short to give an adequate picture of their construction and little would be gained from a complete translation. Where the available text conveyed a clear picture of the mechanism, *Chemical Abstracts* gave a full translation. Abridgments of specifications dealing with processes and compositions were translated in full, even though some were anything but informative. From the time *Chemical Abstracts* started receiving full specifications the abstracts have been prepared from the latter when available.

The earliest Soviet patent abstracted in *Chemical Abstracts* is No. 1, date September 15, 1924. The abstract of it appeared in CA *27,* 3787 (1933). Chronologically, however, this abstract was preceded by others of later Soviet patents. Thus, No. 1420 of July 31, 1926 appeared in CA *22,* 2951 (August 20, 1928).

In the period of 1937 to 1946 *Chemical Abstracts* published 2804 abstracts of Soviet patents and during 1947-1956 1070 abstracts. During 1957-1959 the total was 2960. Generally speaking, *Chemical Abstracts* covers about 25-30% of the total available, which is the percentage of chemical patents. This percentage is rather consistent with the percentage of chemical patents granted by the major industrial countries.

Chemisches Zentralblatt published no abstracts of Soviet patents during the period 1949-1956, *i.e.,* since the Eastern and Western editions of the *Chemisches Zentralblatt* were combined. Prior to that period the Eastern edition did cover Soviet patents and quite frequently borrowed the abstracts from *Chemical Abstracts.* This is a rather curious situation where an abstract journal published in a Soviet controlled area borrows abstracts of Soviet literature from a U.S.A. publication.

Referativnyĭ Zhurnal, the formidable Soviet abstract journal, did not cover Soviet patents until 1960. Since then it covers them only to a limited extent. This too is puzzling because the *Referativnyĭ Zhurnal* publishes extensive abstracts of U.S., British, French, Australian, Austrian, Danish, Italian, Spanish patents as well as patents of other countries.

From this survey it becomes rather obvious that the searching of U.S.S.R. patents must be confined to *Chemical Abstracts,* bearing in mind that *Chemical Abstracts* covers only a restricted number of patents.

Scientific Discovery, Invention, and the Cultural Environment*

IRVING H. SIEGEL**

SUMMARY

ORIGINALLY PREPARED FOR AN AUDIENCE comprised mostly of economists, this revised paper is published here in the belief that it will interest the broader professional public served by the *Journal.* Briefly, this paper distinguishes between "scientific discovery" and "invention", and considers their relations, as ideas and as actual experience, to each other; to other types of knowledge, such as know-how, employee suggestions, and "reinvention"; and to the larger cultural environment.

As ideas and as experience, "scientific discovery" and "invention" may be viewed in two ways—as *activities* and as *results* of activities. As ideas they belong, like the activities of education and communication and like the types of knowledge mentioned above, to the realm of *information,* which is now rapidly taking its place beside *matter* and *energy* as a category considered worthy of attention. They are important to a more complete understanding by experts and laymen of the nature and dynamics of research, technology, production, the new foreign competition, and national defense. Since "scientific discovery" and "invention" involve many specific operations, they may usefully be studied in terms of such component activities as the creation, processing, storage, retrieval, distribution, and application of information.

As experience, "scientific discovery" and "invention" significantly affect, and in turn are influenced by, the larger cultural environment. A common mistake is to overlook their roles in the real world as "effects" and to regard them as "causes" only. In recent years of high and rising public and private expenditures for research and development activity, however, it has become clear that international tension, foreign bids for larger market shares, and company efforts to maintain long-run profitability leave their mark on science and technology—as well as the other way around. Similarly, although scientific discovery may logically precede invention when both are considered as ideas, they may actually proceed together (as in military research efforts that are both "basic" and "applied"); or invention (*e.g.,* of instruments and apparatus) may actually be prerequisite to sci-

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* Revision of a paper on "Scientific Discovery and the Rate of Invention", which was presented May 12, 1960 at the Conference on the Economic and Social Factors Determining the Rate and Direction of Inventive Activity, University of Minnesota.

** Member of the Research Staff of The Patent, Trademark, and Copyright Foundation.

entific discovery. Another practical relation in which time is a relevant factor is the revision of the significance of past scientific discoveries and inventions as new ones are made.

Finally, we may confidently expect continuing spectacular gains in science and technology. But new opportunities will also be tempered by new dangers, especially the hazard that an antagonistic industrial or industrializing nation may build up a decisive military advantage along a particular line. An obvious policy implication is the training of a larger proportion of our youths for versatile participation in scientific and inventive activities without disparagement of the other necessary tasks of a free society. Such a program would increase the probability of breakthroughs, our capacity to exploit them, and our ability to counter foreign technical successes that threaten a decisive military gap.

Introduction

THIS PAPER, AS THE ABOVE SUMMARY NOTES, discusses relations involving "scientific discovery" and "invention", considered as *ideas* and as *experience*. The two entities are connected, as symbols and as realities, with the generation, treatment, and use of "information", which is increasingly being recognized as a fundamental economic and technological "stuff" comparable to matter and energy.[1] They enter into the logical and historical sequences of ideas and events that may culminate in the economic exploitation of new inputs, production methods, and products. In the contemporary setting, they represent typical goals of formal research and development projects, on which billions of dollars of public and private funds are now being spent annually in the United States. They provide opportunities and avenues for cultural change, including economic growth and progress (which may be measured in terms of real income per capita and real output per man-hour, respectively); and they influence, although they cannot alone determine, the pace and directions of such change.

Concepts of "Scientific Discovery" and "Invention"

The terms "scientific discovery" and "invention" signify both acts and results of acts, both processes and outcomes. When used in plural form, they clearly refer to outcomes rather than processes; and when the singular form is preceded by the indefinite article, an outcome is connoted.

Although in legal and other literatures the terms "discovery" and "invention" are often coupled and treated as equivalents, they are assigned different meanings here. A distinction is intended in this paper even when, for the sake of simplicity, the adjective "scientific" is omitted.

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[1] A fourth "stuff" that increasingly deserves separate recognition is "life," which is of primary concern to such industries as medicine and agriculture and is also the subject of considerable basic and applied research.

"Scientific discovery", or simply "discovery", is the act of wresting a secret from Nature; and a secret that is won is "a discovery." More specifically, "a discovery" may be a "new" fact, principle, hypothesis, theory, or law concerning natural (including human) phenomena that are observable directly or through their effects. Novelty is to be determined from the standpoint of a nation or a civilization, rather than an individual; what is new to a person other than the true pioneer may represent a rediscovery or just his education (*i.e.,* diffusion of existing knowledge). On the other hand, the "first" discoverer is not always accorded as much honor for primacy, if his name is remembered at all, as a later discoverer whose work has, in a more congenial context, borne more scientific or technological fruit. Every discoverer actually builds upon a foundation of "old" knowledge that has become part of the cultural heritage; and the acknowledgment of his contribution depends on the manner in which he presents his findings as well as on the "ripeness" of the time in the country of his labors.[2] Too much primacy may be dismissed in retrospect as prematurity rather than acclaimed as originality.

"Invention" may be regarded as purposeful and practical contriving based on existing knowledge (theoretical and applied) and uncommon insight or skill; as the act of bringing to workable condition a potentially economic or useful process or product ("an invention") that has one or more significantly novel features. Again, tradition is relevant and novelty is supposed to be judged from the standpoint of a nation (*e.g.,* according to the standards of a patent system) or a civilization (*e.g.,* all "prior art"); and, again, honor for primacy may be bestowed without a fine regard for historical literalness or the sensibilities of competing inventors. Patriotism, insularity, ignorance, or indifference to exact definitions and to specific patent claims may encourage attribution of an invention to a citizen of one country instead of another. But, the assertion of priority by the country of experimentation, patent registration, or application may also reflect the fact that an invention has a cultural context—that credit for it may even reasonably be sought on the basis of its local development and local significance, rather than its abstract availability to the world at large.[3]

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[2] To avoid repetition of the "classic" cases of men of science against the world, I mention three great young chemists who even defied their own professors: van't Hoff and Arrhenius, who had the good fortune to enlist the aid of Ostwald as champion of their new theories; and Couper, whose humbling by Wurtz led to obscurity and left Kekulé to bask alone in glory. (See Barnard Jaffe, *Crucibles: The Story of Chemistry,* Premier reprint, 1957, pp. 140-154; P. Cook, "The End of Chemistry Is Its Theory," *Science News: 53,* October, 1959, pp. 33-48; and Eduard Farber, *The Evolution of Chemistry,* Ronald, New York, 1952, pp. 164-166, 174-175, 222-225, 265-268.)

[3] In the United States, where exaggerated Soviet claims to various inventions have provided much amusement, it is also common to regard many familiar features of the technological scene as indigenous despite their foreign antecedents—e.g., the automobile, the pneumatic tire, motion pictures, radio, television, cellophane, Dacron, polythylene, penicillin, DDT, tranquilizers, antihistamines, sulfa drugs, oral insulin substitutes, and jet aircraft. A useful corrective is provided by literature which may seem to overstate the European accomplishment with respect to our own—*e.g.,* the treatment of the telegraph, which every American schoolboy "knows" was invented by Morse, in Charles Singer, E. J. Holmyard, A. R. Hall, and T. I. Williams, eds.,

At this point, it should be noted that unpatentable mental "inventions" play a vital role in the process of scientific discovery and that they may on occasion constitute the essence of "a discovery." Fruitful observation or measurement sometimes depends on the introduction of new and particularly appropriate concepts; and the formulation of sound hypotheses and theories sometimes requires the invention of critical "thought experiments" or must await the construction of new, effective "models" of reality. A victory over nature may, furthermore, take the form of a novel theorem, algorithm, or branch of mathematics; or it may be a methodological contribution to some other deductive science, such as statistical theory or logical inference.[4] Indeed, all discoveries that facilitate further discovery or practical invention literally are mental "tools".

On "Rates" of Discovery and Invention

Since events are more discrete than the actions that lead to them, the "volume" of scientific or inventive activity over any period of time is not perfectly correlated with the "number" of discoveries or inventions completed in the same interval. This divergence, however, is only one of many factors that should discourage a quantitative interpretation of the phrase "rate of invention" included in the title assigned to the original version of this paper.

A much more relevant factor is the wide variation in the quality and significance of discoveries and inventions (considered as events), so that a simple count of such events provides no clue to the number of "units" of significant novelty involved. As already noted, every scientist or inventor actually starts *in medias res,* from the standpoint of his culture, even though he may like to think that he starts *ab ovo.* A scientist may either add a small increment to the fund of knowledge or propose or effect a grand reorganization or synthesis; he may show either un-

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A History of Technology, Oxford, New York and London, 1958, Vol. IV. In a British review of this work (D. C. Coleman, "The New Age of Technology, 1750-1900," *Economica,* May 1960, pp. 162-171), the common neglect of continental pioneers in the telegraphic and other fields is in turn criticized: "The self-helping heroes of Smiles' sagas of invention and engineering loom large in the standard iconography of British industrial history. Their achievements were real, but so in a different way were those of other men who contributed variously to the progress of nineteenth century industrialization." A popular book on *The British Contribution,* by Donald Cowie (Allen and Unwin, London, 1941), not only neglects Morse while citing Wheatstone but also claims the steamboat for Symington, a Scotsman (1787), and proudly recalls Bell's Scottish origin and education, Marconi's Irish mother and his use of British equipment, and the participation of Britons in the development of television and the cinema.

[4] According to Stephen Toulmin, *The Philosophy of Science,* Harper reprint, New York, 1960, pp. 28-29, "inferring techniques and models are the core of discoveries." See also N. R. Hanson, *Patterns of Discovery,* Cambridge, London and New York, 1958; and remarks by Herbert Dingle (in *Scientific American,* June 1960, pp. 189 ff.), who insists that the "invention" of a concept must precede measurement and that quantification is not literally concerned with "discoveries" but with "artificially created experiences." Einstein relied heavily on *gedanken experimente:* "In deriving or testing a theory he would imagine some situation in nature, imagine an apparatus to probe it with, then probe it and calculate the results—all within the confines of his own fertile brain" (David Bergamini, "The Methods of Science: Dreamers and Tappers", *Think,* September 1960, p. 8).

usual persistence or genuine creativity, either deftness of hand or incisiveness of mind, either a tolerance of perspiration or a touch of true inspiration.[5] "Happy accidents" may, as Pasteur and Lagrange observed, befall some "prepared minds" and shorten the path to success or provide new goals;[6] while mischance may frustrate others no less deserving. Once a pioneer is acknowledged, his prestige tends to resist depreciation as successors offer more elegant solutions of the same problems on the basis of newer knowledge.[7] A hero may also be overcredited by common opinion with the achievement of his predecessors, colleagues, and assistants;[8] his true accomplishment, on the other hand, may be ungenerously appraised by his peers or by members of a different profession.[9] In an age of sophisticated formal research programs, it is easy to ridicule the empiricism of a Goodyear—and fail to recognize persisting elements of his approach in today's projects for routine testing of established catalysts or medicines in new circumstances, for minor modification of drug molecules, and for systematic screening of molds for antibiotics. Finally, the march of history may confer new significance on a discovery or invention thought to be minor or trivial in an earlier context.[10]

[5] What weights would be appropriate for combining in one measure these three major qualitatively different achievements involving the speed of light: Michelson's painstaking measurement of this constant, Lorentz's use of this speed as a limit in his "transformation equations" relating to the mass and length of moving objects, Einstein's use of it in his expression for converting mass into energy?

[6] On the role of accident, see I. B. Cohen, *Science, Servant of Man,* Little, Brown, Boston, 1948, pp. 36-50, 107-108; and W. I. B. Beveridge, *Art of Scientific Investigation,* Modern Library paperback, 1957, pp. 37-55.

[7] Michelson's mechanical determination of the velocity of light, refined over a half century, was inherently much less accurate than the measurements subsequently made by many little-known workers in Federal laboratories using radar, radio waves, molecular vibrations, and "atomic clocks." Two more recent revisions by government scientists—of the Rydberg constant and of the atomic weight of silver—have caused but little stir.

[8] This is true not only of such bold syntheses as Newton's and Einstein's but also more limited projects involving team research—*e.g.,* the production of new transuranium elements. The reader may find it instructive to check the names he recognizes in the list of credits shown for elements 98-101 by Albert Ghiorso and G. T. Seaborg, "Synthetic Elements: II," in *New Chemistry,* Simon and Schuster, New York 1957, p. 137.

[9] Recall the attitude of physicists like Maxwell and Rowland toward inventors of practical things as simple as the telephone (Cohen, *op. cit.,* pp. 61-63). Much more recently, sociologists and anthropologists have pursued the same general line as the philosopher, C. S. Peirce, developing cultural theories of invention and discovery that minimize the role of the individual. A prominent anthropologist, L. A. White, has stated (in *Science of Culture,* Grove reprint, New York, pp. 213-214) that Urey's isolation of heavy hydrogen (a feat winning the Nobel Prize) did not require "intelligence of a high order" although it did demand more technological knowledge than the familiar feat of "opening a recalcitrant jar of pickles."

[10] The Seebeck, Peltier, piezoelectric, magnetostrictive, and Edison effects are among the many discoveries that have grown in practical importance through time. Ampere's theory of electrodynamics has gained new meaning with the appreciation of the electrical nature of matter. Swan's artificial-fiber filament was not good for an incandescent light, but it pointed the way to rayon. Goddard's early work in rocketry and Jansky's discovery of radio-wave emanations from distant stars are acquiring great significance as our own government and others give urgent support to space science and technology. Patents on stereophonic recording expired before the recent development of popular interest in an alternative to monaural disks.

The availability of statistics on patent grants and applications encourages the computation of "rates of invention" and other arithmetic measures, but it also provides occasions for recognition of the unequal intrinsic or economic import of inventions and of the difficulty of defining a suitable common denominator. An objective, generally accepted standard of patentability still does not exist, and judicial opinions repeatedly remind us of the indefiniteness and instability of legal concepts of invention.[11] The propensity to patent, furthermore, is likely to vary through time. It should be influenced by the degree of industrialization, the level of technical education, the occupational distribution and economic status of potential inventors, the extent and nature of immigration, alternative opportunities available for use of leisure time, the trend of court decisions in infringement and antitrust cases, the ease of obtaining patent licenses, the scope of public financing of invention, the business outlook, and the estimated private marginal advantage of patenting (with due regard to possible litigation costs, royalty rates, etc.). A change in the propensity to patent in the United States is suggested by the disparate trends of patent applications and public and private research and development expenditures in the past two decades.[12]

Two channels of inventive activity—the employee-suggestion plans of larger companies and the informal efforts of smaller companies to expand their "know-how"—are less likely than formal research and development programs to lead to new applications for patents. Employee suggestions are numerous and cover a wide range of subject matter, but they also vary considerably in originality and potential economic usefulness. Relatively few are deemed worthy of awards; and most of those that are accepted probably do not involve invention, or display a low order of inventiveness, or are concerned with the reinvention, improvement, adaptation, or broader use (diffusion) of known technology.[13] "Know-how" ex-

[11] See Gay Chin, "The Statutory Standard of Invention: Section 103 of the 1952 Patent Act," *PTC J. Res. & Ed.*, 3, No. 3 (Fall 1959), pp. 317-329; G. S. Rich, "Principles of Patentability," *The George Washington Law Review*, January 1960, pp. 393-407; and various essays in W. B. Ball, ed., *Dynamics of the Patent System*, Central, New York, 1960.

[12] See Jacob Schmookler, "Inventors Past and Present," *Review of Economics and Statistics*, August 1957, pp. 321-333; *idem*, "The Level of Inventive Activity," *ibid.*, May 1954, pp. 183-190; J. B. Dirlam, "Patents and Progress: Is Our Patent System Obsolete?," *Dun's Review and Modern Industry*, April 1957, pp. 52 ff.; and the discussion by S. C. Gilfillan, J. Schmookler, and I. J. Kunik in *Technology and Culture*, Summer 1960, pp. 201-234.

[13] In its *Annual Report for 1959*, General Motors Corporation noted the payment of more than $4 million in awards for almost 88,000 accepted employee suggestions. This number of suggestions comprised only about one-fourth of the total submitted to the company, although it exceeded the volume of applications made to the U. S. Patent Office in the same year. Maximum awards of $5,000 each were made for 67 inventions. Other corporations also provide information on employee suggestion plans in their annual reports to stockholders. For example, in 1959, United States Steel accepted 11,400 ideas and paid out $411,000; it made one award of $12,475 "for an improved method of handling scale residue from scarfing operations." In the same year, "employees received $256,089 for 8,942 suggestions adopted under the Westinghouse Suggestion System, and $234,450 was paid in invention awards"; four Westinghouse employees had accounted for 992 suggestions, of which 624 had been adopted, during their careers. American Cyanamid reported almost 4,500 awards totaling about $90,000 in 1959; this company received 16,425 suggestions, or 77 per 100 eligible employees.

pansion programs too may be concerned largely with reinvention and the more effective use of existing knowledge (especially through a better distribution of it—*i.e.*, through education of key company personnel). Although the overwhelming majority of small industrial firms do not engage in formal research activity (despite the impression to the contrary that may be created by contemporary journalism and public relations), surveys conducted by The Patent, Trademark, and Copyright Foundation indicate the heavy reliance of such firms on "know-how" development. Companies that have a strong interest in patents also are concerned with the generation of related "know-how," either for direct use or for licensing to others.[14]

Discovery and Invention Seen in a Broader Context

Modern circumstances require that increasing attention be given to the roles of discovery and invention in economic and other cultural change and that more explicit consideration be given to these two categories (or to the specific operations they embrace) in the economic treatment of information. Among the relevant circumstances are: the multiplication and enlargement of corporate research programs; the annual outlay of many billions of public dollars for private contract research; the clarification of accounting rules (*e.g.*, in the Internal Revenue Code of 1954) regarding treatment of private research costs; the increasing importance of the scientific and technological aspects of national defense; the private acquisition of commercially valuable patents and experience through military contracts and subcontracts; the extensive traffic in technical information; the constant efforts in a progressive and relatively free economy to restrain domestic production costs (through process improvements) and to expand the horizons of domestic consumption (through introduction of new, acceptably-priced products); the intensifying competition with foreign industry for various markets at home and abroad; the depletion of high-grade domestic mineral deposits and the growing political and military threats to certain preferred foreign sources of supply; and the impressive advance in information-handling technology (*e.g.*, electronic communication and electronic data processing).

These new circumstances require, for example, a breakdown of the Schumpeterian triple sequence familiar to economists (invention, innovation, and imitation) into more stages and the interpolation of others.[15] (The greater the number of ex-

[14] See reports on the role of patents among other factors (including "know-how") in the creation, development, and current operations of small firms in a number of industries, prepared under the general direction of I. H. Siegel and published in various issues of the Foundation's *Patent, Trademark, and Copyright Journal of Research and Education* (beginning with the first, for June 1957). Other reports in this *Journal* point to the importance of "know-how" as an item of intercompany exchange at home and abroad; see, for example, J. F. Creed and R. B. Bangs, "'Know-How' Licensing and Capital Gains," Vol. 4, No. 2 (Summer 1960), pp. 93-107, and J. N. Behrman and W. E. Schmidt, "New Data on Foreign Licensing," Vol. 3, No. 4 (Winter 1959), pp. 357-388.

[15] Although it would seem desirable to find a place in a general theory of information for Usher's penetrating analysis of the emergence of novelty, his contribution should not be used as a basis for weakening the useful distinction between invention and innovation. The fact that

plicitly recognized stages, the greater is the opportunity for discriminating analysis of interaction.) They also demand the establishment of subdivisions in the categories "basic research," "applied research," and "development"—to distinguish educational activities (which typically involve rediscovery and reinvention) from "creative" activities that aim at discovery, invention, and innovation.[16] Further-

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inventors and innovators are usually different persons argues strongly for the separate identification of their characterizing acts. The position taken here is at variance with that of V. W. Ruttan, "Usher and Schumpeter on Invention, Innovation, and Technological Change," *Quarterly Journal of Economics,* November 1959, pp. 596-606.

[16] In a report of the President's Science Advisory Committee, *Strengthening American Science,* December 27, 1958, reference is made to another significant category, "analytical engineering"—"the sophisticated scrutiny of available knowledge to determine what sort of 'things' are possible to build, or to invent (if need be) and which are not, and what may be the magnitude of their cost." In discussions of the Defense Department's budget and activities, it has become desirable to refer to "RDT & E"—research, development, test, and evaluation—rather than simply to "R & D." (See *Science,* July 8, 1960, p. 75; and David Novick, "What Do We Mean by Research and Development?," *California Management Review,* Spring 1960, pp. 9-24.)

The "basic research" activity conducted by a profit-motivated corporation is bound to show less serendipity and a closer relation to practical objectives than the programs conducted under this same general heading at a university or non-profit research foundation. An official of General Electric Company has used "learning work" as an apt synonym, which implies corporate efforts to assure that the research staff masters knowledge "available" in an abstract sense for adaptation and use in the corporation's longer-term competitive interests. This rationale of corporate basic research seems more realistic than statements made about the need to replace knowledge drawn from the common "bank" so that the "scientific balance remains in healthy condition." Such statements are truer for a corporation's private "account," of course, than for a company's informational transactions with society or civilization at large. (On this paragraph, see C. G. Suits, "Opportunity for Basic Research in Industry," *Proceedings of a Conference on Research and Development and Its Impact on the Economy,* National Science Foundation, 1958, pp. 87-101; C. H. Greenewalt, "Basic Research: A Technological Savings Account," in Dael Wolfle, ed., *Symposium on Basic Research,* American Association for the Advancement of Science, 1959, pp. 127-132; and Edgar Weinberg and I. H. Siegel, "Development and Implications of First Transistor Patents," *The Patent, Trademark, and Copyright Journal of Research and Education,* Winter 1959, pp. 392-397.)

The basic research programs described in 1959 reports of corporations concentrate on those areas that are expected sooner or later to bolster profitability. For example, U. S. Steel Corporation is investigating the "fundamental properties and behavior of steel and other materials" and "the two most important reactions in the production of iron and steel" (ore reduction and oxidation). General Motors Corporation reports the study of solids, new methods of converting and using chemical and nuclear energy, and various aspects of the phenomenon of friction.

According to an advertisement in *Fortune,* July, 1959, the budget of the new Research Center of Republic Steel was to be divided at first as follows: 30% for development projects expected to yield fruit in 1-3 years; 30% for exploratory work expected to pay off in 5 years; 30% for 10-year projects; and 10% for "pure science, work with no currently apparent application." From a description of this last "blue sky" category, however, it appears that steel problems of "the Outer Space Age" are being emphasized.

An academic chemist distinguished for discoveries and inventions involving fluorocarbons believes that company appropriation of the terms "basic research" and "fundamental research" (to mean inquiries promising distant, rather than early, company payoffs) makes desirable substitution of the term "creative scholarship". (See J. H. Simons, "Scientific Research in the University", *American Scientist,* March 1960, pp. 80-90.)