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## FORUM

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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. This section provides a medium for the presentation of papers and notes which do not necessarily rest as yet on a firm basis of empirical research. It is hoped that the material published in this section will stimulate researchers to undertake factual study of the issues.

### Increasing the Production of Inventions

James W. Colvin\*

**T**HE PROBLEM OF INCREASING THE PRODUCTION of inventions by research personnel is not simple but involves consideration and exploration of a number of controlling factors which may be grouped for convenience of discussion under three main headings, viz:

1. The nature of patentable inventions.
2. The selection of individuals having the creative ability necessary for making worthwhile inventions.
3. The environment in which the selected individuals are required to function.

So much has been written about patentability and patentable inventions that it would seem to be a waste of time to go into a detailed discussion of the subject here yet, since this is the basic subject of the discussion, it becomes necessary to at least define the material we are talking about. A patentable invention is basically a physical embodiment of an improvement, or occasionally a new idea, in a structure, machine, apparatus, composition of matter or industrial process. This definition omits plant patents which are not pertinent to the discussion. While almost any new and sound improvement or idea may be inventive, in fact if we accept the broad dictionary definition for invention,

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\* Registered Patent Attorney, now employed by U. S. Army. The views expressed herein and do not necessarily indicate the views of the Department of the Army.

Mr. Colvin has had 15 years experience as a patent attorney for industrial companies and 10 years in private practice. The comments in this paper originally were made by the author in response to the inventor questionnaire card sent him by his former employer in the Foundation's study of rewards and incentives to employee-inventors. Mr. Colvin has made certain additions and changes in his remarks prior to publication.

—Editor.

the ideas do not even have to be sound as long as they are imaginative or ingenious, the designation of *patentable* introduces other criteria. To be patentable, the idea must not only be embodied in a physical existence, such as a structure, for example, a hand tool, fish lure or container, machine such as a machine tool, vehicle or power plant, apparatus, such as a radio, instrument or communication system, composition of matter, such as a metallic alloy, therapeutic drug or plastic composition, or industrial process, such as heat treating and tempering metal, mixing, molding and vulcanizing rubber or the conversion of wood fiber into paper, but must also respond to requirements of novelty, ingenuity, operativeness and utility.

If a new machine comprises an assembly of known components in producing its intended result, the old components of the machine must react on each other and so modify the action of the several components that the result obtained is more than the expected sum of the result of the operation of the several components by an ingredient of ingenuity obtaining a result which could not have been anticipated from an analysis of the accumulative operation of the components. If the results produced by the machine are only the summation of the actions of the several components, we have only an unpatentable aggregation no matter how useful the assembly may be. On the other hand, if the result of the operation of the machine could not have been foretold from a knowledge of its components by standard or conventional engineering analysis, we have a potentially patentable invention. To the evaluation we must then apply the criteria of operativeness and utility.

The Patent Office attitude on operativeness is liberal. If the Office questions the operativeness of an invention, the inventor has only to demonstrate by model or sample that the device or composition will operate at least a few times. The Patent Office will accept this demonstration if it appears that routine engineering could make it practically operative, omitting consideration of the requirement for clinical testing of new drugs. It must also be shown that the invention produces results that are either materially better than the results obtained from prior devices or materials used for the same purpose or that it produces an entirely new result having sufficient utility.

Having, more or less, defined the subject matter in which patentable inventions may occur, we can now turn to a consideration of the kinds of activity in which patentable inventions would likely occur and from that consideration identify the class or group of inventors to which the application of some form of stimulation might be effective to improve the alleged relative lag in the technological development of the country. Having identified the particular class or group of inventors,

it then becomes appropriate to consider what form of stimulation would have the greatest appeal to the type of inventor with which we are particularly concerned.

That kind of research referred to as basic or scientific research, that is research having as its primary purpose the production of information or increase of knowledge, produces a negligible number of inventions. One reason is that this type of research is directed toward learning more about the laws of nature or the principles of life, which material is not patentable subject matter. If the millions spent on medical research in such fields as cancer, polio, tuberculosis, etc., have produced any important patents, this writer is not aware of them. The Salk Vaccine, for example, is not patented and probably could not be. Basic research in the field of astronomy, etymology, microbiology, radiation, sanitation, electricity, and cryogenics, to mention only a few, is not known to have produced much in the way of patentable invention, although, as mentioned above, chemical researchers may occasionally discover a new and useful substance. It is said that during a Congressional investigation of government research, one senator made the remark that, in his opinion, the only result from billions of dollars spent by the government on basic or informational research was millions of pages of uncatalogued, uncollated, and unassimilated information. Perhaps consideration should be given to the question as to whether, under the present economical and political conditions, some of the money and effort now being fed into basic or informational research should be diverted into applied research. This could be in line with a remark the Secretary of Defense is reported to have made at the time of the Cuban crisis. "I don't need exotic aircraft and rockets seven years from now, I need guns now."

A review of a recent issue of the *Official Gazette* of the U.S. Patent Office reveals that of 900 patents issued, 660 were assigned to manufacturing companies or the government and, in the case of 240, assignments had not been recorded. Acknowledging that in some cases there were two or more patents by the same inventor and that in some of the unrecorded cases, assignments will be recorded later, the percentage of organization or captive inventors is approximately 73 percent of the total, and of independent inventors 27 percent. It can probably be safely assumed that on the average, three-fourths of the patents are issued to employers of captive inventors and one-fourth to independent inventors. It is further noted that nearly all of the patents in the chemical and electrical arts were issued to employers and that many of the patents issued to independent inventors were for such subject

matter as games and game pieces, toys, household implements, fish lures, and other gadgets.

In defining the field where stimulation of the production of inventions would be desirable, it seems reasonable to ignore the group of independent inventors. Fishing seems to be particularly inducive to invention while golfing, cooking, and yard work also seem to be helpful and it is not thought that recommendation for greater indulgence in these activities would add materially to the technological status of the country.

Turning now to the captive inventors, the nature of the patents indicates that most of these are working in the field of applied research, including product development and improvement. A few patents, particularly in the chemical and electrical arts may derive from basic or informational research. It is conceivable that a chemist with an inquiring mind wondering what would happen if he added this to that and stirred vigorously, might occasionally produce a new substance and be curious as to what it might be good for. Many such new substances have been found to be useful only as intermediates in a subsequent process and this has brought on a major controversy as to whether utility as an intermediate is sufficient to warrant the granting of a patent monopoly.

While the field of basic or informational research cannot be entirely ignored since it furnishes much of the background knowledge utilized by the worker in applied research, it produces so little in the way of patentable inventions that any attempt to stimulate the production of invention in this field would not pay off.

This then leaves only the workers in applied research who are already producing between 600 and 700 inventions per week. This leads to the question as to whether the lagging technological status of the country may be incidental to the quality rather than the quantity of our inventions. While it is true that the number of patents issued per year has remained fairly constant over the past 30 or 40 years and has not kept pace with the increase in population, it must be remembered that many, if not most, of the simple contrivances needed by the relatively primitive economy of 100 years ago have been provided and the requirement has now moved to more sophisticated ideas as evidenced by the fact that three-fourths of today's patents are issued on inventions of trained technologists working in organized applied research. While it might be argued that the production of more inventions would inherently increase the number of important or far advanced inventions, it is believed that this is not necessarily true. It seems rather that the question should be restated to inquire how we can increase the number

of inventions of a quality that will restore our leadership in the fields of advanced technology.

It is believed that the answer to the restated question is in two parts. The first part involves the selection of individuals capable of producing inventions in the quantity and of the quality required, and the second part involves the creation of an atmosphere in the field of applied research that will be conducive to superior and sustained effort on the part of these individuals.

Selection requires at least two facilities, a place or condition where inventive qualities can be demonstrated and a management personnel capable of making selections without personal or professional jealousies or personal prejudices. Many industrial organizations already have experimental laboratories or experimental shops in which research engineers and scientists work. With some improvement most of these could be used as test grounds to demonstrate the creative ability of research and development personnel.

Some companies do subject incoming engineers and technicians to a test period in such laboratories or shops but usually the test periods are too short, averaging about six months, to provide opportunity for the deliberate or the late bloomers, and do not provide anything near the proper environment for creative effort, as will be discussed later. Also, these laboratories and shops are usually open to incoming employees only and little effort is made to uncover hidden talent in the ranks of employees holding routine or stabilized jobs. Just because an engineer is an excellent production cost analyst does not mean that he is not also a potential innovator but it seems that the premium on production cost analysts is such that it would not be profitable to have such an employee devote even a part of his time to innovation and invention.

In the government, the test ground situation is much worse than in industry. In the first place, it seems to be arbitrarily assumed that Civil Service does not attract technological personnel who really have "anything on the ball." The tendency, therefore, is to contract all experimental and research work to industrial organizations with the result that the government, and particularly the military establishments, have little or no facility for in-house research or experimentation. Thus, the government engineers quickly find that they are not expected to originate anything but are really contract administrators burdened with such a load of clerical and administrative detail that initiative is sapped and such creative or innovative ideas as occur are put off to some indefinite future time when there may be sufficient leisure and freedom to indulge in the almost forgotten delight of un-

regulated thinking. Two of the necessities for increasing the occurrence of inventions among government employed technologists are better facilities for testing inventive ideas through models and application of innovations to existing equipment, and job assignments that will provide the necessary freedom for creative thinking. If these requirements could be met, there would be at least a chance of recognizing some of the few creative thinkers among the host of administrative and clerical personnel composing the multitude of government employees.

Even with the existence of an adequate proving ground, the selection of inventors is not always easy. Granted that there are a few outstanding individuals, men like Firestone, Kettering, and Steinmetz, whose inventive enthusiasm cannot be suppressed, many potentially good or even great inventors require, at first, reasonable encouragement and a sympathetic reception of their offerings. This requires in those members of management charged with this responsibility, an enthusiasm for invention and innovation, a policy of dissatisfaction with present products and a desire for improvement, a willingness to sacrifice a part of current profits for dominance in future competition, and an ability to give credit where credit is due without personal jealousy or connivance for personal aggrandizement. For example, there have been cases where nearly all patents on inventions of a company engineering department have been taken out in the name of the chief engineer regardless of who originated the idea. Probably one of the best current examples of selection and encouragement of inventors is provided by the International Business Machines Corporation although other companies including General Electric, Minnesota Mining and Manufacturing, and Bell Telephone Laboratories are doing an excellent job of selecting competent inventors and obtaining a high production of worthwhile inventions.

While it is true that the majority of engineers probationally placed in the research laboratory or experimental shop to prove their ability to make improvements and innovations must ultimately be removed from the list of potential inventors and assigned to other duties or separated, discovery and development of the few creative thinkers in each group has proved to be well worthwhile to some manufacturers.

Even though a group of the highest capacity for constructive thinking and invention were selected and established in an industrial or government organization, the result of their efforts could be completely disappointing unless they were able to work in an environment conducive to original and constructive thinking. The basic areas of such an environment can be estimated from a consideration of the

characteristics of the typical inventor. Since by the very nature of the requirement the inventor is an original and free thinker endowed, like the true artist, with an ability to see what others overlook, with a singular imagination that can transform what he sees, whether abstract theory, concrete experimental data or factors of experience, into physical concepts of matter, form, and dynamics, with an analytical competence that can discard the husk and proceed directly to the heart of the matter, with a sense of logic that enables him to break down the most complex problem and find a solution in the relatively simple, concrete embodiments which form the subject matter of patentable inventions and last, but not least, with a power of concentration and faculty of determination that will see him through failure after failure to an ultimate success, it follows that he is, in many ways, a unique individual. The typical inventor may be said to be a rebel, a nonconformist and a rank individualist. He is jealous of his ideas, his time and his prestige, he may be asocial and frequently cantankerous. He is dissatisfied with things as they exist and believes that most things can be improved and some should be eliminated.

Although the patent law states that the evaluation of novelty shall not be based on the manner in which an invention is made, all inventions require ingredients of inspiration, imagination, and ingenuity, in some cases perhaps even genius, and every invention has at least its inception in the mind of a single individual. To advance the development from the inceptual or germ stage to a practical or useful product requires further ingredients of observation, concentration, determination, rationalization and technical competence, frequently also including contributions from others, particularly from experts in disciplines other than that in which the originator is specialized.

Assuming then that the group of inventors selected for special incentive is the group of inventive individuals in the class of trained technologists or engineers working in the field of applied research, what then is a suitable environment to encourage such an individual to exert his best efforts? First he cannot be burdened with the details of routine and administrative duties. There are cook book technicians, many of whom hold engineering degrees, accountants, clerks, and expeditors who can handle such details much more expeditiously and efficiently than the inventor. In fact, the inventor should have a personal assistant to relieve him of such details in his own work. His position and his work must be given their due importance in the organization routine and his prestige should be at least in proportion to his contribution to the organization which, in many cases, is its continued existence.

The established inventor should have not only his own private office and security of his privacy until he is ready to disclose his results, but also his own shop or laboratory, his own reference material, his own tools, including computers if he needs to use them, and any materials he needs for his approved projects. He must have adequate time and opportunity for maintaining his notebooks and diaries, for reading to keep abreast of new technology and for discussion of technical subjects with others in his field. At times, he should even take refresher courses in subjects on which he may have become rusty and to take educational courses in new subjects.

While there are certain outstanding exceptions, it is felt that the attitude of management is typified to far too great an extent by the following extract from a management statement of a large organization engaged in extensive research and development work.

"In recent years there has developed a pronounced belief that major breakthroughs can be achieved only by taking unconventional approaches to engineering problems. Technical history demonstrates that this belief is not always valid. Lack of major progress along conventional approaches may not be due to the exhaustion of inherent growth potentials. Instead, it may be attributed to such factors as:

"1) lack of creative research engineering effort, or incentive therefore;  
"2) lack of a published base in experience and research data broad enough to indicate the problem areas hindering growth.

"We believe, therefore, in the advantage of a design breakthrough along conventional engineering lines. It is coming to be realized that new approaches bring new problems. In the main, this is because a new approach does not build on a solid base of proven empirical experience, but must establish a new base. Such an establishment takes time and money, especially when reliability and life factors are prominent.

"In contrast, advances along conventional approaches built upon reliability/life bases already established. It is exploitation of accumulated engineering research capital. It is making past experience pay off."

This attitude can lead to substantial loss of business to competitors, including small business and foreign organizations, having new ideas, new methods and new products. The fact that applied research organizations of the more progressive European countries have created an atmosphere favorable to inventions is believed to be evidenced by the following statistics from a recent issue of the *Official Gazette* of the U.S. Patent Office.

Of a total number of 866 patents listed in this issue of the Gazette, 673 were issued to U.S. citizens or residents, including U.S. corporations, and 193, or 22 percent, of the total were issued to foreign citizens or residents. The total number of European patents issued in all countries for the same period is not known but was probably greater than the number of U.S. if enough foreign patentees or assignees

thought it worthwhile to seek U.S. patent protection to make up over one-fifth of the number of U.S. patents issued. This trend may be back of news items such as the following excerpt from a recent newspaper:

"France and Britain jubilantly hailed on Wednesday an American order for their jointly built "Concorde" supersonic airliner as a major victory in the struggle for world commercial dominance in the air."

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"The British-French consortium has promised delivery in 1968 and 1969 of the slim delta-winged "Concorde" which will cross the Atlantic in two and one-half hours at about 1,450 miles per hour.

"Experts here believe the earliest date an American matcher could reach the airlines would be in 1971 or 1972."

In addition to adequate facilities, proper recognition and a more sympathetic attitude on the part of management, the inventor should also have efficient and expeditious patent service, both in providing him with digests of the prior art and in obtaining patents on his inventions. The delays in the Patent Office are already too long, and if to these are added long delays by the organizational patent personnel, indecision, and in some cases opposition, on the part of management toward filing applications and a demand for an unreasonably large margin of patentability, the inventor becomes discouraged and his work depreciates.

In any case, it is believed that the provision of a favorable environment or climate is perhaps the most important answer to the question as to how the production of patentable inventions of suitable quality can be increased.