obtained with a very appreciable reduction in the time constant. After a little more outgassing and with a metallic film thickness estimated to be 10 angstroms thick, curve 3 resulted; and after a relatively heavy outgassing resulting in a film thickness of the order of 50 to 100 angstroms, the characteristic time had been reduced to its normal value of the order of a minute. This simple experiment clearly indicated that the helium ions are driven into the metallic deposit at the surface and that the pumping efficiency is strongly affected by the surface material. Very preliminary data would indicate that if the process of reemission of gas from the metallic surface could be described by a diffusion process, the diffusion coefficient would be approximately ten orders of magnitude less for helium in metals than for helium in Pyrex glass. Actually, Varnerin has shown in preliminary experiments that the reemission of such gas after it has been driven into the surface cannot be described by a simple diffusion process, so that we are not in a position to give diffusion constants for this material. Nevertheless, it is of interest to mention that we thought we were opening a new area in utilizing ultrahigh vacuums for the study of diffusion of helium in glass; we have now begun to investigate processes that are perhaps 10 orders of magnitude slower. Experiments are in progress that are intended to enable us to gain insight into the physical mechanisms by which excited or ionized gas may be attached to the surface of various types of solids.

Conclusion

With the description of these various fields of research, I have tried to outline a broad range of experiments that are greatly facilitated by the availability of a pressure range 3 or 4 orders of magnitude lower than that previously attainable. At the same time, I have indicated that there are a number of experiments for which even these new pressures are too high. I believe that we can produce significantly lower pressures than we can measure and that we need a pressure gage for the new range of pressure. I believe that the researches which are now being carried out at very low pressures will have interesting consequences for many areas of future scientific investigation.

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Patent Work in a Small Company

Theodore C. Browne

It sometimes happens that a large industry has a gap in its technology. That industry may make a product that receives wide acceptance, but the public may be utterly unaware that any manufacturing difficulties exist; nevertheless, the manufacturers are continuously harassed by their efforts to skirt around a technological hiatus.

When an inventor outside the industry finds a way to plug the gap, founds a company, and plans to service the industry with the element that had previously been missing, the best laid plans for an orderly development of the new company may go awry. Research men necessarily become production engineers, treasurers, packaging engineers, traffic experts, customer service men, product improvers, capital raisers, and experienced salesmen simultaneously. Things happen so fast and customers' demands become so pressing that the truly creative minds in the organization have little time to work with patent counsel, to build an ordered plan of protection, or to secure sound foreign patents. Then, too, there is no time for these men to study the art, learn its direction, study newly developed materials, and be made aware of the trends that they must know.

So, I would say to a young man: "If you have a faith in the idea, an urge to help a business grow, and if you are well trained in patent soliciting and the techniques of research, even if the enterprise is tiny, join it, and found its patent department; the growth of a company you know you have helped to grow will be your reward."

I will assume that you have been a junior in a patent law office or an examiner in Washington. As soon as you become a member of the new organization, the environmental change will be nearly overwhelming. If you have been an examiner, you have always been met in patent matters by a *fait accompli.* The story came to you complete, and if you are like most examiners, you read the claims before you read the patent specification and therefore you knew how the detective story would come out. If you have been a junior in a law office, you have had the inventor sit at your elbow, explain his idea, show you photographs of his machine or samples of his product, and here also you were met by a completed technological accomplishment. True, you might have spent a day or two at your client's plant, studying the process or watching the operation of the machine. You might have dug into books to inform yourself on possible ranges of equivalents. You might have asked for further tests and more detailed information, but ultimately there came a time when you realized that neither your client nor you could afford to spend any more time on the problem and that you had to write the best specification possible from the information already at hand.

In the new organization, you will have no such advantages. Your associates will be out of the laboratory more frequently than they are in it. You will have to catch their ideas and suggestions as they drift

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by you like dandelion tufts, piece them together, and build an ordered invention from the harassed efforts of your confreres.

The first question you will face, therefore, is not one of drafting a specification or of determining the form and scope of claims but of asking, "What must we, all of us in this new organization, do? What must we find out? What type of test and what type of developmental effort must we undertake in order to turn this suggestion into a patentable reality?"

It follows that these questions cannot be answered until the new attorney has a thorough familiarity with the field in which the products will be utilized, knows how they will be used, understands competitive procedures, and knows the scope and the direction of the prior art. When he has learned these first requisites thoroughly, quite unconsciously he will find himself able to answer many of the questions that will be raised in discussions with his confreres concerning the new idea. He may remain unaware of the change at first. Then he will come to realize that his associates are asking him questions during the preliminary stages of their thought. What he knows or what can be pumped out of him is definitely influencing the developmental course of the invention. As he realizes this, it will become a matter of pride for him to dig up all the information possible and to be able to lay before his associates the best and fullest information concerning the problem on which they are engaged.

It is natural in a small organization that such duties should fall on a patent man. He almost alone can enjoy a specious kind of isolation. Nobody will want him to call on a customer. The emergencies of the manufacturing division will rarely make any demands upon his time. He is not concerned with inventories, with credits, or with finance. In short, he has time to study, while his associates quite obviously do not; and since he has demonstrated his ability to assemble, to digest, and to apply the information he has acquired, his associates soon acquire the habit of first asking the patent department what it knows or what it can find out about the problem before much serious investigational work has been done.

Possibly I have generalized too broadly from my own experience; but it seems logical to me that in the young beginnings of a company, the patent man should assume the responsibility of assembling all the patent, scientific, and technical information that is possible. That assemblage of information begins, of course, with a working file of patents, and this cannot be assembled without long searches in Washington. I should suggest a run-through of all likely patent classes on the first search. On successive searches, I should begin to order the closest art and also to select the best illustrations of departures from that art that I could find. I believe that the working file of patents should be highly selective and highly illustrative and that no attempt should be made to make the file complete. The very volume of a complete file would swamp the capacity of any tiny patent department.

I have in mind the experience of one company. The patent counsel for that company objected to company patent men and, whenever possible, refused such companies as clients. He advised that the work could be handled properly by himself, provided that a research engineer, in addition to his usual duties, was assigned to go over all the art, become familiar with it, and then keep the counsel advised of company developments. The victim chosen began by ordering copies of all patents in every classification that he could conceive of as bearing any relation to the activities of the company. He died some 15 months later. His successor found that, although marginal notes had been written on hundreds of patents during those months, the man had made no selection or abstract file of any of the patents—he had apparently attempted to rely on his memory. His coat closet was found to be stuffed with piles of unopened packages from the U.S. Patent Office that reached nearly to the ceiling. He had stalled applications, hesitating to approach counsel while the art was still undigested. And, while his successor raced against statutory deadlines, a young woman, fortunately a trained searcher and abstractor, was put on the job of bringing order out of the chaos of prior art. But it was months before that wilderness of paper was reduced to workable dimensions.

Up to this time, this has been an era of ideas, of bench work, of pilot plant runs, and of experimental tests under customers' conditions. But then we learn what we want to make and how we must make it. And now comes the serious work of writing applications, of making them broad enough yet at the same time accurate and explicit enough to stand the test of litigation and to protect the young beginnings of the company. The company man should not attempt this work alone. Foundation patents should be the joint effort of the company attorney and experienced counsel.

Finding counsel is a tremendously important step. It requires the most careful consideration of what type of counsel the company needs and what are to be the company's plans for its patent department of the future. The company will turn to its counsel for experienced legal advice. Obviously, he must be chosen on the basis of his reputation as a lawyer, but there are other considerations to be weighed before the relationship of client and counsel, of inventor and his attorney can be as fruitful as it should be.

Actually, if a patent counsel gives thoughtful care to building up the strength of his office or a patent department head plans the personnel of his department well, he will recruit as assistants those persons whose background training fits them to understand, to study, and to progress in that art which they are employed to protect. It has always been true, when facts are in dispute, that attorneys should avoid preparing a brief or arguing a cause until they have prepared themselves so thoroughly in the background developments of the art and the implications of their client's invention that they for the moment are experts in the field. As developments have become more and more complex, the requirement that the attorney know the field thoroughly has become more and more necessary. Today it is quite unthinkable for an inventor in, for example, the fields of computers, guided missile mechanisms, or solid state physics to walk into any patent counsel's office and expect that counsel to understand the problem that he has solved. Quite probably the inventor himself has spent some years in coming to understand the problem. Unless he is prepared to pay the tremendous cost of educating his counsel, he should choose that counsel and the personnel of the counsel's office for their familiarity and success with inventions in his art. Thereafter, if there is lack of understanding between the attorney and the inventor, then one may well question how broad and how thorough the attorney's training in "classical engineering" really was. Did it give him a sound understanding of the laws of matter and a secure knowledge of how to uncover the reports of the detailed application of those laws?

But sometimes, no matter how thorough the attorney's training may be, understanding is missing, and in these instances I believe one may well question the inventor's training. Some inventors, particularly those who have received the pragmatic training of the war years, are data hounds; they dump reams of data and calculations upon an attorney's desk, saying, "Well, this is the story. You write it up." Some have no facility in language. They have never been trained to express themselves and do not understand that their entire concept must be expressed in words of the English language in order to have the legal effect that they desire in the patent specification. Some insist on the use of popularly unintelligible or confusing terminology. If they do, is the resulting lack of understanding the fault of the public or is it their own? If the attorney asks the inventor, "What do you mean by that?", does this show that the attorney is ignorant? On the contrary, can it not show that the attorney is prod-

ding the inventor to express the whole of his idea?

The attorney sometimes faces another problem. Each new art is to a degree undisciplined. Its workers push their theories forward as facts and insist that their field is *sui generis* and, until that art becomes mature, continue to insist that the old laws do not apply. This is a too convenient out for those inventors who have hold of but the tail feathers of an idea. The attorney, however, may recognize that what is put forward as a fact is really speculation. Often, when the attorney questions a pet theory, the inventor reacts by feeling that the attorney lacks proper "scientific" understanding. Sometimes, the inventor insists that his professional argot be embalmed and perpetuated in a public document. Who could read it with understanding if it were? The inventor will not try to express his thoughts intelligibly and lucidly but becomes impatient when the attorney says, "Well, let's try to phrase it this way."

To procure effective patents, the inventor and the attorney must learn to work together with complete understanding. Often it is difficult for a thing-minded inventor to understand that the job of an attorney is to translate the thoughts and expressions of a narrow and generally unknown field of endeavor into the personally minded speech and expression of society. Somehow, before a successful specification can be written, the working of a calculating machine must be made dramatic. Somehow, the problem of control of a guided missile must be made the analog of some experience common to ordinary mortals. Otherwise, a judge, who possibly cannot comprehend the mechanics of an apple corer, bewildered by verbal confusion, will cut the Gordian knot and hold the entire invention not inventive. And we must never forget the efforts of the opponent's counsel and his experts. They will do their best to show that the inventor faced no problem whatever other than the limits of his "inferior" mind.

This is a terribly difficult job, and it fails frequently, not because the attorney is deficient in training, but because there has been no true communication between the inventor and his counsel. Industrial and research establishments have this considerable advantage: they can place a person on their staff who not only is trained in patent practice but who has the background to understand the developments of the art with which the organization is concerned. These difficulties tend to disappear in established institutions where the attorney and his searcher assistants are and should be thoroughly cognizant of the art, know the inventors, know their language, and know what their expressions mean.

The ideal time for the choice of counsel, is I believe, when the prior art and technological search is reasonably complete. Very few of today's experienced counsel will attempt to make a silk purse out of a sow's ear by briefs or arguments in court. The "spectacular clarifications" of designedly indefinite language, which so impressed the courts of an earlier day, make no impression upon the courts of this technologically knowing generation. Today's counsel wants facts, a great mass of detail, and much technological information before he will advise a client. If he finds that a company patent man can give him that information promptly and accurately, it is far easier to establish rapport between counsel and the company attorney. There should be a clear division of effort. The young company attorney is a trained technologist, not an experienced lawyer. He has not had the long court experience, which alone develops a sixth sense for the selection of the soundest argument and gives a sure touch in the manner of its presentation that insures it a reasonable chance of being sustained. He should realize this. On the other hand, the counsel confronted with a new development is an amateur in the technological aspect of the problem. He should realize this and realize also that accurate knowledge of the invention, of its art, and of its surrounding technology is the forte of the company patent attorney.

The happiest kind of relationship will develop from the mutual recognition of the capacities of each man. But even if the company attorney becomes in time an experienced lawyer, even if a legal division of the company is later developed, respected outside counsel should always be retained. As the company grows, some people may enter it whose intellectual integrity appears to run on ball bearings. In a small company, enmities tend to be personal, not departmental. The internal atmosphere will remain far clearer, and a man, if told he may consult counsel, will be stopped in his plea for approval of a devious scheme if he hears counsel's serious voice say, "My clients don't do such things. I insist that you stop and understand precisely what this implies." After such words from one outside the company and beyond reach, that man will not try to kindle backfires around the company office. There is a parallel from my Army Ordnance days that illustrates this advantage. A friend, when asked why there were so many civilian consultants to the department, replied, "Because there must be someone to say 'damn' to a general."

We now enter the third phase. We have patent counsel, a good selection of patent and technological art, the beginnings of a card file, and a cross-index system. The first applications have been prepared and filed, and amendments are due. The company now has a small but formally organized research department. A steady rain of requests for aid in the searches of the research men begins as the second generation of inventions starts to appear. The attorney needs help.

I believe that his first technical assistant should be a woman. He will lose her sometime, of course, for women do get married; but he will not lose her nearly as quickly as he will lose a young man who has his heart set on becoming a patent lawyer as soon as possible.

My choice is a master or baccalaureate with distinction in the appropriate field. Holders of a doctorate, I have found, are set on teaching, become nostalgic for bench work, or are so interested in their specialty that they have lost that wide range of interest that makes a good searcher. My first assistant stayed 7 years. I had but to suggest that data must have been recorded somewhere, and she was off on its trail like a Scotland Yard inspector.

We made no attempt to build up a scientific library or collection of periodicals. New, small enterprises show a surprising tendency to nestle close to the schools that their founders attended. In our case, the great libraries of Massachusetts Institute of Technology and Harvard University are located but minutes away. Treatises, textbooks, monographs, and publications in our fields were bought by the patent department or by the research department as occasion required. They were maintained in the library of the research department. This library has now grown to one of considerable proportions, but its contents are working books, not collections. Overshadowed as we are by the great collections of the universities, we have never felt the need for a more formal establishment.

What we did establish formally was a continuing selection of patents. The weekly *Official Gazette of the United States Patent Office, British Abstracts* in appropriate fields (in the years when their publication was timely), the *Canadian Patent Office Record,* and the *Australian Official Journal of Patents* were paged as each issue appeared. From these, patents that appeared to be pertinent were ordered. Those which were found to be germane (as were most of those selected) were abstracted, filed, and cross-indexed on cards; and then the patents, with comments when necessary, were routed to the attention of the research worker concerned with the subject. United States patents were then filed by classes according to the Patent Office classification. This system seems illogical to a research man, but it is justified because preliminary searches in the department are easily coordinated with searches in Washington.

A file of selected patents is merely illustrative. It is designed to exemplify the type and trends of the art one may expect to face. If, from a search of such patents, one can point out the pertinent patents to one's Washington associate and give him their Patent Office classifications, one saves a great deal of time. Often, we obtain a thoroughgoing advisory search for less than the cost of a trip and stay in Washington. But if one files patents according to the Patent Office classification, he must be prepared to make cross-index cards under substance, process, and end-use classifications; and in our case this is done.

But just as the patent department grows in formal organization, so too the research department becomes more tightly organized. Definite projects must be assigned to particular persons, and these projects must be selected by a director with a clear plan in mind. Very early it will become apparent that the best new work in the research department is accomplished by those who are familiar at firsthand with the antecedent work on the subject. We have always held that this knowledge should not be spoon fed to the worker by others, and that the job could not be done well by the reading of a list of abstracts. Therefore, men who are assigned to a new problem are urged by the research director to study fully the antecedent publications as a preliminary to their work on the subject.

The patent searcher will help them and sometimes assembles many of the articles and journals, but we do not select the articles or make prior judgments on their pertinence. We have two reasons for this: (i) the man himself is the best judge of what he must know for understanding; and (ii) in some instances, if someone else has the responsibility for background information, the reading which we believe is necessary for understanding is just not done.

Patents are another matter. We believe that our experience in evaluating a patent's meaning, its content, and its scope is valuable and that in the case of patents we can say legitimately: "This applies to your work, and this does not."

Some patent attorneys have shown surprise on seeing our foreign docket. Because of this, I believe that it is probably an oddity of my experience that foreign patent applications assumed the importance that they did. The controlling fact was, however, that substantial foreign demand developed almost immediately and sound patent protection was necessary. It became evident that filing what was in effect a translation of the United States application in a foreign country could never give the degree of protection comparable to that which could be secured if the individual foreign case was prepared initially in the language of the nation and with the peculiarities of the nation's patent practice clearly in mind. This is not so necessary in Germany, the Netherlands, and the Scandinavian countries, where a rigorous and competent examination allows language and procedural differences to be beaten out in the prosecution of the application, but it can be fatal for registration in countries where the specification is the sole document. For this reason, applications to be filed in those nations where it is easiest to obtain patents—France, Italy, Belgium, and Argentina, for example—require initially the greatest care in preparation and draftsmanship.

This is not the place to discuss the differences in practice or the various philosophies that underlie the patent practices of the more important nations. What I want to stress here is the fact that foreign applications frequently break down because of the language barrier and because the proper expressions are not used in translations. One can check the language with a dictionary and believe that equivalent meanings in translation have been secured, and yet find that the patent coverage is not parallel. I remember one application in which the foreign examiner struck out a word and substituted another of his choice. If the change in sense had remained undetected, the patent would have been concerned with a flatbed letter printing press; instead, the invention was that of a rotary calico printing range.

It soon became apparent that the type of coverage that was needed to protect sales and operations abroad required not only that the applications be separately and individually prepared but also that a substantial amount of technological reading in the language of the country be done before one could be certain that the terms used in translation were accurate and understandable in the new language. A translator was necessary.

True philological interest and skill proved to be a more important requisite for this position than technical training. In fact, the person who proved to be the most effective was an American citizen whose father had held official positions abroad. She was a graduate of the International School at Geneva and of an American college. She was completely fluent and very well read in English, French, and German; and since her early schooling had been in the Baltic states, she spoke Russian with reasonable skill. The problem of finding exactly parallel terms and the language of the trade in which the invention was involved interested her greatly. She did a great deal of outside reading of foreign technical trade publications to be sure that the terms that were used were those that had an exactly parallel meaning to those that appeared in the parent specification. She did this reading as the invention was developing so that foreign cases could be promptly prepared.

"Safeguarding acts," import restrictions, and other government regulations made it necessary to plan very early for manufacture abroad, and as a preliminary to this, infringement and validity searches in the foreign countries were necessary. Translations of all foreign patents that appeared from these searches were made by the department translator, and these translations were placed in the general patent file. She conducted correspondence with our agents abroad in their own language. In this way, we began the prosecution of foreign cases almost as soon as the applications were filed in the United States.

Filing cases in the Scandinavian countries and particularly in the Netherlands where the examination is thoroughgoing helps in the prosecution of the United States application. The response of these foreign patent offices is so prompt that it is frequently possible to close the prosecution before the first amendment of the United States application is due in Washington. The search is so good that it is a check on our own, and one can find out how successfully he has differentiated from the references before he must respond to the American examiner's action.

Foreign subsidiary companies need local patent counsel, for there are many times when the authority of a managing director would be misunderstood if, in response to a patent or license question, he should be forced to refer the question to the parent office. Yet, if the subsidiary independently retains counsel, confusion results. Therefore, the next activity of the company attorney is possibly the selection of local counsel in those countries where operating subsidiaries are planned. In England, this can be complicated, for it entails the selection of a patent agent, a solicitor, and at least a junior barrister on retainer; but finally a system of local advisers is set up, and the foreign managers are satisfied.

Under this system, the number of cases appearing on an attorney's docket increases at a guinea pig rate, and since each case is individualized, the prosecution cannot be handled in any standardized manner. For the necessary help at this time, the company patent man needs an assistant attorney. For that assistant, it does not seem to make much difference in the long run whether one chooses a young man who has been a member of the examining corps in Washington or whether one persuades a promising, well-trained member of the research staff to enter the department and go through the tedious training of night law school while at the same time he learns patent law by working in the patent department. Both

men bring very distinctive capacities to the department, and both ultimately become effective and valuable members.

I have a feeling that, until the formal work of writing and amending cases is sufficient fully to occupy his time, it is possibly unwise to bring in as an assistant one who has spent several years in the Patent Office. Such men have been trained to handle an invention on the basis of what appears in the file and may miss the smell of an invention in the wind at a time when the research man himself may not be aware that he has hold of an important idea. On the other hand, a research worker who turns lawyer has this sense. It does not seem strange to him to work with the inventor in the embryo phase of the invention. He senses when a search will be helpful in resolving an inventor's early doubts, and often he succeeds in drawing a man out and spurring his imagination by careful questioning. On the other hand, if the load of formal cases is sufficient to make a man from the Patent Office feel that his abilities and training are being completely utilized, one of the real contributions that he can make to a department is to bring to it a sure sense of the way the Patent Office will look at the invention. If he plays the part of the devil's advocate and shows what is wrong with the specification and claims, a strong specification results and many difficulties in prosecution are avoided. And, of course, he can play a surer and more expert part in appeals and in interferences.

From this stage onward, the department grows in a more nearly conventional manner. The practice of the continuing selection of patents, of abstracting, of cross-indexing the abstracts, and of circulating the patents to members of the research staff goes on as before. More foreign patents appear in the files, for in addition to those revealed by one's own searches, patents and publications are called to one's attention by employees and patent associates abroad. The background information grows because the reports of searches list each patent and each technological article up to the date of the search. Since each new invention is usually a projection of the present activities of the company, it becomes somewhat easier, by consulting earlier search reports, to make sure that the art has been thoroughly surveyed. This work and continuing help in their own search for information are at hand for the research department. But this continuing study is not for the research staff alone. More importantly, it teaches us.

I believe that many patents fail because they give no sense of time or history and they do not attempt to fit the invention into its proper place in a developing technology. Knowledge after the event is so insidiously easy that such a patent unconsciously may be judged on the basis of the knowledge of today. The important part of the specification is to make manifest in accurate, convincing, and factual words the difference between what has now been accomplished and all that was hitherto known and to show this difference by setting forth results which even everything in the old art could not accomplish. A daily study of the art does give a sense of history and does give a sense of proportion and makes it possible to prepare a specification that does not lose its sense of time.

Additionally, familiarity with the art is a requisite for the members of the patent department who serve on the new products committee or on the patent policy committee of any company.

I have seen a form, "Disclosure and request for patent application," that is used by one of our great companies. If every question were really answered, the story revealed would become a patent attorney's dream. There are the necessary questions, of course, such as

"On what notebook pages has the work been recorded? Has the product been sold? When? What are the numbers of the laboratory and progress reports?"

Then the questionnaire goes on, and I find

"State exactly what your invention is. What problems did it solve? How was it done? Differentiate your work from the prior art. Explain its advantage in yield; in operative efficiency; the improvement of the product; in cost. Support your invention by comparing its results with those of the closest references. Give detailed examples of how your process is carried out. List closest patent and literature reference relating to this invention. State the nature and extent of your literature and patent search. Supplement this request with charts, data, memoranda, and reports."

As companies grow, departments grow, and divisions between their activities become formalized. But for men who once shared the necessity of working together intensely and cooperatively, these divisions are not barriers but guides to professional responsibilities. Somehow, such men will continue to work together no matter how large or how complicated their individual departments may become, and somehow they will infuse in their departmental members habits of working together.

I can imagine the answer that I would get from any of our research men if I should send him such a questionnaire as the one cited and require that it be completely filled out before a patent application could be begun. It would be something like this: "How many pieces of paper do you want to collect and file? You know most of the answers anyway because you helped us to find them." And this to me is the greatest satisfaction —to feel that in each new development we have had some small but recognized part in its creation.

Meanwhile machines deprive us of two things which certainly are important ingredients of human happiness, namely, spontaneity and variety. Machines have their own pace, and their own insistent demands: a man who has an expensive plant must keep it working. The great trouble with the machine, from the point of view of the emotions, is its regularity. And, of course, conversely, the great objection to the emotions, from the point of view of the machine, is their irregularity.—BERTRAND RUSSELL, Sceptical Essays (1928).