PATENTS AND CHEMICAL RESEARCH

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BY

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AS A TOKEN OF APPRECIATION

OF A GENEROUS FRIEND AND

PARTNER

PREFACE

Progress in industrial chemical research and invention is intimately dependent on the efficiency of the patent system. Patent law deals with such complex problems that a heavy responsibility is thus cast upon practitioners of the law. Therefore it is most desirable that chemists should familiarise themselves with the leading principles of patent law; first, to enable them to co-operate with the patent agent and thus contribute to the object of obtaining secure protection for their inventions, and, second, so that their criticism will stimulate patent agents to maintain the highest level of professional skill. In this way, better work will be done, and the greatest benefits will be derived from the patent system.

It is hoped that this book will be helpful to those engaged in industrial research work, and especially to directors of research; but the problems of patent law are so inherently fascinating that those engaged in academic research may find some points of interest. Since any legal readers may desire to study the decided cases, I have added references to the original Reports of Patent Cases (R.P.C.). I have not hesitated to employ hypothetical cases freely for purposes of illustration. It may be added that the book deals with British law as it now stands, and not with any ideal but non-existent system. It is too soon to estimate the full effect of the wise provision of section eight of the 1919 Act, which provides that one invalid claim need not invalidate the whole patent: if generously interpreted by the Courts, this section should remove one of the chief weaknesses of the old law.

The first six chapters are based on lectures delivered by invitation to the Liverpool Section of the British Association of Chemists; I wish to thank Dr. F. W. Kay, who made the arrangements. I also wish to thank my partners for assistance and encouragement; Mr. W. R. Sharpe and Miss D. Gray, who read the proofs: and the University Press, who have increased the debt which I owe to the University of Liverpool. Finally, I must thank my friends Mr. S. J. Duly, Dr. F. W. Atack and Mr. J. L. Fairrie with whom I have discussed various of the general scientific principles on which parts of this book are based.

H. E. P.

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Chapter I

PATENTS AS AN ELEMENT OF BUSINESS POLICY

Many inventions have been made to meet special needs, or have been developed by investigation of chance suggestions; others have been discovered accidentally. But, at present, the advantages of systematic industrial research are widely appreciated, and improvements in manufacture often arise as the result of a deliberate policy. It is therefore more than ever important to consider how the results of such research work can be best protected.

The first great difference between chemical and other industries is that in the former we are at once faced with two alternative methods of protection of processes, namely, patents and secret working, whereas in the latter, if machines are sold to the public, it is usually impossible to preserve secrecy. One of the most important decisions to be taken, therefore, is the choice between patenting chemical inventions or keeping them secret. In this introductory chapter, it is proposed to put the case for patenting, and to do this effectively it will be necessary first to discuss the history and principles of the patent system, and then to compare the relative advantages of patents and secret working. This will also involve a discussion of the attitude displayed by manufacturers towards the patent system, both in this country and abroad, and of the part which patents can play in the development of business policy both at home and internationally. These preliminary considerations of a business nature will deal mainly with patents as they affect an employer.

The respective rights of employer and chemist can better be considered later.

First then, let us examine the patent system historically. The English system, which is the oldest, has developed in the usual English manner, not logically but as the result of a process of evolution. Logically, it may be admitted that it is to the common good to provide some system of reward for inventive genius. Energy and professional skill may well be left alone to find their level and to obtain the reward of merit as a result of the advantage they give to their possessor in the competitive struggle; other things being equal, initiative and knowledge exert a steady pressure all along the line. But mankind is naturally averse from change, and the inventor who breaks new ground has to contend with the conservatism of his fellows in addition to the natural difficulties of his problem. Much effort is required to make the necessary experiments and to introduce the new process into practice, and it would not be fair if others could stand aside from this preliminary work and yet enjoy the advantages of success. It would be natural, therefore, for a State to provide some means whereby inventors should obtain some encouragement. In fact, authors and artists receive protection in the form of copyright, and such protection is still more necessary for inventors, because although they themselves, like the artist, may find their fullest reward in the exercise of their creative instincts, they differ from the artist in that the resources of the industrialist or the capitalist are usually necessary to provide the opportunity for the extensive and costly experiments which are needed. These resources will only be available if a commensurate reward is possible. Theory therefore would indicate that the encouragement of invention depends on the possible reward to industry.

It need scarcely be said that English law has not evolved consciously from any such theoretical conceptions. As usual in our institutions, the development of our patent system has been irregular and accidental. Yet it is interesting to note that it has always aimed at fostering new industries rather than at directly stimulating inventive genius.

Historically it arose as an exception. In the sixteenth century a favourite means of replenishing the royal purse was the grant of monopolies in exchange for cash, and ultimately this became such an abuse that legislation had to be introduced to limit the royal power to give to an individual the sole power to sell salt, for instance. Even to-day, it is recognised to be a nuisance when a Government reserves to itself a monopoly of the sale of some article such as tobacco or matches, and it will be recognised that it was intolerable when all manner of common commodities were monopolised by rapacious individuals. Hence the famous Statute of Monopolies was passed to abolish this abuse. But it made an exception which proved to be of incalculable importance, when it recognised the power of the Crown to grant a monopoly to "the true and first inventor" of "any manner of new manufactures within this realm." The whole complex structure of modern patent law throughout the world has been erected on this slender foundation.

Of course, every word of this formula has been the subject of exegesis by generations of legal commentators, but at the moment the word "manufacture" may be emphasised. At the very beginning it was clearly recognised that patents dealt with industry, first and foremost. The principle of the patent law is to encourage new industries in this country, and a patent is regarded in the light of a contract between the Crown and the inventor. If an invention has been made, the

Crown will grant a monopoly of its use for a period of 16 years, and the consideration for this reward is that the inventor shall give a full account of his secret so that the public will be able to use it freely at the end of the monopoly period. This contract is fair, because both parties gain if it is executed in good faith. The inventor can put forward his best efforts, and justify the expenditure of capital with the assurance that others will not be able to appropriate the results of his work. The public at once gain new information, which stimulates further research, with the assurance that the invention will become public property in 16 years. In each case industry is stimulated, and it is only by the grant of a monopoly that this can be done. If it were a question of rewarding inventive ingenuity, this might conveniently be done in other ways, *e.g.*, by special money grants to inventors, such as those awarded for inventions used during the war. But to encourage industry it appears necessary to give some form of monopoly. It is unfortunate that in England the word monopoly has always retained somewhat of the bad odour of the original monopolies, such as those for salt and oil and other common commodities of daily life. There has been a constant tendency to be jealous of the monopoly afforded by a patent, and even to-day our Patents Acts limit the monopoly power more stringently than those of America.

Meantime let us assume that patents are intended to encourage industry and, in so doing, to reward invention. It will be convenient to discuss patent policy in this order, first from the point of view of a firm, *i.e.*, the industrialist, and second, from the point of view of the inventor himself. This is of especial importance in chemical industry because so many of the great inventions are worked out in the laboratories of, or in collaboration with, industrial firms.

We shall first discuss the value of patents to an industrial firm conducting organised research, and then to an individual inventor who is working independently or with the aid of a capitalist or syndicate.

The object of this book is strictly practical, but it is worth mentioning that the patent system undoubtedly appears to conduce more to the public interest than the system of secret working, since it helps to avoid overlapping of research. This is important for those who take wide views. For the moment, however, we will leave aside the question of public interest and will merely put the case for patenting from a cold business point of view, as it will affect the individual prosperity of the firm.

We have to consider therefore that research work is being steadily performed on a given subject, and it is desired to obtain the maximum financial return. If the invention consists in a new filter press or centrifuge sold by a maker of chemical plant, it is clear that he will obtain an immense advantage over his competitors if he can obtain a monopoly of the new type, and it is evident that he will be well advised to protect himself fully by patents. His difficulty will be to decide whether to try to supply the whole demand himself, or whether to increase the turnover by licensing his competitors to manufacture under royalty.

In any case it will be almost impossible to keep the design secret. But if the same filter press is invented by a chemist working for a firm using filter presses very extensively, although they would probably obtain the best return by licensing the new press to others, yet they might conceivably feel that it would be worth their while to prevent any one else from using the press, whether under royalty or not; in this case it may be desired to keep the matter secret. Or, to take a more likely problem, a new process of purifying a raw material is invented; is it wiser to obtain a patent, or to work the process in secret? It will be seen that this problem arises much more acutely in chemical processes because it is often possible to sell the product without giving any information as to the nature of the process, whereas a machine, once sold, can usually be copied. The problem is met especially when a firm is developing a complex industry which is new in a very broad way, *e.g.*, the contact process for sulphuric acid. Is it better to obtain a monopoly by patents, or to rely on maintaining the most rigorous secrecy? Let us compare the advantages of the two systems.

Since the case for secret working can be stated by the manufacturer himself, and the case for patent protection can only be stated after a full consideration of the relevant principles of patent law, we will set forth the latter position as lucidly as possible. In the first place, it must be remembered that we are not concerned with such a simple choice as that between two extremes, namely, absolute secrecy and absolute patent monopoly. If so, the deciding factor would be the possibility of an independent inventor discovering the same process, so that an absolute patent monopoly would be obviously preferable, if it could be secured.

In practice, the problem is complicated by the fact that absolute secrecy and absolute patent monopoly are usually impossible. It is then necessary to consider relative risks. Such a comparison presents the cardinal difficulty of business policy. In a scientific problem it is usually possible to estimate the advantages and disadvantages quantitatively, but a business problem often resolves itself into striking a balance between two risks. If a firm is faced with competition, it must decide whether the risk of loss in turnover through competition is greater than the risk of bringing a law suit against the rival firm, and such a comparison cannot be made on a quantitative basis—in fact, this and other business problems are often solved by weighing up the pros and cons as far as possible and then making the final decision by semi-unconsciously integrating the results of previous business experience.

It is necessary therefore to compare the advantages of secret working, with its attendant risks of possible disclosure, and patenting, with its attendant risks of possible failure to sustain an infringement action.

From the patent point of view therefore everything depends on the kind of patent protection obtainable. We will not anticipate by discussing the breadth of patents at this stage, but will only add that the utmost skill and labour is required if effective protection is to be obtained. It is simple to obtain a document bearing the seal of the Patent Office, but its value depends entirely on the wording of its claims. If these are skilfully drafted, the patent may dominate a whole industry, and if not, it may be almost valueless, although in either case the Patent Office would pass the specification. This difficulty applies with special force to chemical patents, and it has been suggested that one reason why chemical patents have been unsatisfactory in the past has been a failure, either of the patent agent to comprehend the chemical side of the problem, or of the inventor to realise that the legal difficulties of chemical cases call for special treatment. In what follows therefore we will assume that if patents are taken, they are to be prosecuted with skill and thoroughness: in this task, the legal experience of the patent agent must be supplemented by the experiments and technical knowledge of the inventor, and both must co-operate in studying the invention and all its possibilities.

The chief points made by the advocates of secret working are the difficulty of effectively preventing infringement of a patent, and the advantage of preserving impenetrable secrecy so that rivals will not be able to guess on what lines the process is being carried out, and possible competitors will be obliged to waste valuable time in repeating the experiments and, it is hoped, the mistakes which were required to start the process. Let us consider first the possibility of secrecy and the consequences of failure. Then we can discuss the difficulties of preventing competition by patents and the ways in which these difficulties can be met.

The possibilities of successfully carrying on secret working are clearly much less now than they were in the days when chemical industry was less developed in this country. There are two important difficulties; firstly, independent invention by others and, secondly, leakage of information whether accidentally or as a result of want of good faith.

Firstly, then, it must be remembered that inventions are often made to meet a long felt want—if we may quote the phrase used so often in the catalogues of publishers. Chemical research is so wide-spread that when a new problem arises, it is probable that several investigators will hit on the same solution independently. There are classic illustrations of this simultaneous discovery in the world of pure science, *e.g.*, Adams and Leverrier, and Wallace and Darwin. In my own practice many cases have arisen in which inventors in England or in Germany and America, or in England and America, have almost simultaneously made the same invention. Once one inventor consulted my firm in England, and another inventor signed an application in Australia on the very same day for identically the same invention. In fact, such contests of priority are so common in the United States Patent Office that there is a special Examiner of Interferences appointed to deal with them. Since the decision in the Macbeth—Evans Glass Co. case (in U.S.A.) the position of one of such inventors who works his invention secretly has become very serious. In England, a patent will be granted to the inventor who first files an application at the Patent Office. When this happens, what will be the position of a prior inventor who has kept the invention secret?

The first result will be that he has lost all chance of monopoly in this country, and if foreign patents are filed, he may be absolutely prevented from using his invention in various foreign countries. This is already serious, especially to-day when industry has become internationalised to such an extent. Business allies in foreign countries will at once be seriously prejudiced. Although the British firm may have used the invention secretly in England for many years, another inventor may obtain a foreign patent and prevent the British firm or its foreign associates from using the invention abroad in any way.

But worse than this may happen. If the secret user can prove that he has actually used the invention on a commercial scale in England, before the date of the patent, it is true that he will be able to upset his rival's patent, but this may involve him in very expensive litigation, into which he enters with the initial handicap that a Judge will naturally require the strongest proof of prior use before declaring the patent invalid. The sympathy of the Court will be against him because the patentee had proceeded by way of patenting and thus first given the public the benefit of the information, whereas he has given nothing to the public.

But it will only be possible to upset the patent if the invention has been used beyond the experimental stage. There is a doctrine that an abandoned experiment does not anticipate a patent, and the Edison patent for the carbon filament lamp was saved because the Court held that an alleged prior use was only experimental. It is certainly not sufficient to prove that someone else knew that the patented process was possible before the date of the patent. Actual use must be proved and laboratory demonstration might well be inadequate unless followed up by *bona fide* commercial use. There is thus the danger that many improvements, which had been only tried in the laboratory and then pigeon-holed for use in the works on the first convenient opportunity, might be validly patented by others so as to debar the original inventor who had kept the suggestion secret.

Thus if an independent inventor patents the secret process, the result is that the monopoly is entirely lost, the position in foreign countries is gravely prejudiced and serious trouble may be encountered even in England.

The second difficulty is the possibility of leakage of information. This may occur accidentally. For instance, suppose that a certain metal is used as a catalyst for a reaction. Normally, this metal is completely removed from the reaction-product. But it may happen that sometimes traces of the catalyst may be left behind as a result of carelessness or irregularity of operation. A competitor may be testing the product in the hope of such an accident occurring, and once the metal has been detected qualitatively in a single sample, there would be little hope of preserving the secret as far as the use of that particular metal was concerned. I have myself come across a case in which an astute chemist was put on the track of a most valuable process by a simple observation made on a single sample of the final product which had been carelessly made so that traces of a certain reagent were left behind. It is possible to imagine similar cases in which accurate inferences might be drawn from a study of the physical properties of the final product.

Probably the greatest difficulty is the leakage of information through employees. Attempts are made to guard against this by imparting the secret to as few people as possible. Reagents may be used in the works under arbitrary names, and weighing machines may be provided with invisible weights, but these precautions are not conclusive, especially against spies. The chemical staff are often held under restrictive agreements, but even with the best of good faith, a chemist, before or after his leaving the works, may unwittingly let fall some remark which serves as a sufficient clue if it reaches a watchful competitor.

For all these reasons, therefore, there is grave danger of leakage, with the possibility of patents being filed by other parties. It is true that if a patent has been obtained by fraud from the secret user, it can be upset. If it is found that an employee is about to disclose a secret, it may be possible to prevent him from doing so by injunction. But these remedies are unsatisfactory because such leakage is difficult to detect and still more difficult to prove.

In addition to the two practical difficulties of secrecy we have just discussed, it should be remembered that a secret process is not an easily negotiable asset like a patent. It is extremely difficult to sell a secret process, to use it as a weapon, or to conclude a business agreement into which it enters as an important feature, whereas a patentee can place his cards on the table and negotiate directly and openly. The first visit I paid to America was for the purpose of disclosing a secret process which had not been protected by patents, so that it was impossible to conclude any agreement by correspondence.

Probably many manufacturers would admit these disadvantages if they could be satisfied that the patent system provided a reliable alternative. The obvious objection to patents is the publicity which is the price paid for the monopoly, and clearly this will be dangerous unless rivals are willing or can be compelled to respect the monopoly during the life of the patent. The value of patent protection obviously depends on the strength of the patents. Many manufacturers here make the mistake of paying too much attention to single patents. They are willing to take out a patent for an individual epoch-making invention, but they overlook the necessity of protecting the small inventions too. The aggregate effect of a series of patents for small inventions is extremely strong.

The first result of ownership of good patents is that many competitors will accept the position without litigation and will respect the patents, which will exercise an inhibitive action. This moral force, as it were, will also be a powerful deterrent to possible future competition. Even when the sixteen years monopoly has expired, later patents for improvements may well hold the field.

Ultimately, however, we must consider the rival who is not prepared to recognise patent rights unless he can be compelled to do so. The opponents of the patent system argue that it is difficult to enforce patents because (*a*) they may be held invalid, and (*b*) it is necessary to prove infringement.

We shall consider invalidity later, and we must admit that there are difficulties, but it may be noted here that in a series of years before the war, an analysis of the cases which came into Court showed that in 65 per cent. of the chemical patents, the patentee was successful in proving validity. Naturally the validity of the patent is influenced enormously by the skill and attention which have been devoted to the collection of adequate experimental data and the preparation of a good specification and claims. The patentee can materially decrease the chance of invalidity of his patent if he is prepared to give this matter the minute investigation and care which it demands.

The alleged difficulty of proving infringement is perhaps that which impresses a manufacturer most. It is asked how can a patentee tell what is being done by his competitors in the secrecy of their works, and still more, how can he possibly prove it? This is the reverse aspect of the problem of secrecy and it admits of similar but more conclusive answers. Leakage of information often occurs, either from employees or otherwise. Analysis of the products may allow of a probable inference as to the process which must have been used. Thus by the constant presence of minute traces of nickel in a fat, it would be possible to conclude with some certainty that the product had been hydrogenated in presence of a nickel catalyst. A study of the competitor's prices and of market conditions may show that he must be using the patented process since the cost of any unpatented process may be absolutely prohibitive. In the Saccharin cases, the plaintiffs admitted that they did not know *how* the defendant worked, but they alleged that they held 23 patents covering all the practicable commercial methods and that the defendant must therefore have infringed.

Once it is possible to establish a *prima facie* case, the Court may grant an order for inspection of the competitor's works by independent scientific men or others, to determine whether the alleged infringement has occurred, or the Court may order the defendant to answer interrogatories as to what he is doing. Such orders for inspection have been given in chemical cases, and infringement of chemical process patents has been proved even when the defendant refused to disclose his secret in public so that part of the case was heard *in camera;* this happened in the leading case of Badische v. Levinstein. The Court has even granted relief in a case in which the defendant was selling goods manufactured abroad by a process which he alleged to be a secret, but which the Court held to be an infringement; this patent dealt with the manufacture of silica bodies by fusing sand about a carbon core in an electric furnace (Thermal Syndicate v. Silicaware, Limited). At first sight it might be considered hopeless to prove infringement of such a process when the defendant bought goods manufactured abroad, and yet the patentee won his case. For the moment therefore it is sufficient to say that the law has not overlooked the difficulty of proving infringement and has provided elaborate machinery to assist the patentee in upholding the monopoly to which he is entitled.

In general therefore it must be admitted that the case for patenting new chemical processes demands very careful consideration before secret working should be attempted. Possibly drugs and food products are the most likely branches of chemical industry in which secret working will be attempted in the future, because the 1919 Patents Act contains a provision that any patent for drugs or food stuffs shall be liable to be licensed to any one who is prepared to pay a fair royalty to be fixed by the Patent Office in default of agreement. If therefore a manufacturer does not wish his competitors to use his process, even with the handicap of having to pay a royalty, he may desire to endeavour to work the process secretly. This is an exception, and usually the objections already mentioned will apply against secret working even in this case. In the manufacture of drugs, in particular, analysis of the product would yield valuable information to a competitor.

So far we have spoken mainly of improvements made by large firms, often in existing processes. But if the invention founds a new industry, and is to be worked by a manufacturer or exploited by a syndicate, the case for patenting is stronger *a fortiori*. Much expense will be incurred in pioneer work by the founders of the new industry, and their safest protection is that afforded by patents. The individual inventor of an entirely new process, if not already a manufacturer, will usually only be able to obtain initial capital on the strength of his patent protection, and his syndicate will only be able to go to the public for further capital when the invention is fully covered by patents.

Perhaps sufficient has now been said to give an outline of the case for patenting, and at any rate the following chapters are based on the hypothesis that patenting is a wise procedure. Let us now consider the possibilities of patent protection, when the advantages of patents may be more clearly apparent after further explanation has been given. Assuming for the moment therefore that a firm has decided to embark on a patent policy, let us consider the business aspect. The actual machinery of obtaining protection will be considered later.

The first essential in framing a patent policy is that the subject must receive serious attention as a branch of the larger business policy pursued by the executive. It is not a detailed matter which is merely incidental to the business and technical aspects of a new departure. It must be considered as an integral part of any new development, right from the beginning. It is a striking feature of technological work in both America and Germany that the importance of patents is fully appreciated, and in these countries the patent system is usually well understood and utilised.

In England, there seems to be an impression among many able business men and technologists that patents are not of much importance unless they are master patents, or cover vitally important processes. This is a fundamental error which overlooks the most important strategical conception of patent policy, namely, that of creating a favourable *patent situation*. Let us analyse this conception of a patent situation a little more closely. The simplest case is certainly that in which a firm succeeds in obtaining one or more master patents which entirely dominate a particular field of industry. Thus in the contact process for sulphuric acid, it was impossible satisfactorily to effect catalysis by platinum alone without using the fundamental patent for maintaining a low temperature, *e.g.*, by cooling the reacting gases, so that the temperature of catalysis was less than about 500 degrees C. Again in the manufacture of amino-arsenobenzene pharmaceutical bodies, such as "606," it appears to be impossible to obtain success without using the fundamental patent for reducing aromatic nitro-arsenic bodies to the amino-arsenobenzenes. In such cases a monopoly can clearly be obtained as long as the patents are valid.

But there is another way in which a favourable patent situation can be built up. Suppose that a firm possesses a large number of patents, none of which alone and individually is sufficiently strong to give a monopoly, it may well be that the cumulative effect is to give a practical monopoly.

For instance, the contact process for sulphuric acid was further protected by a network of patents for various steps and alternatives; although one of these alone might have been evaded with impunity and comparative ease, the combined effect was exceedingly strong. If a competitor finds that he is hampered at every turn by having to evade some minor patent for one stage of the process, he may well find it impossible to compete on equal terms with the owners of the patents who can pick out alternative processes at will, and vary them from time to time in accordance with changing conditions. Such a network of patents may be compared with the threads with which Gulliver was bound by the Lilliputians; any individual thread could be broken, but the combined effect was paralysing.

Hence a firm which desires to create a patent situation will protect not only the processes which are best at the time, but also those alternative processes which could be used at a slight sacrifice of efficiency, or could be used in the future under different economic conditions.

It will be necessary for the organisers of such a patent policy to consider the offensive and defensive aspects of the patent situation as a strategic conception.

Offensively, the main idea will be to obtain an actual or virtual monopoly so as to be in a position either altogether to prevent others from competing, or to force them to pay tribute in the form of royalties.

Defensively, the main ideas will be (*a*) to prevent others from obtaining a monopoly, and to break up rival patent situations, and (*b*) to obtain patents which will serve as counters for bargaining, so that in case of need a rival patent can be used in return for suitable concessions of such patent rights.

This offensive and defensive policy will cover foreign countries, as well as England, because it will be necessary to ensure that the firm's sales abroad are not hampered by hostile foreign patents, and it will be desirable to take tribute from abroad for any inventions made here.

In speaking of offensive policy, it will be understood that we are not referring to litigation alone, but much more to the steady pressure which is brought to bear on competitors by the mere existence of a strong patent situation. Defensively, of course, it will be necessary to examine hostile patent situations closely and to determine how a new process can be performed in such a way that the rights of others will not be infringed. In America it is common for an expert survey of the field of patent literature to be undertaken even before research begins, so that developments can be guided along the lines which are least impeded by hostile patents, and the scope and validity of dominating patents may be determined. In some cases it may happen that such a survey will show that the field is really free. In others it may be advisable at once to purchase or license patent rights of others, which is far cheaper than waiting till the new industry is fully developed, when negotiations will be much more difficult.

Accepting the aim of creating and maintaining a favourable patent situation, close collaboration must exist between the business men and the technologists on the Board. It will be for the business man to exploit such a situation to the uttermost and to assist in developing it by authorising research and in other ways, including any necessary negotiations with other patentees. It will be for the technologist to direct research in such a way as to build up the strongest patent situation and to find means for nullifying hostile patent situations. The following chapters will deal with this difficult problem of the technologist, but it must be insisted that the efforts of the research staff must be translated into terms of patents, and vigorously exploited by the Board as a whole.

This policy should be a continuous one rather than a series of sporadic efforts to protect individual processes. As far as possible, the area of patent protection should be coterminous with the scope of manufacture, and the patent situation must be considered as a whole. Patents help to give a monopoly in production, just as advertising helps to give a monopoly in selling. If, therefore, it is desirable to protect the goodwill of the sales department by advertising all the products which are sold, it is also desirable to protect the manufacturing department by patenting new developments throughout.

Chapter II

A SHORT GENERAL ACCOUNT OF PATENT PROCEDURE

The usual explanations of patent law bristle with details of procedure, but it is possible to treat the subject in a more philosophical way, and to bring out the interesting general principles. I wish to show that there is a coherent body of theory underlying patent law, and to link up the various points of chemical interest by these principles. Nevertheless, there are a number of details to which constant reference must be made, and it is therefore advisable in this chapter to give a general account of patent procedure so that in the subsequent chapters the chief subjects can thus be treated without having to explain these details. This short general account will then be illustrated by examples.

The first step in obtaining patent protection in this country is usually the filing of a patent application. Except in cases originating abroad, the actual inventor must sign the application, although the name of another individual or of a firm may also appear, and of course the patent may be assigned to others once it is granted. There is often difficulty in deciding as to who is really the inventor; and this difficulty arises especially when research work is being done, so that it is much safer if the application is made in the joint names of all who have contributed anything of importance to the invention, *e.g.*, the research director who made the original suggestion, and the chemist who performed the laboratory work and contributed additional suggestions. If the names of the inventors do not appear on the application, the patent could be held invalid. Hence all who have contributed anything substantially novel should be included, and their respective rights should be defined by agreement. A few comments on such agreements will be found in an addendum to this chapter. On the other hand, it is settled that the original inventor is entitled to obtain the aid of experts to work out his invention, and these collaborators do not necessarily become joint inventors merely because, acting as the " intelligent instruments " of the inventor, they have made ancillary improvements in his original idea and shown that it is feasible in practice. If there is any doubt, it is better for too many rather than too few names to appear.

Protection begins from the date at which a provisional or a complete specification is filed at the Patent Office. In most chemical cases it is advisable to file a provisional specification first, since this gives opportunity for further experiment without the necessity of secrecy.

The provisional specification must contain a statement of the nature of the invention. It is not usually sufficient to describe exactly what work has been done, because it is also advisable to foreshadow future work. Thus in protecting a process of polymerising isoprene to rubber, care should be taken to include the application of the process to dimethyl-butadiene and other homologues.

It is possible for the inventor himself to prepare the documents of a patent application, but he usually finds it preferable to obtain the professional assistance of a specialist, namely, a patent agent; by the 1919 Patents Act, no person is allowed to act as a patent agent in this country unless he is registered by the Board of Trade.

Registration now depends on passing stringent examinations in patent law and practice, held under control of the Board of Trade.

After the provisional specification has been filed, it is examined at the Patent Office by an Examiner to determine whether it deals with a "manner of manufacture." This term is very wide, and it includes chemical processes of all kinds, from small improvements in detail in existing processes, such as choice of an optimum temperature of reaction, to wide patents broadly protecting a new reaction. Occasional exceptions are rarely met. Thus a process for extracting lead from the human body was held unpatentable because it was not a manufacture. But usually this objection is not raised. The Examiner also considers whether the specification is a clear description of the nature of the invention, and he may call for explanatory amendment if he is not satisfied. If he considers that it covers more than one invention, he may call for further amendments which would restrict the scope of protection very much. It is important to note that he does not make any search for novelty at this stage.

Provisional protection lasts for nine months under the new Act (instead of six), and one month's extension may be obtained on payment of a fine. During this time it is nearly always most important that experiments should be made to determine how far the provisional specification can be expanded, or what correction or limitation it may require. The complete specification must then be filed, otherwise the application is abandoned, in which case it should be remembered that the provisional specification is not published. The complete specification differs from the provisional specification in two ways: first, it should contain one or more examples, since it must give sufficient information to enable the skilled chemist to work the invention—not necessarily on the best commercial scale, but in such a way as to give some beneficial result. Above all, the information in the complete specification must be adequate, and accurate; if it fails in either respect, the patent would probably be held invalid in the Courts.

Secondly, the complete specification must contain a distinct claim. The word "claim" is not used in its ordinary sense, but has a special technical meaning. The "claim" of a patent is a definition of what the inventor considers to be novel, and all his rights depend on it. Thus if the invention lay in the use of acetic acid in a certain process, instead of sulphuric acid, it would be wrong to claim the use of a suitable acid, because this would not exclude sulphuric. Nor would it be wise to claim the use of acetic acid, because this would leave an infringer free to use other acids. The correct claim might be for a weak acid, if boric acid or carbon dioxide would serve also, or a fatty acid, if formic and propionic, etc., were the only equivalents, and so on.

The complete specification thus calls for the utmost care in drafting, because on the one hand all its statements must be accurate in substance, and yet on the other hand all possible equivalent variations of the invention must be protected to guard against possible infringement.

The complete specification is examined by the Patent Office to determine whether there is an adequate and clear disclosure of the invention, and whether the specification comprises more than one invention. Further, the Examiner reports the result of the official search as to whether the claims are anticipated by any British patent specification filed within the last 50 years. The official search does not extend beyond British patents for reasons which will be discussed later, but within these limits the British search is one of the most thorough in the world. If prior patents are cited, these citations, as they are termed, must be considered by the applicant, and the specification and claims must be amended to define the invention in such a way as to distinguish from the citations. Thus if, in the example we had mentioned, we had known that sulphuric acid was old, and had claimed " weak acids," the Patent Office might find a prior patent describing the use of boric acid. If so, we could then amend by limiting our claim to " weak organic acids," thus excluding sulphuric and boric but including propionic and benzoic ; incidentally we should exclude trichloracetic by this amendment, so that we might find it necessary to claim " organic acids " broadly. Before doing so, we should have to satisfy ourselves that other organic acids would serve, *e.g.*, sulphonic acids.

Fine points often arise, and much argument and amendment may be necessary before the specification is in a form which will meet the requirements of the Patent Office and yet give the inventor the protection to which he is entitled. The Examiner is supposed to hold the balance between the applicant and the public, and it is a great mistake to dismiss his objections as absurd, since it is to the interest of the applicant that the claim should be free from anticipation. At the same time, the Examiner feels that the rights of the inventor are being watched, and that it is his duty to the public to make sure that the inventor does not claim too much. Differences of opinion may exist, and it would also be a mistake to allow the Examiner a free hand, since this would often result in an undue limitation of the inventor's rights.

The function of the Examiner is critical, as a result of his special knowledge of the published patents in a particular branch of technology. The function of the patent agent is constructive, to prepare a specification containing a form of words which will give the widest protection to his client. Hostile discussion should be, and usually is, avoided; the procedure is simplified in practice by the fact that each party exercises a friendly appreciation of the difficulties of the other.

A period of not less than six months is allowed for the official search and the necessary amendments; the specification must be "allowed" or "accepted" by the Examiner within that time, *i.e.*, within 15 months from the date of filing the original specification. This period may be extended for three months on payment of fines, and if the specification is not accepted then, the application normally becomes void.

If a deadlock is reached between the Examiner and the inventor or his agent, it is possible to file an appeal.

When the specification is accepted, a printed copy is issued within about a fortnight, and the application is open for opposition for a period of two months. Any interested party can oppose the grant of a patent on certain grounds, *e.g.*, that the applicant obtained the invention from him by fraud, or that the invention has been described in a printed publication in this country. The grounds of opposition are now wider than the official search, as scientific literature can be used.

If no opposition is lodged, the application is "sealed" after about a month, and it then becomes a patent. Its life is 16 years (not 14, as previously) from the date of application, provided certain Government taxes are paid. If the invention is not worked by the patentee within four years from the date of application, interested parties may apply for a compulsory license under certain conditions.

When the patent is sealed it becomes a negotiable asset: it can be worked by the patentee, or sold to others by assignment, or licensed to one or more users who may pay royalties. In any case, the patentee has the right of preventing anyone else from infringing his monopoly; if, therefore, unauthorised persons use his invention, or obvious modifications of it, he has his redress in the possibility of suing them in the High Court by an infringement action.

The infringer will often disclose what he is doing, as he may wish to fight the matter out. If not, it may be necessary to supplement evidence by questions, termed interrogatories, or by bringing sufficient *prima facie* evidence to induce a judge to grant an order for inspection of the defendant's works by experts.

In the infringement action, the infringer is at liberty to contest the validity of the patent. As explained above, the Patent Office search is confined to British patents only, and it is thought inadvisable to refuse patents except on the most conclusive evidence, because if an invalid patent is allowed, it can always be contested in the Courts, whereas if the patent is refused, irreparable injury may be done to the inventor. Too great severity on the part of the Patent Office has led to some absurd results in Germany, where patents have been refused for epoch-making inventions. In Great Britain there is thus a double standard. The Patent Office grants patents freely, after a partial examination for novelty, and leaves the Court to determine questions of validity and infringement.

Hence the infringer will usually attack the validity of the patent, on the ground of prior publication or prior use of the invention, or, especially in chemical cases, on the ground that the specification contains inaccurate statements or examples which will not work. The patentee must rebut these objections, and must show that the infringer is doing something which falls within the scope of the claims of the patent.

A firm which pursues a consistent patent policy will study the literature very closely to see that its own patents are drafted so as to be valid, and to amend them if fresh partial anticipations are discovered after the patents have been granted. This study of the literature will also extend to the patents of competitors, because if these are found to be invalid through prior publication or other reasons, they ought not to restrain others from using the patented process. There is usually no moral or legal obligation on a firm to refrain from using a process if the patent for that process is invalid, because the monopoly only exists while the patent is valid.

This procedure may be summed up, therefore, by saying that a provisional specification should be filed as soon as it is possible to give an account of the nature of the invention. This application should be made before any publication of the invention, or disclosure to anyone except in confidence. The period of provisional protection should be utilised in amplifying and checking the information contained in the provisional specification. The complete specification should then be filed and the broadest valid claims obtained in the Patent Office.

Questions of infringement should be settled as they arise after a careful re-examination of the validity of the patent.

I shall now illustrate the procedure by examples from the Flour Oxidising cases.

(1) In 1901, John Andrews and Sydney Andrews, who were millers in Ireland, filed a provisional specification for "Improvements in conditioning and improving the quality of recently ground flour, semolina, or the like." The specification pointed out that flour is greatly improved in quality when kept for two or three months after grinding, but that after this time the improvement does not increase, and, if anything, deterioration begins. It then stated that the invention was designed to bring about this improvement immediately after grinding, and, in fact, to bring about a greater improvement than that obtained by mere storage. The invention was described as consisting essentially in exposing the flour to the action of nascent oxygen, or a gaseous oxidising agent producing nascent oxygen in the flour. The inventors mentioned that they preferred to use air passed through nitric acid, but they included other oxidising gases. They added that ozone could be employed, but that the result was not so good, and that it was expensive. As an example, they stated that the flour could be passed through a reel having a screw conveyer to remove the falling flour, and that the oxidising agent

could be introduced into the space surrounding the reel, *e.g.*, air passed through nitric acid; obviously other apparatus could be used.

(2) A complete specification was filed subsequently which elaborated this description by giving a drawing of a suitable reel, and a device to generate the oxidising gas from nitric acid and ferrous sulphate. The specification also contained a more precise definition of the gaseous oxidising agents employed: it mentioned nitrogen peroxide, and it claimed the invention in the following words:

"In the process of conditioning flour and the like, passing the same with full exposure through an atmosphere containing a gaseous oxide of nitrogen or chlorine or bromine oxidising agent in the gaseous or vapourised state."

Note that, although the drawings showed a reel, and jars of nitric acid and ferrous sulphate, the above first claim was not limited to these details, but covered any gaseous oxide of nitrogen or chlorine or bromine oxidising agent in the gaseous or vapourised state. The specification carefully stated that ozone might be suggested, but that its results were unsatisfactory, and that the inventors did not recommend it but excluded its use.

It will be seen here that in the provisional specification the inventors wisely covered the ground of gaseous oxidising agents as thoroughly as possible. During the period of provisional protection, for what reason we are not told, they equally wisely, as events will show, decided to exclude ozone. They amplified the description by giving a drawing of a suitable apparatus and details about the generation of the oxide of nitrogen : they also specifically mentioned nitrogen dioxide. They thus did two things :

(*a*) they defined their oxidising agents more precisely, mentioning nitrogen dioxide and excluding ozone ;

(*b*) they gave a detailed example, to which, however, the scope of their claim was not in any way limited.

The patent was allowed and sealed. In those days there was no official search for novelty. If there had been, the Examiner could have cited a patent to one Frichot, which mentioned ozone, but Andrews had already excluded ozone, so that, although the Examiner might have asked Andrews to mention that ozone had been proposed before, he would have been bound to allow Andrews the patent for the other specified oxidising agents.

This patent was then vigorously exploited commercially. Much of the success of a patent depends on the business men behind it, and Andrews patent was most skilfully handled by the Flour Oxidising Company. The process rapidly came into commercial use on a very wide scale. The course adopted was to license the process to millers under royalty, and a sum of over £100,000 was received in such royalties. It was found that the treatment with nitrogen peroxide bleached the flour and raised its selling price by about a shilling per sack.

(3) The bleaching of flour became very popular, and one Alsop filed a patent application for treating flour with the gases produced by passing air through a flaming arc. This application was opposed by the Flour Oxidising Company, who argued that their patent (Andrews) disclosed the use of nitrogen oxides, and that the gases from a flaming arc owed their bleaching action to the presence of nitrogen oxides. However, the authorities gave Alsop the patent, as he alleged that certain remarkable advantages were obtained.

Heavy litigation then began in the Courts, in which each side attempted to revoke the patent of the other. The Andrews patent was of prior date, so that Alsop wished to revoke it to prevent infringement actions, while the Andrews interests probably wished to be able to use the arc process if they felt inclined. The owners of the Andrews patent were successful all along the line. They then brought infringement actions against the users of the arc process, and were successful each time.

(4) The Alsop arc process had been opposed before the Patent Office, but, as explained, this tribunal always gives the applicant the benefit of the doubt. Surprise is often expressed that the

Patent Office grants patents on so-called improvements which appear to be obvious. It should be emphasised that the function of the Patent Office is to make certain that the exact thing claimed is not disclosed in a prior British patent: it grants patents freely, and does not pretend to guarantee their validity, which is left for the determination of the High Court.

Accordingly the Alsop patent was attacked in the High Court for two reasons. First, because of anticipation by the Andrews patent. Alsop attempted to meet this attack by the argument that as prediction is so difficult in chemistry, it would have been impossible to say that the nitrogen oxides produced chemically by Andrews could be replaced by the mixture of oxides produced electrically by the flaming arc, and that this involved an exercise of the inventive faculty, especially as the arc process was in some respects easier to control than the chemical process. The judge stated: "If the mere fact that a man who ascertains by experiment that a gaseous medium, the known constituents of which suggest the probability of a certain result, does produce that result, has subject-matter for a patent because of the possibility that some unknown factor may prevent the anticipated result being obtained, the field for new patents would be enormously extended. . . . Any patent for the application of a chemical substance to a commercial purpose would give rise to a crop of other patents, the novelty and subject-matter of which would in each case depend on the fact that prevision in chemical matters is likely to be falsified by the possible existence of some unknown factor, the effect of which cannot be foreseen, and there must always, in the present state of chemical knowledge, be a possibility of unknown factors." In this case, therefore, the arc process was anticipated by the chemical process. It should be noted that this was an extreme case, since experiment was mere verification of an expected result: even here the Patent Office allowed the patent, although the Court held it invalid. But if experiment shows that any result is obtained which could not have been foreseen, the Court will not readily find anticipation.

The second ground of attack illustrates the necessity for accuracy. Alsop had sent samples of treated and untreated flour to an American University for analysis, but apparently had said nothing about the treatment. The guileless analyst, not suspecting bleaching by nitrogen oxides, found the treated flour contained a higher percentage of nitrogen (probably present as nitrite, etc.), and calculated the nitrogen as protein. His analysis thus indicated that carbohydrate had been converted into protein, and Alsop emphasised this alleged remarkable new result in his patent. He thought and stated that the gases from a flaming arc were capable of increasing the nutritive value of flour by transforming carbohydrate into protein. Of course such a transformation does not occur, and this erroneous statement was held to invalidate the patent. It was therefore revoked for both reasons—anticipation by Andrews, and failure of the process to achieve the stated result.

It may be interpolated here that, even if the Alsop patent had been held valid, it could only have been worked under license from Andrews, although conversely Andrews would not, in that case, have been able to use a flaming arc because of the Alsop patent.

(5) Alsop brought an action in the Court to revoke the Andrews patent. The chief ground of attack was that the invention had been anticipated by a patent to Frichot, which disclosed the use of hydrogen peroxide or ozone for bleaching grain or flour. It was argued that, once it was suggested to use ozone, other gaseous oxidising agents were merely chemical equivalents. If Andrews had claimed all gaseous oxidants, their patent would have been held invalid, but they had been wise enough to exclude ozone. It was shown that ozone did exert a bleaching action, but it imparted a peculiar garlic-like taint to the flour. Hence the Court held that the Andrews nitrogen oxide process was undoubtedly not anticipated by the Frichot ozone process; ozone is almost the ideal

oxidant, since it leaves oxygen behind, and yet the apparently innocuous ozone taints the flour; the poisonous and strongly smelling nitrogen dioxide might be expected, therefore, to give a still worse result, and yet, contrary to expectation, it is a satisfactory bleacher. The discovery that a noxious gas gives good results when an apparently innocuous gas gave bad results is clearly a patentable invention, in spite of the fact that both are known to be oxidising agents when applied to other purposes. This decision was sustained by the House of Lords, and it shows that if unexpected results are produced, a valid patent can be obtained for the use of a known oxidising agent for a certain special purpose.

It may be added that, although the House of Lords sustained the patent, the High Court had first declared it anticipated by Frichot. This illustrates the danger which would exist if, as in Germany, the Patent Office freely refused patents. The Andrews case might have been refused for anticipation by Frichot: the Patent Office would not have had the evidence of the successful commercial use of nitrogen dioxide and the failure of ozone, but would have regarded both proposals on the same plane. It is for this reason that the English system freely grants patents, because until they have been tried in practice for some years it is often difficult to distinguish between a practical process such as Andrews, which was worth over

£100,000, and a mere paper process like Frichot's, which was sold for £50. Hence the Patent Office merely makes a preliminary examination, and leaves the question of validity to be thrashed out in Court.

At this stage of the proceedings it will be seen that the Andrews interests were in a commanding position because their patent was in force, so that they held a monopoly of the use of nitrogen peroxide for bleaching flour, whether produced chemically or electrically, and they could use the Alsop arc process if they wished, since that patent had been revoked.

(6) Finally, various millers used the Alsop process without paying any royalty to the Andrews interests. As they had a master patent for oxidation by nitrogen peroxide, the matter was fought out in two infringement actions; Flour Oxidising Co. v. Carr, and Flour Oxidising Co. v. Hutchinson. The defendants attacked the validity of the patent on a number of grounds.

They argued that the patent contained serious misstatements in that it alleged that the quality of the flour was improved much more by bleaching artificially than by storage for several months, and they also argued that bleaching was not in fact useful because it decreased the digestibility of the flour. A long controversy raged on these points, because if such misstatements had occurred in the patent, it would clearly be invalid. However, the objection was not sustained; but it shows how careful the patentee must be to make sure that all his statements are as accurate as possible. I again emphasise that this is a characteristic difficulty in chemical patents, where it is so hard to make accurate assertions without the fullest experiment to justify them: in mechanical cases, once a careful drawing has been made, it is usually, though not always, possible to be reasonably certain that the statements in the specification are substantially accurate, often without actual trial.

The great objection to the Andrews patent was an alleged prior use at a mill in Kirkaldy. This miller apparently had the idea that as bleaching was often assisted by sunlight, it would be a good idea to expose the flour to artificial light, and for this purpose he fixed metallic points in the shoot leading to the rolls, and passed an electrical discharge between these points. It was true that this particular apparatus *could* have been worked in such a way as to yield an arc and thus to produce nitrogen dioxide electrically. The evidence showed, however, that in fact the apparatus had actually been worked in such a way as to produce a brush discharge which would give ozone with only very small quantities of nitrogen dioxide. Ozone was not an anticipation of nitrogen dioxide, and the Court held therefore that the use of a brush discharge was not a prior use of the Andrews invention. It must be noted that prior use (if commercial and not secret) is sufficient to upset a patent, but such use must be clearly proved; if the Scotch miller had used an arc discharge, in a commercial way, the patent would have been invalid, but as he had only used a brush discharge, there was no anticipation.

Thus the charge of infringement was sustained as the Andrews patent was valid, so that the Andrews patent was left in full possession of the field of bleaching flour by oxides of nitrogen, whether produced chemically or electrically.

It is hoped that this short account will be sufficient to give a general idea of the procedure in patent cases. It may also help to show :—

(*a*) That a patent may be allowed by the Patent Office, and yet, in spite of the official search which is now made, it may later be found by the Court to be invalid by anticipation and to describe an infringement of an earlier patent. Both these possibilities must therefore be carefully considered while prosecuting a patent application.

(*b*) That infringement and anticipation are entirely different issues. If an earlier patent claims all oxidising agents, a later patentee may possibly obtain a valid patent for one particular oxidising agent, if this shows unexpected advantages. But in such a case the first patentee will not be able to use the second process except under license, because it is patented, and the second patentee will not be able to use it, except under license from the first, because it infringes the general claim for all oxidising agents. In such a case, therefore, in absence of agreement, the first patentee would have the right to use all oxidising agents except the special one covered by the second patent, and the second patentee would not be able to use his own oxidising agent until the first patent expired.

Addendum

The Relative Position of Employer and Chemist

In general, it is presumed that the inventions of an employee are his own, even if made in the employer's time and using the employer's materials. This presumption may be rebutted if it can be shown that the employee was employed for the purpose of inventing. Thus in a recent case in 1917 a draughtsman was sent to a colliery to report on a suggested piece of work. He produced several alternative schemes and filed a patent application for one of them. When the employers brought an action against him, he contended that he was employed solely as a draughtsman or assistant engineer, to discharge the duties ordinarily discharged by a person occupying that position, and not to apply any inventive ingenuity he might possess for the benefit of his employers. The Judge made the suggestive comment that the *mere* fact that he was engaged as an assistant engineer or draughtsman would not have entitled the company to claim the advantages of any invention which he made, although the invention had been the result of knowledge and experience gained with them, and might have been suggested by difficulties which had come to his knowledge by reason only of his having been employed with them. But the Judge observed that the peculiar circumstances of each case must be considered, and in this case he was definitely sent down a colliery to design, if he could, a structure which would comply with four essential requirements enumerated in his report. *From that moment* the terms of his employment imposed on him an obligation to place at the disposal of the company the best design which he could, by the exercise of his industry, skill, ingenuity and inventive ability, produce for the purpose of completing the work on which he was employed. Thus the patent was declared to be held in trust by the defendant for his employers.

It seems clear therefore that if a chemist in the analytical department of a works spontaneously makes a suggestion for improving a process in the works, which is outside his daily employment, the patent will be his property, whereas if a research chemist is definitely instructed to solve a certain problem, the patent may belong to his employers. Numerous intermediate cases are possible, so that in all cases it is best to avoid the difficulty of determining ownership by settling the matter beforehand by agreement. Often such patents are taken out in the joint names of the inventor and the firm, but here again complex questions of the respective rights of joint owners may arise, so that it is far better to define these rights accurately by agreement.

There has been much discussion as to whether patents should belong to the employer or the employee. In this connection it may be useful to draw a broad distinction between the invention made by a routine worker, which is outside the ordinary range of his duties, and should be substantially remunerated, and the invention made by the research worker, who is definitely employed to make improvements or inventions. If the remuneration of the research worker is to be contingent on the patents taken out in his name, there may be a tendency for work to be concentrated on the immediately profitable problems rather than on the fundamental research which may be all-important for future development. Further, team-work will not be helped if there is a feeling of secretiveness arising from each worker trying to monopolise his own ideas. There is much to be said, therefore, for the policy of paying the research worker adequately without reference to the patents resulting from his work, which would then become the property of the employer. It must be remembered that the lucrative patents must carry the overhead expense of the whole of the research work, all of which will not be financially successful.

Paragraph 35 of the First Report of the Royal Commission on Awards to Inventors states:

"Indeed, in the extreme case of the employment of an individual for the very purpose of research and discovery, his remuneration in that capacity obviously covers all the results to be derived from his investigations, and he can have no valid reason to expect any reward, however meritorious and fruitful the service; though it may be that the exceptional brilliance and utility of a discovery made even in these circumstances might be such as to merit a special exercise of the bounty of the Crown."

On the other hand, certain foreign laws, *e.g.*, in Holland and Austria, provide that service agreements are void if they take away all rights of an employee in the inventions he makes without a reasonable recompense.

Perhaps agreements might provide that, although inventions belong to the employer, successful patents should be rewarded by a special remuneration to be given at the discretion of the directors, or a special committee of the directors. In these matters it is not possible to go very far unless there is a good deal of mutual confidence.

Possibly the main advantage of the patent system to the research worker is not the immediate cash remuneration per patent, but the fact that the existence of a series of patents earmarks his contributions to the knowledge of the firm, and increases his standing both with the firm and with the public. The financial part of the reward is probably best given in the form of increases of salary and status, which will naturally follow the appearance of important patents.

Chapter III

OBTAINING MAXIMUM PROTECTION FOR AN INVENTION: THE THEORETICAL PROBLEM

The chief object of patenting is to inhibit infringement and thus secure to the patentee an effective monopoly of his invention. The value of the patent depends on the scope of its claims, and therefore to obtain the maximum protection for an invention it is necessary to prepare a specification which will be accepted by the Patent Office in such a form that when the Court has to interpret it the claims will cover the widest area possible consistent with validity. It so happens that chronologically the proceedings at the Patent Office come first, as they must be finished before an infringement action can begin. For this reason, therefore, it is usual to defer the discussion of infringement, and to begin the study of patent law by considering novelty and patentability as they are regarded by the Patent Office and by the Courts; as we have seen, the Patent Office practically leaves the question of infringement untouched.

For the present discussion I propose to reverse this normal order. Firstly, and in particular in chemical cases, it is useless to confine our efforts merely to drafting a specification which will be accepted by the Patent Office, and we must fix our attention on the necessity of satisfying the more stringent requirements of the Court. Secondly, we must regard the matter in a practical light : our object is to obtain the maximum protection, not to compile an instruction-sheet for working a particular novel process, or to present the results of scientific research to the learned world. Hence, as practical men, we should endeavour from the outset to foresee how an infringer might gain some or all of the advantages of the invention by making modifications in our process, and we should then devote our attention to closing up these avenues of escape from the patent so as to secure the most complete monopoly possible. It seems reasonable and useful, therefore, to assume that an invention has been made, and to consider various modes of infringement in some detail, after which we shall appreciate the problem we have to solve in drafting the patent specification. We can then consider the solution of the problem, using those materials which are at our disposal in the early stages of the development of the invention. This will lead to a discussion of the technical aspects of the general principles which govern the preparation of a provisional specification; the legal details of the problem can hardly be considered here, as they depend on experience of patent law and practice.

Of course, it will be generally admitted that it is better to stop infringement before it has started, by obtaining a really strong patent, than to attempt to fight on a patent which is unsound. This preventive work is one of the functions of the patent agent, and it is his duty to foresee and then inhibit infringement as far as possible by the most skilful use of the materials before him. In mechanical patents it often happens that the inventor brings in a drawing of a successful invention, and the possible variations can be foreseen by the patent agent, since experiment may not be required to verify his generalisation. But the possibility of valid generalisation or induction is much more restricted in chemical patents, and to obtain efficient protection it is of the utmost importance that the inventor and the patent agent should co-operate in active exploration of the possibilities of infringement. If a strong patent policy is being pursued, the invention cannot be regarded as commercially complete until this study is performed, even though some special experimental work may be required for the sole purpose of preparing the patent specification.

It is already recognised that an invention may be regarded as complete in more than one sense :

(*a*) It may be complete in the laboratory; for instance, a full study may have been made of the conditions necessary to obtain a synthetic perfume by oxidising an aromatic alcohol to an aldehyde with a certain oxidising agent.

(*b*) Another stage is that of technological completeness, when the chemical engineering and other problems of large scale operation have been solved.

(*c*) But there is another stage. Legally it is not complete until possible variations have been explored to provide sufficient material on which to base a strong patent. Commercially, the invention is not complete until it has passed all three of these stages, because until it is legally complete, the monopoly of the results of the technological work is not secure.

Let us begin therefore by considering the possible ways of infringing an invention. It is not usual for the infringer to make a bare-faced Chinese copy of the invention, and he generally modifies it more or less. Suppose it has been discovered that a certain organic body can be sulphonated under certain conditions if an inert solvent is used as the reaction-medium; that an excellent solvent has been found in the laboratory, and that a large-scale plant is working satisfactorily. Three types of infringement are possible:

(1) The same idea may be taken, but a real improvement or development may be made; thus it may be found that some new inert solvent is

much better than those mentioned by the inventor.

(2) A really alternative idea may be worked out, *e.g.*, it may be found that while still using the principle of a solvent as diluent, the results can be obtained by using one of the reaction products as the diluent.

(3) An evasion may be attempted. If the patent is important, it may be worth while even to sacrifice some of the advantages of the invention, if, by so doing, the infringer can work outside the claim of the patent. Thus instead of using an inert solvent, he might find that some of the chief advantages of the invention were still obtained by using a reactive solvent.

An infringement may therefore be an improvement, an alternative or an evasion. Let us consider these separately.

(1) An improvement may well be an infringement, and yet a patentable novelty. It is vital that this distinction should be grasped. In the early days of the dye industry, the Badische Company held a patent for coupling sulphonated naphthols with diazo compounds. It was found that the sulphonation could be performed by the use of oleum instead of sulphuric acid. This might have been clearly a patentable improvement, and yet it was also an infringement of the patented process. In such a case the first patentee cannot use the patented improvement, nor can the

second patentee infringe the earlier patent, so that a deadlock will result until one of the patents expires, or until a licence is given by one of the patentees. The same position occurs when A patents the use of a reducing agent in a certain process and B discovers that one particular reducing agent, *e.g.*, zinc hydrosulphite, gives unexpectedly valuable results: A's first patent prevents B from working at all, but B's patent stops A from using zinc hydrosulphite and confines him to the reducing agents he himself had indicated.

When a patent specification is being prepared, it is necessary to pursue and extrapolate the inventive idea as far as possible to forestall such improvements.

(2) Alternatives are often used, especially when independent inventors have been working on the same problem along somewhat different lines, and one inventor has patented his solution. If he realises the breadth of his invention, he can often obtain a patent which will cover the other solution. In any case, he must remember that apart from independent invention, rival firms will endeavour to find a solution which will not be tributary to the patent.

Some help is to be obtained here from what is termed the Doctrine of Equivalents. It is a principle of law that the claim of a patent not only covers the exact class of process defined in words, but also any process which would be obviously regarded by skilled chemists as equivalent at the date of the patent. Thus in an aluminothermic process, a mixture of aluminium and silicon was held to infringe a claim specifying aluminium itself. And in the U.S.A. a pyrophoric alloy of magnesium and cerium was held to be chemically equivalent to an alloy of iron and cerium. But the scope of the Doctrine of Equivalents is singularly limited in chemical patents, and the House of Lords has held that soluble nitrocellulose in an explosive was not the chemical equivalent of insoluble nitrocellulose and, in another very old and classical case, that a mixture of manganese oxide and tar was not the chemical equivalent of manganese carbide added to molten iron in steel making. It is not wise therefore to place too much reliance on this doctrine, and the greatest attention should be devoted to foreseeing possible equivalents, and verifying the possibility of their use. It is at this point that the inventor usually begins to become restive at the advice of the patent agent. He is fully prepared to study possible improvements, because of their technical value, but he often, and naturally, objects to devoting time to the investigation of untried alternatives which may be no better than the well-tried process which is in practical operation. Yet this investigation is necessary if the patent is to give an effective monopoly.

(3) The improvement and the alternative are at any rate of potential technical importance. But an infringer may attempt an *evasion*, in which a worse process is used in the hope that it will be regarded as outside the patent : it would be good business to sacrifice 5 per cent. in yield if this avoided payment of a 10 per cent. royalty. Or he may rely on some ambiguity of language and choose some process which is verbally not included in the patent. Thus if the patentee specified urea as a catalyst, the infringer might use ammonium cyanate. The possible use of isomers is thus one of the many possibilities which may have to be considered. These evasions can often be prevented, if the inventor is willing to take some trouble to ascertain the second-best variations of his invention. We may say that an improvement represents an extension of the original inventive idea in a forward direction, further into the unknown. The alternative is an extension of the idea in a lateral direction, to cover the possibilities which may be regarded as parallel with the original idea. An evasion is often a modification in a backward direction, nearer the old practice, in the hope that it will be sufficiently good to be valuable and yet not quite good enough to be an infringement. Thus if the patent depends on the discovery that oleum of 27 per cent. strength does not attack iron vessels, the infringer may calculate how near 27 per cent. he may go to avoid the

patent and yet retain substantial advantages. This should be foreseen by the inventor, who should indicate within what range these advantages can be obtained, even if only partially. This may be expressed by saying that while for technological purposes the inventor lays down the optimum conditions, for legal purposes he must ascertain the pessimum conditions of success, that is, he must find out how far he may depart from the optimum and yet obtain a result which is novel and useful even to a limited extent.

All these possible infringements must be considered. If we regard the old process as a point A, and the new process as a point X, improvements will be found by extrapolating along the line AX beyond X; alternatives by investigating points lying on either side of the line AX and level with X; and evasions will be found by interpolating between A and X. It will be realised that a naked description of the actual successful process will not form a satisfactory specification to meet these requirements. Let us therefore consider what will serve the purpose.

The function of a provisional specification is to describe the nature of the invention, and bearing the above requirements in mind, we must remember that the invention is something intangible which is much wider than the process as worked on the plant. The task is to generalise the original idea by a process of induction and deduction, and the whole legal and technical equipment of inventor and patent agent should be concentrated on this problem.

The following materials will be required in the ideal case :

(1) The existing state of public knowledge, especially as shown by patents and literature, but also as modified by the knowledge of processes actually used by others in the United Kingdom; all this is termed " the state of the art," using the word " art " as synonymous with the branch of technology in question.

(2) The experimental results obtained by the inventor, including the negative ones as well as the best.

(3) The theory which is considered to underlie the invention, or the mechanism of the reaction, not necessarily for inclusion in the specification, but for use in the mental analysis of the invention.

(4) A forecast or programme of future work. The provisional specification need not be confined to fully-developed processes, but can foreshadow developments to be tested out during the period of provisional protection.

These materials, the state of the art, the experimental results, the theory, and the programme of development, are the ingredients which must be thrown into the legal crucible and fused into a provisional specification. At this point I may be forgiven for adding that if the inventor consults a patent agent it should not be necessary for him to write a specification himself. It is usually much better for the work to be shared in that the inventor first collects these materials, which is a difficult enough task. It will often be simplest for the patent agent to receive these materials in the form of rough notes : indeed excerpts from the chemist's note book or reports are usually very suitable. After discussion, the patent agent will draft a specification for the criticism of the chemist. This leaves the patent agent free to adopt the style of language which he has found by experience to suit legal requirements best, whereas if he is presented with a *fait accompli* in the form of a specification, it may sometimes prove difficult for him to explain in detail why he instinctively feels that various amendments of language are necessary for legal purposes.

Let us assume then that we are in possession of these raw materials, and that it is desired to draft a provisional specification. The next steps are :

(5) To generalise.

(6) To test the generalisation deductively by considering possible infringements, whether improvements, alternatives or evasions, and to repeat these steps until finally

(7) the invention can be expressed in its most generalised form. It will be easiest to follow these mental operations by taking a hypothetical case in some detail :

Let us suppose that some years ago a chemist discovered that the hot vulcanisation of rubber by sulphur could be accelerated by adding to the mixing about $\frac{1}{2}$ per cent. of thio-urea. If he had consulted his patent agent and simply told him that litharge was a known accelerating agent, but that this was a better one and that he did not know of anything else, it would have been possible to protect thio-urea, but no general protection could be obtained. But let us suppose that, although the chemist has only made one experiment, he instinctively feels that he has made an important discovery and that other substances will probably serve the purpose. He will discuss the invention with his patent agent and they will formulate the following statement of the position.

(1) The state of the art is that vulcanisation is known to occur more rapidly at a high temperature, or with a higher percentage of sulphur. The reaction is accelerated by the presence of litharge, which is largely converted into the black sulphide during vulcanisation. But the reaction is also accelerated to a lesser extent by the presence of lime or magnesia in the form of oxides, though not by carbonates, nor by zinc oxide.

(2) The actual experimental result is that a marked acceleration is obtained by incorporating $\frac{1}{2}$ per cent. of thio-urea. It will be as well to mention in the specification the actual experimental details, *e.g.*, composition of mixing, especially the

amount of sulphur and kind of rubber, the method of mixing and vulcanising and the time and temperature of vulcanisation, with an accurate statement of the result obtained. Such details will not limit the invention if introduced as examples only.

(3) The theory of the reaction appears to be based on the fact that the rubber mixing is a colloidal gel in which solid particles of mineral matter are heterogeneously distributed. The sulphur melts at the temperature of vulcanisation, and can therefore distribute itself more homogeneously. The litharge or lime is heterogeneously distributed. Probably the organic accelerator now discovered is effective because it is miscible with or soluble in the rubber, and thus comes into more intimate contact with it and the sulphur.

(4) The programme of future work is to study thio-urea more closely, and then to try other nitrogen compounds, especially amines.

(5) With these materials before us, we must now attempt a preliminary generalisation. At first sight, it is difficult to see much connection between the various accelerators, *i.e.*, thio-urea on the one hand, and litharge, calcium oxide and magnesium oxide on the other, remembering that zinc oxide is not an accelerator. We find, however, that litharge is largely changed into lead sulphide during the reaction, while the other known accelerators are not affected, so that it occurs to us that possibly

litharge acts specifically. In fact, we find from the literature that it has been suggested that its action is purely one of raising the temperature of reaction by burning up the rubber resins through an exothermic reaction, so that the resins act as fuel, heat up the rubber, and accelerate the reaction. If therefore we assume that litharge acts differently, we are left with calcium oxide and magnesium oxide which are then seen to resemble thio-urea in being *bases;* the unsuccessful zinc oxide and calcium carbonate are only feebly basic. As our first tentative generalisation, then, may we not assume that possibly other organic bases will accelerate vulcanisation, if added to the rubber, even if only feebly basic, because we should expect them to be readily miscible with the reacting bodies during vulcanisation?

(6) The next step is to consider whether this statement is wide enough to forestall infringers. We must consider improvements, alternatives, and evasions.

The most likely improvement, if our theory is sound, would be the discovery of another base which would be cheaper or more effective. At the moment we cannot do more than draft the specification widely enough to allow of such a possibility, for example among aromatic compounds instead of aliphatic compounds.

Alternatives demand more attention. If we are correct in assuming that the mechanism of the acceleration is the homogeneous distribution of a basic substance throughout the mass, it will occur to us that the accelerator need not necessarily be an organic base, if the desired intimacy of contact can be secured. This might suggest using a solution of an inorganic base in an organic solvent. In fact, an ingenious patent has been taken out by Twiss for the use of caustic soda plus glycerol. We should have considered, and possibly rejected, alcoholic caustic soda because of the volatility of alcohol. Further possibilities are the use of colloidal organosols of inorganic bases, perhaps using rubber itself as protective colloid. These possibilities would be noted for the future programme of research to be tested during the period of provisional protection.

Finally, we should have to guard against the possibility of evasion. *A priori*, we cannot say whether the product obtained by heating sulphur with thio-urea in absence of rubber will act as an accelerator when incorporated with a rubber mixing. Further, certain sulphides of metals are soluble in organic liquids. It will be necessary to test whether the base must be added as such, or whether, since presumably it reacts with the sulphur in the rubber mixing, the product of reaction is the catalyst. If so, this product might not be a base, and yet its use would clearly be an appropriation of our discovery, so that care must be taken not to exclude this possible variation.

Another evasion would be the use of isomers, such as ammonium thiocyanate and derivatives of pseudo-thio-urea, instead of derivatives of thio-urea.

(7) We are now in a position to draft a provisional specification, which will foreshadow developments on the lines we have considered. This might be done by referring to the fact that litharge, lime and magnesia are known to accelerate vulcanisation when incorporated with the rubber mixing in the usual way as powder. We should then state that it had been discovered that more rapid acceleration could be obtained by incorporating small quantities of a base, preferably an organic base such as an amine, in the mixing in such a way that the base was practically homogeneously distributed throughout the rubber.

We should add that, by way of example, excellent results could be obtained by adding thio-urea, and we should give the fullest details, but we should indicate the possibility of using aromatic amines. We should observe that the result appeared to be due to the basic nature of the amine and its miscibility with the rubber, and we should add a reference to the possibility of using the inorganic bases in a state of uniform distribution. Finally, we should guard against the possibility of an infringer heating the amine with the sulphur separately, and then adding the reaction product to the mixing, by stating that the result might be due to the presence of the base or to the catalytic activity of the reaction product, and that both modes of activity were included within the scope of the invention.

Naturally it would be far better to make a few more experiments to test these possibilities before filing the application. Several well selected crucial experiments would make our task far easier, and would perhaps allow us to generalise still further. I have assumed, however, that only one experiment was, in fact, available, and have attempted to show how it should be provisionally protected. It must be admitted that the above is an ideal case, and in practice it will usually happen that it is not possible to carry generalisation so far. Still, it will be agreed that the possibilities of logically unfolding the implications of a given observation are correctly stated, and I suggest that the method of attack is sound.

Of course, such a specification would require immediate research to verify and amplify the generalisations which it includes. It is true that to a certain extent this work may diverge from that which would normally be performed in practice. Instead of confining the research to the investigation of the conditions of use of thio-urea, it will be necessary to try a number of widely different lines of experiment. In so far as these will help to explain the mechanism of the reaction, they will clearly be valuable, but it is highly probable that such a systematic study of the catalysis will lead to the discovery of a substantial improvement, *i.e.*, an accelerator which is cheaper, better, or easier to use.

We will not discuss the actual history of acceleration except to add that a patent was taken out by the Bayer Company protecting the use of bases having a dissociation-constant in aqueous solution greater than 1×10^{-8}, and that Peachey discovered that there was another class of accelerators, namely, nitroso compounds including the basic *p.* nitrosodimethylaniline and the acidic *p.* nitrosophenol.[1]

After this practical illustration showing how the materials are used, let us once again consider in general the kinds of material required.

(1) The state of the art is valuable because it assists in providing data for formulating a theory, and because it is a necessary background against which the invention stands out in its true perspective. In the example we have considered, a knowledge of the prior use of lime and magnesia was all-important, since it was by the aid of a comparison of these reagents with the new reagent that a general statement could be made. Without such knowledge the invention may well be limited or be stated in far too broad language, and although such a statement can often be restricted

(1) See British patents 11209/13, 11530/13, 11615/13, 12777/13, and especially 4263/14, 12661/14 and No. 110059 and 124276; also Peachey J.S.C. I., 1917, 950.

in scope at a later stage of the proceedings, it is desirable to know the scope of the invention as early as possible. Thus, when Stiasny had invented synthetic tanning agents made by condensing formaldehyde, sulphuric acid and cresol in certain proportions, it was of advantage to know that a condensation product from these ingredients had been described, though not as a tanning agent, since the specification could then lay emphasis on the relative proportions of the reagents which were necessary for success.

It is true that at the provisional stage a knowledge of the state of the art is not quite so important as it is at the complete stage, and it is also true that the inventor himself often works without a full search of the literature. But the requirements for the logical and analytic study of the invention for the purposes of patent law are not those for the intuitive discovery of the invention by a stroke of inspiration, and there is no doubt but that for patent purposes it is well to know the art thoroughly. Chemical literature is fortunately so extensive, accessible, and well indexed, that it is much easier to ascertain the state of the art in a chemical case than in an electrical or mechanical one.

(2) The next, and the most important material of all, is the statement of the experiments done or the new idea in its concrete form. The provisional specification is based on this information, which

should be as exhaustive and detailed as possible. Although this material can be amplified in the complete specification, the provisional is the foundation-stone, and it should be securely laid. Further, the provisional is of enormous importance in establishing priority in foreign countries. For example, suppose that the inventor has discovered that a certain nitration is successful if dilute nitric acid is used. The exact strength and temperature of operation should be specified by way of example, and the protection need not be restricted to this example. Suppose it is discovered later that dilute nitric acid had been tried without success, and that our inventor had only obtained success because he worked above a certain temperature, or below a certain critical strength. If he has merely made a general statement that dilute nitric acid is used, he will not have described anything new, whereas if he has given the essential information he will be able to obtain a monopoly of the process which uses the critical strength or temperature. This illustrates the importance of giving full information. As already explained, the patent agent should have *all* experimental results before him, even negative ones, otherwise he cannot intelligently follow the whole situation. He cannot do his work adequately until he has been given all the information to put him in the mental position of the inventor, and for this purpose he may require much detail which may seem irrelevant at first sight.

(3) This remark will also apply to the theory of the process. The inventor often has some hypothesis or some theoretical views, and this theory should be utilised as a means for broadening the scope of the protection by an attempt to anticipate future developments.

(4) A corollary to the theory will be the programme of future development. The ideal plan of campaign is for a few selected experiments to be made at this stage for the purpose of the patent specification if necessary. Such investigation may be regarded as scouting or prospecting, with the object of ascertaining the general character of the country, and the probable situation of the valuable fields. The actual surveying of these fields can be performed later during the nine months' period of protection, after which the country must be mapped out and the area of the invention defined so that the territory of the patentee does not encroach on that which is common ground, but yet includes as much of the valuable new field as possible.

(5) Lastly, we may consider the problem of generalisation and foreseeing infringements. This calls for a logical mental process in which the available materials are first analysed, so that a guiding principle may then be synthesised. There are certain artifices which may be employed, and certain types of development which recur.

For instance, a reagent must be considered not as a substance but as a member of a class. The difficulty often is to ascertain which is the class. Thus if phenol is used, can we expect cresol to behave similarly, and, if so, can we expect hydroxylic bodies in general to be useful, or shall we find that even dihydric phenols are excluded, and so on? The first point, therefore, is to compare every reagent with its equivalents, especially its homologues, or compounds containing elements from the same group of the periodic system. But we must be on our guard for exceptions, *e.g.*, even caustic soda and caustic potash are not always equivalent in organic fusions.

Again, if sulphuric acid is used, it may often be replaced by other reagents which are very different: we may have equivalence of function, not equivalence of composition. Thus sulphuric acid may be a sulphonating agent, or an electrolyte, or a condensing agent, or an acid, or a desiccating agent; the respective equivalents might then be oleum, or caustic soda, or zinc chloride, or hydrochloric acid, or calcium chloride: these reagents are not general equivalents for sulphuric acid, but only equivalents *quâ* some specific function. If we have sufficient data, we can use the logical methods of agreement and difference to place the reagent in its true class, when we can obviously extend the monopoly enormously. It is no use protecting the use of sulphuric acid if phosphoric acid or zinc chloride will serve the same purpose, and yet there are no iron-clad classes of chemical equivalents which will enable us to write down the possible variations unless we know the mechanism of the reaction. If, therefore, we cannot formulate any principle at all, we can only protect what we have tested by experiment.

Having considered equivalents for the reagents, we must next consider the operations involved. If we use a high-boiling solvent, for instance, we must remember not to leave an infringer free to use a low-boiling solvent under pressure. If we mix a raw material with a reagent, we must consider the possibility of generating the reagent *in situ*, *e.g.*, reactions with chlor-sulphonic acid might perhaps be done by treating the raw material simultaneously with sulphur trioxide and chlorine, and reactions with sulphuryl chloride by simultaneous treatment with sulphur dioxide and chlorine. Possible equivalence of single-stage and two-stage processes may thus be very important; another example is the manufacture of cyanogen bromide by treating potassium cyanide with a mixture of an acid, a bromide and a bromate instead of with bromine alone.

Again, the experimental data should be considered on physico-chemical lines, and in particular the possibilities of mass action should be studied.

It will be seen that the preparation of a provisional specification, if well done, opens out issues much wider than purely legal ones.

Although time and trouble are required in some cases, it will often be a much simpler process than that which has been described, and it may be unwise to delay filing a provisional application because the experimental work is incomplete.

In any case, it is an essentially scientific procedure, and it follows the broad lines laid down by scientific method. I have often thought that scientific method is the cinderella of the sciences: we all learn some branch of science, but many fail to realise the underlying principles. A study of patent law tends to emphasise the importance of method.

It will be seen that the procedure I have outlined begins by considering the data, first those previously known, and then those just ascertained. It classifies those data, and formulates hypotheses to correlate them, and it finally puts forward a generalisation which embraces them all. Such a statement is not only a summary of this chapter, but a succinct account of scientific method itself.

Now the great inventor probably does not work on the orderly lines of development which scientific method would prescribe. Inventive genius is bound up with the creative faculties, and creation involves an intuitive and non-logical element. But we are not all great creative geniuses, and it may help us in our research if we are forced for a moment to leave the atmosphere of inspiration, to come down to the solid ground of logical analysis; and we may find that our work will develop along new lines if we turn aside from the strictly technological path of advance, and make an ordered survey of the roads and by-ways around us.

Chapter IV

ACCURACY OF EXPERIMENTAL DATA AND THEORY IN PATENT SPECIFICATIONS: THE EXPERIMENTAL PROBLEM

The characteristic difficulty of chemical patenting in this country arises from the legal requirement that the complete specification shall contain an adequate and accurate description of the invention in all its phases. The difficulty of prediction in chemistry is so great that a novel reaction applied for example to a primary amine may not give any result when applied to some homologues, and yet it is necessary to extend the scope of protection to other primary amines, if possible. As the law heavily penalises any failure to comply with the conditions of accuracy, it will be appreciated that the problem of describing a chemical invention calls for unusual care. I propose to begin by explaining briefly the reason for these requirements of accuracy, and to indicate the criteria which the Courts apply to determine whether the specification fulfils them. I shall then discuss five possible ways in which a specification may be inadequate or inaccurate, and give examples from decided cases.

Finally, I shall consider the preparation of a complete specification in the light of these requirements, and I shall make some suggestions as to the experimental work which should be undertaken during the period of provisional protection to verify the generalisations made in the provisional specification, to develop the invention further and to lessen the danger of invalidity.

It has been already explained that a patent is a contract in which the monopoly is given to the patentee in return for a disclosure of his secret. This disclosure must be such that the public will enjoy the benefit of the invention after the expiration of the period of monopoly, otherwise the inventor has not fulfilled his obligation. Further, as a patent is given by the Crown rather as a privilege than as a matter of right, the patentee is bound to show the utmost good faith, and if he obtains his monopoly as the result of misstatements, he is considered to have deceived the Crown and to have invalidated his patent. It will be agreed that these principles are equitable if an inventor deliberately holds back part of his secret, or makes wrong statements, because clearly in such a case he is obtaining the monopoly under false pretences. But it often seems unfair that an inventor who has made a valuable invention, and *bona fide* described it in a specification to the best of his ability, should find his patent invalid because of some inaccuracy. In patents for machines the present system is perhaps fair enough, because if a man really wishes to make an honest disclosure of his invention, he can usually give enough information on which to base an adequate specification. It is not unfair that there should be some penalty for failure to give an adequate description, otherwise there would be too much temptation to prepare misleading specifications. But it may be argued that the present British law is too severe in chemical patents, in which with the best will in the world it is difficult to avoid making a mistake sometimes, and it is significant that one of the leading grounds of attack on the validity of chemical patents is usually that the specification is bad for "insufficiency of description."

Still, much can be done by thoughtful anticipation of the criticisms which may be made on the specification, and undoubtedly many of the weak specifications in the past have been produced because of imperfect collaboration between the patent agent and the inventor. Further, Section 9 of the 1919 Patents Act should prove valuable in that it allows a Court to give relief on valid claims of a patent, in spite of the invalidity of other claims, subject to certain provisos. The exact scope of this section is uncertain till it has been judicially construed. The dangers I shall discuss can be best overcome if the patent agent is prepared to make himself familiar with the chemical aspect of the invention in all its details, and if the chemist is prepared to co-operate by studying the problem and, if necessary, making some special experiments for the purpose. Above all, the utmost frankness must prevail between the patent agent and the chemist, and the inventor must be prepared to give a fair disclosure of his process to the public. If this is done, surprisingly wide protection can be obtained. It should be remembered, too, that the Courts take a common-sense view of the requirements, and that trivial errors are not fatal, especially when the specification is prepared in good faith. Further, there are possibilities of curing errors by amendment.

Let us consider the chief types of insufficiency and inaccuracy, of which five may be enumerated :

(1) Insufficiency in the sense of inadequacy.

(2) Inaccuracy in working directions or in data.

(3) Erroneous statements as to the advantages obtained by the invention.

(4) Mistakes in theory.

(5) Inclusion of inoperative examples, that is, examples which will not give a result. Thus, if we state that the invention relates to a new process of oxidising xylenes, and give para-xylene as an example, the patent will be invalid if we claim all the xylenes, and it is proved that ortho-xylene gives no result. This is the cardinal difficulty, since we meet it at every turn when we attempt to generalise the invention and to secure the widest protection possible.

Before discussing these five classes of errors in detail, it is well to state that the Court will usually only hold them fatal if they tend to mislead, or if they involve false suggestion.

This raises the preliminary point—to mislead whom? The answer used to be given by saying that specifications are addressed to the skilled workman, and that the Court in construing a specification must try to read it with the intelligence of a skilled workman, and see whether he would be misled, or whether he would find sufficient directions to enable him to perform the invention. Later decisions have established the principle that chemical patents are addressed to persons possessing chemical skill, to an extent varying with the subject matter. Thus a patent for decarbonising filaments in electric lamps has been held to be addressed to lamp makers, although in 1917 Lord Parker stated that he regarded the Just and Hanaman patent for the squirted tungsten filament as addressed to chemists also. A patent for improving the cyanide process of gold extraction has been held to be addressed to mining metallurgists, and it has been stated that the skilled workman in a dye case would be a chemist who had specialised in organic chemistry. Without pursuing the subject further we may say that chemical patents are addressed to those skilled in the art, who are presumed to exercise common-sense in following the instructions of the patentee.

The need for consideration of the type of person addressed will be clear if we reflect what surprising results might be obtained if a mining engineer tried to prepare aceto-acetic ester from the directions given by Gattermann, or if an organic chemist tried to operate a mine from the descriptions in the text-books.

It has been held, too, that the hypothetical person skilled in the art may be required to practice before he obtains the desired result, but on the other hand it is also settled that a specification must be complete without requiring the public to perform further research : a patentee must not set a problem and call it a description. It is difficult to decide exactly how much experiment the skilled person may be expected to perform, as a matter of routine ; all we can say here is that the specification must not call for the exercise of invention and research, though it may call for common-sense and experimental routine or practice.

The patentee is to be judged by the state of knowledge at the date of the patent, and he will not be penalised by difficulties which only arise at a later date. Thus in the incandescent mantle cases, it was found that serious trouble was met if the directions of the patent were followed with commercial zirconium salts for impregnating the mantles. It appeared, however, that at the date of the patent, zirconium salts were little used in commerce and the only available materials were pure.

The fact that as a result of the patent, zirconium salts became commercial products, which were frequently impure, could not invalidate the patent which worked well with the only zirconium salts available at the original date.

It further follows that the utility of the patent is not to be judged in the light of the advance which has occurred since the date of the invention—an advance which may be due to the efforts of the patentee himself. Provided that his invention does in fact give some beneficial result, it is not to be regarded as lacking in patentable utility merely because better results have been subsequently obtained. Thus in Badische v. Levinstein, the dyes made by coupling diazo compounds with naphthols according to the patentee's directions were far inferior to those subsequently made and sold, but this fact did not make his patent bad. Again, if a patentee claims a chemical body and its homologues, the requirements of the law will be met if some useful result is obtained with such homologues, and this need not necessarily be a competitive commercial result, provided that the original body does give a substantial novel and useful result. In the Andrews case, for instance, although the patentee claimed nitrogen peroxide or a bromine or chlorine oxidiser, nitrogen peroxide was the only one commercially used, and it was sufficient for him to show that some substantial result could in fact be obtained with each of the alternative oxidisers, although these were not used commercially. But if even a single one of these bodies had totally failed to give any result, the result would have been serious, as we shall see later.

We conclude therefore that the specification must contain an adequate and accurate disclosure of the invention and that everything claimed by the patentee must give some result though all variations need not give the best commercial result. Let us now examine the possibilities of failure in detail.

(1) First, then, let us consider the danger of insufficiency. As an example, we may take the Normann patent[1] of 1903 for hardening fats by hydrogenation in presence of nickel. The patent referred to the work of Sabatier and Senderens on the hydrogenation of hydrocarbons by passing the vapour mixed with hydrogen over a catalytic metal such as nickel, and stated that it had been discovered that unsaturated fatty acids or glycerides could easily be hydrogenated by this method. It then added that the fat or fatty acid could be used in the liquid condition. The working directions were as follows:—

"For instance, if fine nickel powder obtained by reduction in hydrogen, is added to chemically pure oleic acid, then the latter heated over an oil-bath, and a strong current of hydrogen is caused to pass through it for a sufficient length of time, the oleic acid may be completely converted into stearic

(1) 30 R.P.C. 297.

acid. The quantity of the nickel thus added and the temperature are immaterial and will only effect the duration of the process."

The Court had to decide whether in 1903 a skilled chemist could have hydrogenated oleic acid by following these directions, without the necessity of further invention. It will be seen that this is a decision which can only be given upon evidence by skilled chemists. The Judge stated: "I come to the conclusion upon the evidence that Normann's process will not produce the result he claims for it unless the fine nickel powder is obtained in a special manner not indicated by the specification, or unless a very strong current of hydrogen is used and mechanical stirring or some other special device is resorted to." He added: "To say that a direction to pass a strong current of hydrogen through a mixture of fine nickel powder and oleic acid, in order to expose the acid to the action of hydrogen and the catalytic substance, connotes the resort to every device known to science for making the exposure as complete or as frequent as possible, seems to me extravagant." The patent was therefore held to be invalid for insufficiency, since though Normann had made a most important discovery he had not given the public any practical means of taking advantage of it.

On the other hand, Tiemann's patent for pseudo-ionone and ionone was sustained.[1] The specifica-

(1) 16 R.P.C. 561.

tion contained a direction to remove unchanged acetone, citral, etc., by steam distillation after the condensation. The witnesses against the patent, relying on the absence of a sharp end-point, steamed until most of the pseudo-ionone had been destroyed. Although the specification gave no explicit warning of this, the Court held that a statement as to " ready removal of citral, etc.," implied short treatment, and the patent was held valid.

Another example of insufficiency is found in a case decided by the Privy Council[1] on an appeal in respect of a Western Australian patent of 1894. This covered the use of cyanogen bromide in the cyanide process for the extraction of gold, for the purpose of increasing the solvent action. It was held that this specification was addressed to persons engaged in gold mining having a knowledge of the existing cyanide process and a sufficient knowledge of chemistry to understand and work the new process. Their Lordships observed that such persons would assume that the new process using potassium cyanide plus cyanogen bromide was to be worked in the same way as the old MacArthur-Forrest process using potassium cyanide alone. Now, in practice in 1894, that process was always worked with a large amount of caustic alkali to combine with acid which would destroy the cyanide. But caustic alkali was fatal to cyanogen

(1) 1919; 36 R.P.C. 95.

bromide, and if the old process were followed with the new solvent, the cyanogen bromide would be destroyed. The patentee gave no warning to modify existing practice by avoiding alkali, and the specification was therefore insufficient. The Court concluded that the real secret of success was to let the cyanogen bromide react on the material in the form of slimes, and then to protect the potassium cyanide by adding the alkali some time after the operation had begun. This was a complete reversal of ordinary practice in 1894, and the patent was invalid because the patentee had failed to give the necessary conditions of success.

A striking case was that of Badische v. Usines du Rhone[1] in which the patent covered heating rhodamines in an autoclave with alkylating reagents. It was shown at the trial that an iron autoclave was essential, since the iron combined with hydrochloric acid liberated in the reaction. An enamelled autoclave did not give the result. The patentee did not state that the autoclave must be of iron and the patent was held invalid for insufficiency of description.

These cases therefore clearly illustrate the proposition that a patent must describe the invention adequately enough to enable a skilled person to obtain some beneficial result by following the directions of the patentee.

(2) Insufficiency is a negative defect, arising

(1) 1898; 15 R.P.C. 359.

when detail is lacking. Inaccuracy is a positive defect, which is also very dangerous. It often results from the inclusion in the specification of probable alternative reagents or processes whose suitability has not been experimentally verified; sometimes it is due to ambiguity of language.

In the Vidal dye case,[1] the specification stated that black dyes were obtained by heating diaminophenol with sulphur either with or without sodium sulphide. It stated further that dinitrophenol could be used, but that in this case it was " necessary " to add the sodium sulphide; these processes were successful. But the specification also stated that dinitronaphthols could be used, and that in this case also it was " useful " to add sodium sulphide. The evidence showed that an explosion was likely to result if dinitronaphthols were heated with sulphur in the absence of sodium sulphide. Yet the patentee by employing the word " useful " clearly left himself free to claim protection for the reaction in which sodium sulphide was omitted, since the word " useful " was in sharp distinction to the word " necessary " employed in describing the process for the dinitrophenols. Accordingly the patentee was held to have implied that the process would work with the dinitronaphthols without sodium sulphide, and this inaccuracy was held by the Court of Appeal to invalidate the patent.

(1) 1912; 29 R.P.C. 245.

Another illustration is afforded by the Just and Hanaman patent[1] for the manufacture of the squirted tungsten filament. The process consisted in making a paste of tungsten or certain of its compounds with a suitable binder, squirting filaments, carbonising them and then decarbonising to metallic tungsten by heating in an atmosphere of steam and hydrogen. The specification said:— "For the manufacture of filaments of this kind finely divided tungsten or tungsten compounds, such as tungstite, tungstic acid or tungstic sulphide, is mixed with an organic binding medium such as collodion or a solution of cellulose in chloride of zinc, or cupreous ammonia oxide or the like. . ." The evidence clearly proved that the cupreous ammonia binder failed with metallic tungsten, though it succeeded with tungstic oxide.

The defendants argued that this sentence must be read distributively, that the patentee had represented that each of the binders could be used with tungsten and its compounds and that this inaccuracy was fatal. The patentees contended that at the date of the patent any chemist skilled in the filament and artificial silk industries would have known that cupreous ammonia could not be used in contact with metals, and therefore as the patent provided alternative binders, a skilled person would have tried cupreous ammonia with tungstic oxide and avoided it with tungsten.

(1) 1917; 34 R.P.C. 369.

The House of Lords accepted this favourable interpretation of the patent by a three to two majority, so that the patent was upheld. But the case is a good illustration of the danger of inaccuracy nevertheless.

Moreover, if the specification is not ambiguous and clearly directs the skilled workman to do something which will be useless, it will then not avail the patentee to say that any skilled workman would see the mistake. Thus in an old dye case, the patent stated that aniline could be treated with arsenic acid either with or without heat. The patent was held invalid because the cold process was a failure, in spite of evidence which showed that a skilled person would reject the proposal to perform the reaction without heat: the patentee had definitely protected it and must take the consequences of his error.

The most dangerous inaccuracies are those which imply a false suggestion by the patentee or those which would mislead the public. The Courts are reluctant to upset patents for minor errors; thus the description of a 93 per cent. yield as "theoretical" was held not to make the patent invalid.

The two dangers, insufficiency and inaccuracy, tend in practice to shade into one another. Thus, in the Normann case, one of the points raised by the defence was that the specification stated that commercial gas mixtures containing hydrogen could be used for fat hardening instead of pure hydrogen. The Judge did not find it necessary to decide the point, but if this defence had succeeded, it would have been because the statement was either inaccurate, in that such commercial gas mixtures would poison the catalyst, or insufficient, because the patentee had not warned the public of this difficulty nor shown means to overcome it.

(3) The specification may contain errors in theory.

These are, fortunately, not so serious, except in so far as they may lead the patentee to claim the wrong thing. But, in themselves, errors in theory do not invalidate a patent, provided the invention is described so that practical results can be obtained in accordance with the statements of the patentee.

In Z. Lamp Works v. Marples, Leach & Co.,[1] the patent was for the treatment of tungsten filaments by the use of phospham. The patentee referred to the release of nitrogen from the phospham. In practice it was shown that absolutely dry phospham would not be effective, but that such a body had never been described in the literature. In presence of the slightest trace of water, phosphamide was formed, so that even if pure phospham were obtained, it would at once give phosphamide under the conditions prevailing in a lamp works. Such a body gave off ammonia, not free nitrogen, but in practice successful results

(1) 1910; 27 R.P.C. 737.

were obtained, and it was held that such errors in theory would not mislead the lamp makers to whom the specification was held to be addressed.

A further point was that the result of the use of phospham was to diminish the blackening of the glass which occurred during use of the lamp. It was quite clear that the patentee thought that this blackening was caused by carbon volatilised from the filament and that his process prevented blackening by removing the carbon. The evidence showed, however, that the deposit on the bulb was tungsten. Nevertheless the fact remained that lamps made with phospham did not blacken, that the blackening was in some way connected with the presence of carbon and that the phospham treatment removed some carbon. Hence the patented process removed injurious carbon even if it did not remove all carbon present chemically. Thus the patentee's views of the theory did not affect the practical importance of his process nor lessen the value of his teaching that the phospham treatment prevented blackening. The patent was therefore held valid in spite of the various errors in theory. Lord Justice Moulton, as he then was, said:

"The patentee's obligation is not to be omniscient; the patentee's obligation is to put the public in the possession of his invention and if he does that *bona fide* in such a way that they know its advantages practically and they can obtain those advantages practically, the fact that he has formed an erroneous view in theory of that which procures those advantages, or the state of things in which those advantages occur, does not in my opinion, militate against him. He does not thereby deceive the Crown in such a sense as to militate against the validity of the grant.''

On the other hand, if the error in theory is so vital that it leads the public astray in practice, it may be fatal. Thus, in Monnet v. Beck,[1] the patent stated that bodies termed anisolines could be prepared from rhodamines by two steps. The first step consisted in heating the rhodamine hydrochloride with potash to yield a potassium salt, and the second step consisted in treating the potassium salt with an alkyl halide. The defendants showed that the patentee's theory was absolutely incorrect in that the so-called potassium salt was non-existent, and that the first step of the process was useless. The Court held that here the error in theory was fatal since the whole patent was based on the preparation of this non-existent potassium salt, and the public were misled into thinking that two steps were necessary for the manufacture of anisolines whereas, in fact, the first step was utterly useless. This was an exceptional case, and in general it is accepted that errors in theory are not fatal. At the same time, it is very important to ascertain the correct theory at the earliest moment, because without it, the patent

(1) 1897; 14 R.P.C. 777.

may be valid, but yet of much more limited scope than would otherwise be possible. Thorough protection is much easier if the patent agent is in possession of an accurate theory, and often errors in fact can be avoided by a knowledge of theory.

(4) The patent may contain errors with regard to the results obtained by the patented process.

Usually an inventor desires to set forth in the specification the advantages he obtains by his invention. This is not usually required by the law, unless the advantages actually serve to define the scope of the invention. If a process is accurately described, and its application merely indicated, the Court will consider what advantages it possesses by the aid of expert evidence. But if the patentee inserts laudatory and inaccurate statements of the alleged advantages he obtains, he may invalidate his patent. In chapter two we considered the Alsop patent for treating flour with the gases produced by passing air through a flaming arc, and we saw that the Court held it invalid because of the erroneous statement that the protein content of the flour was thereby increased. Another example is the Just process for drying milk by delivering it between two rollers which were internally heated to about 270° F. These rollers rotated and delivered the milk in the form of a thin dried coating which was scraped off to yield the dry milk powder. The patentee stated that the milk solids were obtained in an unchanged form and that milk of excellent quality could be obtained by the addition of hot water. The evidence showed that the casein was changed by the process in such a way that on addition of hot water, the milk rapidly lost its homogeneity. The House of Lords accordingly held the patent invalid, because the patentee had alleged that certain results could be obtained, which, in fact, were not obtained by using his process.

These cases clearly show the danger of making exaggerated statements as to the advantages of the invention.

(5) There is the danger that the patent may claim a class of chemical individuals as reagents, and that although the examples specified will work, some of the unspecified members of the class will not work. Suppose the patent claims alkaline substances broadly, and gives caustic soda and lime as examples. If it is shown that potash or baryta are useless, such a claim will be invalid. This is one of the greatest difficulties experienced in chemical patenting, especially with regard to dyes and drugs, where it is so difficult to predict whether any results can be obtained with the homologues or derivatives of any given reagent which has proved successful. The problem overlaps that of providing against the dangers of insufficiency and inaccuracy, but it may be illustrated further by two examples.

In the Normann case, the patentee described his process with reference to the hydrogenation of oleic acid by a nickel catalyst, but he claimed unsaturated acids or glycerides. The Judge stated that in his opinion the patent broadly covered all unsaturated acids and glycerides, and that it would be invalid if the process failed for any acid or glyceride, with any of the specified catalysts, though he added that a single exception might not be fatal if it were not of commercial importance.

On the other hand, in Leonhardt v. Kalle,[1] the patent dealt with the production of a fast yellow dye by the treatment of *p.* nitro-toluene sulphonic acid with alkali and an oxidisable substance. The patentee mentioned about a dozen oxidisable substances, and gave six detailed examples of quantities of reagents. The defendants alleged that the patent did not give quantities and details for other oxidisable substances, nor any theory as to the data, and that in particular no details were given as to ferrous sulphate which they alleged presented difficulties. They also added that the patent did not mention the shades of the dyes obtained by all the variations. The Judge made the common-sense remark that it would be impossible to write chemical specifications if objections of this kind were upheld. It was decided that a competent chemist could, in fact, obtain satisfactory results with other oxidisable substances than those specifically mentioned, including ferrous sulphate, if he worked on the lines indicated by the patent.

(1) 1895; 12 R.P.C. 103.

There is some ground for hoping that the common-sense of the Courts will induce them to exhibit reasonable leniency in chemical cases in the future, for in Berlin Anilin Fabrik v. Levinstein in 1914 the Court said : " To require the patentee in a chemical case to define rigidly the limits of variation of time or of proportions sufficient to ensure his result, would end in invalidating a large proportion of the patents which protect most valuable and meritorious chemical discoveries." Yet in Vidal v. Levinstein the Court held that a patent was invalid because it stated that black dyes could be obtained by heating diaminonaphthols with sulphur, without giving any directions as to time and quantity. The statement was true, but inadequate, because if the skilled chemist treated the diaminonaphthols by the same process as that described for the homologous diaminophenols, no useful result was obtained and it was, in fact, necessary to heat to a higher temperature. It is still necessary therefore to be very careful in making generic statements about classes of reagents unless it is quite certain that all members of the class can be used to give some result, without calling on the skilled chemist to exercise invention in using such bodies. On the other hand, it would be very unfair if an inventor discovered that aniline gave a certain result, and could not obtain protection for methyl-aniline, if this would also serve the purpose.

We must now consider how this problem, and others we have discussed, is best treated in practice. I must again emphasise that the only possible solution lies in the fullest collaboration between the patent agent and the research department. Much can be done by legal skill in making the best use of a given set of facts, and in preparing separate claims for classes and sub-classes to obtain the protection of a restricted claim if a wider claim cannot be sustained.

More still can be done if the research department is prepared to co-operate in making experiments to verify the accuracy of the data and generalisations contained in the provisional specification, and in short, to devote a certain amount of research work to the problem of strengthening the patent. After all, the duties of the chemical department are not confined to the discovery of novel processes. They include works control, and often extend to such subjects as settling disputes on quality between buyer and seller. If their duties cover development work, factory control, and commercial or business problems, it is not unreasonable to suggest that some little time should be devoted to the patent situation, which is of very great importance from the point of view of the general business policy of the firm. It may be added, too, that the work undertaken for patent purposes will at all events lead to further knowledge of the chemistry of the process, and it will therefore be of direct value for its own sake, which cannot be said of much of the chemical control which has to be done for business reasons.

Let us consider the procedure which should be adopted in the development of a chemical invention which is being patented, first in general, and then with reference to the hypothetical invention we considered in the last chapter.

What usually happens is something like this: A provisional specification is filed, and the patent agent tells the inventor to consult him again if he makes any great improvement, but that otherwise it will be necessary to file a complete specification in nine months. The patent agent sends out a warning and finally the inventor re-appears with instructions to prepare the complete specification and include in it the improvements he has made.

This procedure is often satisfactory for mechanical inventions, but in chemical cases it often does not give good results because in practice the experimental work on a new process is directed naturally towards improving the yield or making some other technological improvement. This course of development is not the same as that which the invention will take in the hands of a competitor who will deliberately experiment to seek out alternatives or evasions. Now it is unsafe to cover such alternatives or evasions in the specification, unless we are reasonably sure that they are practicable, so that experimental work is clearly required to verify these possibilities, which have been suggested by a mental analysis of the invention. Again, a sound grasp of theory is most important since it enables the writer of the specification to go much further with safety than he could do otherwise, and yet in the rough and tumble of practical development of a new process, research on theory is likely to be neglected in favour of study of the detailed conditions of practical success. These are, of course, essential, but I suggest that the other work is also necessary if the research department is to reap the full reward of its endeavours. The time and expense devoted to patents may be regarded as an insurance premium to protect the results of research.

It is hardly possible to lay down detailed rules for the experimental study of a patent application, and if both patent agent and inventor fully realise how vital this work is in chemical patents, they will be able to deal with each invention on its merits. In simple cases very little trouble may be required, and the works may possess all the necessary data already. In more complex cases we may consider a few suggestions without covering the subject exhaustively.

In general, it may be said that when a provisional specification has been filed, the patent agent should outline to the inventor the possible sources of legal difficulty if the patent had to be completed at once, and they should discuss the experiments which are necessary. In the course of the period of provisional protection, any important new discoveries can be protected by so-called cognate provisional specifications which can be merged with the original provisional into a single complete specification. Finally, a full discussion should take place before the complete specification is prepared and any outstanding difficulties cleared up by study or experiment.

Some of the chief lines to which the attention of the chemist should be directed are as follows, but these are only to be regarded as suggestions. It is impossible here to treat the subject fully, although I regret that I cannot refer the reader to any publication containing an adequate treatment of this important question.

(1) Any examples in the provisional should be verified on the commercial scale. The influence of agitation, of thermal conditions, and of impurities, to take only instances, is so great that the directions which lead to success in the laboratory may be hopelessly insufficient for large scale working, even after considerable practice by a skilled person. The specification cannot give a hundred page monograph with full size blueprints of the plant, but it must at least see that the essential conditions of success are fairly indicated.

(2) Care should also be taken that *all* the vital conditions are enumerated, and this can best be

done by repeating the example under changed conditions to eliminate the possibility of unknown factors. No better example can be given than that of the rhodamine case in which the statement as to heating the mixture in an autoclave was correct, if an iron autoclave were used; but the patentee had overlooked an unknown condition of success, namely, that the iron of the autoclave entered into the chemical reaction. This can be summarised by saying that the reaction must be studied so that the conditions of success can be enumerated exhaustively.

(3) It will be necessary to verify the accuracy of the inductive reasoning which led to the generalisations contained in the provisional specification. If an aldehyde is used in a certain condensation, it will be necessary to satisfy ourselves that some result can be obtained with all aldehydes, unless it is possible to give some criterion by which the operative and inoperative aldehydes can be readily distinguished. For instance, if we ascertained that solubility in water was an essential element of success, we might thus exclude the inoperative aldehydes.

The specification need not mention by name all the operative members of the class, even though there are some inoperative members, provided that the document gives indications for discrimination. This is a principle which must be applied very cautiously, but it is illustrated by the case of

Thermit v. Weldite, in which the patent dealt with aluminothermic reduction and the Court said that the claim "did not extend to all oxides sulphides or chlorides, but only to those which are capable of being reduced by aluminium under the conditions described in the Specification. There are certain compounds in reference to which a chemist could say, from thermal data readily accessible, whether they would or would not come within the above description. There are others which are on the border line and it might be necessary as to those to try by experiment, but the experiment would be merely for the purpose of ascertaining whether a particular compound answers a certain description sufficiently indicated in the Specification; and the fact that in certain cases an experiment of that kind might be necessary ought not in my opinion to affect the validity of the Patent."

Beyond this, as the Vidal case shows, if we mention other substances we must endeavour to indicate the variations which will be necessary in the process, *e.g.*, that diaminonaphthols require treatment at another temperature than diaminophenols.

Such verification of the applicability of a specific reaction to members of a class can be performed often by very carefully selecting a few crucial experiments, each one of which contributes some additional information.

The patent agent must also use the greatest care in foreseeing and preventing attacks of this kind. In many cases it may be possible to define the invention by giving criteria of applicability of reagents and by giving illustrative examples of the kind of reagent which is excluded as unsuitable, as well as the kind of reagent which is included as suitable.

In very important cases it may prove advisable to split the patent into two, so that one contains subject-matter which is limited but certain, while the other contains the valuable but more problematical extensions to whole classes of reagents.

Even after the patent has been granted, it may be necessary to follow up the combined legal and chemical study of the problem, because fresh improvements can be protected by patents or patents of addition, and errors may often be removed by amendment, which is allowed in the form of explanation, correction or disclaimer (*i.e.*, cancellation of an inoperative example) provided that the amendment does not make the scope of the patent substantially larger or different.

(4) During the period of provisional protection the theory should be explored to serve as an aid in the analysis of the invention and as a basis for further induction and improvement. For instance, suppose a reaction with aqueous ammonia is accelerated enormously by the addition of copper sulphate. We should ascertain whether this is acting as a catalyst, in which case other catalysts

should be found, or whether it is precipitating traces of acetylene present in the ammonia and thus removing a possible anti-catalyst, in which case an entirely different set of equivalent measures could be found to give the same result. This point need not be elaborated because no one but a sheer empiricist would seriously deny the value of theory, and even the empiricist would find that a patent specification gives more protection if the theory is known to the inventor.

Let us conclude by a brief illustration of the general nature of the experiments required in the development of the provisional specification discussed in the last chapter, which was based on the discovery that thio-urea accelerates the vulcanisation of rubber, and was drafted to protect a wider field, especially amines in general.

(1) Operation on a large scale. (*a*) Does it give good results with various kinds of raw rubber, highly resinous and otherwise, and does it work with synthetic rubber which is known to behave in a peculiar manner with vulcanising agents? (*b*) Ebonite is made by heating rubber to a high temperature with a large percentage of sulphur. The reaction is exothermic and as the thermal conductivity of rubber is very low, it is found in practice that large pieces of ebonite must be vulcanised very slowly indeed; otherwise the heat of reaction raises the temperature of the mass so high that excess heat cannot be removed by con-

duction so that burning takes place. If therefore our efficient accelerator is used, must we warn the public that a lower temperature of vulcanisation may possibly be essential with ebonite, other conditions remaining the same?

(2) We should satisfy ourselves that the acceleration is not due to impurities in the thio-urea as in the phospham case, or to reaction products of thio-urea with sulphur or rubber.

(3) In applying the invention to new bodies we should find it wiser to divide the original application into two or more patents, so that one covers thio-urea and its homologues, and another covers the wide field broadly. The experiments to be tried might include—

(*a*) urea;

(*b*) xanthates and other sulphur compounds;

(*c*) substituted ureas and pseudo-ureas;

(*d*) aliphatic amines;

(*e*) aromatic amines, primary, secondary and tertiary;

(*f*) inorganic compounds plus organic solvents.

Other experiments would also be made and perhaps we might discover a criterion of applicability of organic bases, as the Bayer Company did in selecting bases having a dissociation-constant in aqueous solution of more than 1×10^{-8}.

I do not wish to press the details of this case, because it is one which might be a master patent and would require an abnormal amount of attention. What I do wish to make clear is that the difficult problems considered in this chapter can only be satisfactorily solved if there is the fullest co-operation between the patent agent and the chemist.

When discussing infringement it was pointed out that the patent must be wide enough to prevent rivals from obtaining the benefits of the invention, as a result of a deliberate study to ascertain what the patentee has failed to protect. It is equally true that the rival will also attempt to show that the patent is invalid for insufficiency and inaccuracy, by performing deliberate research to find some fatal misstatement. This is the commonest objection raised against a chemical patent and if the patent is to stand the fire of such hostile attack, it is quite clear that such objections ought to be forestalled when the specification is being drafted. Hitherto, enough attention has not been devoted to this danger, and I hope that this discussion will show the necessity of the co-operation on which I have insisted so often. I am confident that chemical patents would be much stronger if such a policy were consistently followed.

Chapter V

VALIDITY OF PATENTS: THE HISTORICAL PROBLEM

In the previous chapters we have considered the special problems which arise in chemical patents through the fact that prevision is so difficult in chemistry and that analogy often breaks down as a guide in determining the course of an untried reaction. We shall now see that in one of the chief sources of weakness of a patent, namely, the possibility of its invalidity for lack of novelty or invention, this difficulty of prevision much favours the patentee in that it enormously extends the potential field of valid patents. Chemical industry is, in fact, prolific in patentable inventions, and more of them would be protected by patents if this question of patentability were more generally understood by chemists. It has been my experience that many chemists resemble the man whom Molière described as being surprised at learning that he spoke prose every day: they make inventions without knowing it, and do not realise their patentability. Sometimes they consider that the improvement they have introduced is too trivial to be capable of protection; sometimes they fear that it is impossible to monopolise the results of the discovery of a new reaction. In fact, we may say that while it is appreciated that patents can be obtained for great discoveries, such as viscose or saccharine manufacture, it is not generally appreciated that patents can often be obtained for choice of conditions leading to a better yield in a known process, or for the application of a catalytic reaction to a new class of bodies. Too much attention is fixed on the idea of an invention as a heaven-sent flash of inspiration, as something uncommon and incalculable, and too little thought is given to the fact that chemical research almost inevitably results in improvements, which in actual fact are inventions, patentable according to British law. The research chemist will assent to the proposition that the usual result of research work is the discovery of improvements in manufacturing processes, either in principle or in detail. I propose to demonstrate the further proposition that the British patent system broadly provides for the protection of almost any substantial improvement which complies with the condition of patentable novelty. I shall further indicate that this condition of novelty may be regarded as less stringent in chemical than in mechanical cases.

The reason for the requirement of novelty need not detain us, as it will be remembered that the Statute of Monopolies was passed in order to abolish monopolies in *known* manufactures; it allowed the grant of patents to the true and first inventor of any manner of new manufacture which others in this realm shall not use. Novelty is thus an essential condition of the grant. The inventor can only pay the price for his monopoly by putting the public in possession of something which was not in their possession before; the information he imparts must not be public property.

It follows, therefore, that it is irrelevant to consider the evolution of the invention in the mind of the patentee. If patents were designed solely to reward brilliance or assiduity, the inventor who re-discovered a process, in ignorance of the work of his predecessors, might well argue that he had exercised more skill and diligence than another inventor who produced some novel but relatively minor improvement. But the main object of the patent system is to encourage industry, and therefore the fundamental condition which justifies the grant of a monopoly is that the inventor must add to the knowledge of the public and must be judged by the extent of such addition only, irrespective of the work which he himself had to perform in repeating results unknown to him but already available to the public.

The standard of comparison is therefore the knowledge which is public property. The determination of novelty involves the historical problem of determining the extent of public knowledge, as a preliminary. In other words, we must begin by ascertaining the "state of the art." In so doing we shall defer considering prior use of the invention, especially prior secret use, and merely remark that prior public use, *i.e.*, use in public, is regarded in much the same light as publication of the invention. Once an invention has been publicly used, it is considered to have fallen into the public domain, and the inventor is no longer able to justify his monopoly on the ground that he can add something to public knowledge.

The state of the art mainly depends then on prior publication. Public use of the invention will constitute publication, and so will disclosure of the invention to persons not under the bond of secrecy, *e.g.*, disclosure to trade rivals. But usually publication is proved by printed documents. It is not every document which is admissible, but if, for example, the document has been laid open to public inspection on the shelves of the Patent Office Library in London, before the date of the patent application, it is regarded as a publication, and it is not necessary to prove that anyone did actually read it. Documents in French or German are effective publications. But publication abroad does not invalidate a patent, unless it can be proved that the knowledge reached the public in this country: an invention need only be novel "within this realm."

It will be seen, therefore, that the state of the art is chiefly determined by collecting all the relevant literature which was available in this country before the date of the patent. Fortunately chemical literature is well indexed, although there are striking differences, *e.g.*, the patent and scientific literature on dyestuffs is much better classified than that on paper-making or other industries in which chemistry plays a less dominant part. It will be appreciated that searching is an empirical art and not a science, and that it is essentially a tentative process which can hardly be truly exhaustive. Still the chemist can usually obtain reasonable assurance of the novelty of his invention, as the possible sources of anticipation are more or less known, whereas mechanical patents can often be anticipated by analogous devices indexed in the most unlikely places. It is usually easier to determine the novelty of a new drug than of a simple everyday article such as a saucepan lid, because the latter may be anticipated by a publication in so many quarters.

If a firm is pursuing a consistent patent policy, it usually follows the state of the art very minutely, so that the inventor may actually start out from the standard set by the law. But in practice it often happens that some out-of-the-way publication approaches still nearer to the invention than anything which was known to the inventor. Nevertheless this publication forms part of the state of the art, and it is therefore fortunate that the

Courts do not consider that an invention has been anticipated unless the prior document comes very close indeed to the invention, and contains an adequate disclosure of it, instead of a mere hint. Let us consider the comparison between a patented process and the prior processes disclosed by the publications which constitute the state of the art.

Our problem is to determine whether the new process is patentably novel, and it may be divided into two further problems :—

(1) A qualitative comparison of the old and new processes to determine whether they are different, or identical ; and

(2) if they differ qualitatively, a quantitative comparison to determine whether the difference is substantial enough to deserve a monopoly for 16 years.

It may simplify further discussion if I mention that a process which differs qualitatively from the state of the art is said to possess " novelty," and that if it differs quantitatively to such an extent as to justify patentability it is said to possess " subject-matter." Logically, these terms shade into each other, but in practice it is convenient to consider them separately. Novelty, then, implies a qualitative difference between the patented process and the state of the art. Subject-matter implies that this difference has been quantitatively considered, and that it is regarded as sufficiently substantial to make the patent valid. Thus, a proposal to make hammer-heads of manganese instead of iron might be novel, but would probably be utterly without subject-matter, as the relative advantages and disadvantages of the two metals are well known and obvious. But a proposal to use manganese instead of iron as a catalyst for a particular reaction might be novel and also might possess ample subject-matter, because catalytic phenomena are so recondite.

Let us consider novelty first, because it is a pre-requisite of subject-matter, and the qualitative determination of the existence of a difference is a simpler problem than the appraisal of the amount of that difference, which is necessary to decide on subject-matter.

The following points are important:

(1) There is a distinction between discovery and invention.

(2) Commercial astuteness is not invention.

(3) Very subtle differences between new and old will establish novelty if they change failure into success.

(4) Novelty is not negatived by mere hints or adumbrations of the process, and a combination of known steps may be novel.

Let us consider these points more fully:

(1) A process is not novel unless it is more than a mere discovery. Judges have often commented on the distinction between discovery and invention. When Galvani discovered the effect of the electric

current on a frog's leg, as Lord Lindley observed,[1] "he made a great discovery, but no patentable invention. Again, a man who observes that a known machine can produce effects which no one knew could be produced by it before may make a great and useful discovery, but if he does no more his discovery is not a patentable invention. He has added nothing but knowledge to what previously existed. A patentee must do something more; he must make some addition, not only to knowledge, but to previously known inventions and must use his knowledge and ingenuity so as to produce either a new and useful thing or result, or a new method of producing an old thing or result."

It follows therefore that the discovery of a new chemical law cannot be the subject of a patent, but a new process based on such a law can be patented. This first point lies at the root of the old saying that a principle cannot be patented. I venture to think that it is safer for the layman to forget this dictum altogether since the word "principle" is ambiguous and it is true in another sense to say that every broad patent really protects a principle, *i.e.*, a generalisation.

It follows further that a man cannot have a patent merely for discovering the theory of a known process, or for discovering unsuspected advantages in a known process, though often such a discovery will enable him to prescribe novel

(1) Lane Fox v. Kensington &c. (1892.) 9 R.P.C. 221,413.

conditions defining a patentable process. In Patterson v. Gas Light & Coke Co. (1875), Lord Blackburn said: " The appellant appears, from what he says in his specification, to be of opinion that if he first discovered the theory and reason of that which had before been done empirically, he is entitled to a patent. I need hardly point out that this is a mistake; if by reason of knowing the theory he is enabled to make some improvements, he may take out a patent for those improvements, but he cannot take out a patent to prevent others using what they had used before, though empirically."

A modern case on these lines is Partington v. Hartlepools Pulp & Paper Co. (1895),[1] in which the patent claimed " the improvements in the treatment of ' sulphite pulp ' used in the manufacture of paper and the like from wood, consisting in the application or addition to such ' sulphite pulp ' during the process of manufacture of petroleum or paraffin oil or other suitable mineral hydrocarbon oils for the purpose of removing or preventing the formation of partly insoluble specks of a pitchy or resinous nature in the said pulp and for preventing the partial coating or fouling of the vessels or other parts of the machinery therewith." It was proved that before the date of the patent, paraffin had been used in such machines, and that decided advantages were

(1) 12 R.P.C. 295.

obtained, *e.g.*, that the stuff flowed more easily. But the paraffin did not give the same results as those of the patentee, which were only possible if the machinery were thoroughly cleaned. The patentee had therefore made a discovery, namely, that paraffin only exerted its best results when the machines were first thoroughly cleaned, but this discovery was held not to be a patentable invention, since if the patent were sustained, it would prevent those who had been using paraffin before, from cleaning their machines. The Court quoted with approval, that this was a very valuable "working caution and direction," but nothing more. "It may be a direction and instruction of the greatest possible value and utility, but it is utterly impossible to make such a direction and instruction, however valuable, the subject of a patent. It does not differ in principle, though it does differ enormously in scale, from a cook's instructions and directions as to the best means of manipulating articles of food. . . . No one has a right to prevent a workman from using care to keep his tools in the most efficient state. No one has a right to prevent a manufacturer from cleansing his vessels and throwing away the useless contents whenever he likes, or to ask him his motives or intentions in doing so."

A good hypothetical case as to discovery of advantages can be taken from the history of the blast furnace. It has been pointed out that the effect of the hot blast (Neilson) or the dry blast (Gayley) is much greater than would be expected by thermal calculations based on the knowledge of the time. But if suggestions had been made to use a hot blast or a dry blast, even if they had not been tried, it would not have been patentable to prove that these suggestions were unexpectedly beneficial in practice, unless such a patent disclosed additional valuable details of practical operation, *e.g.*, Gayley's patent specified cooling the air to O°C to dry it. Patentable improvements are, of course, often possible in cases of this kind.

(2) Commercial astuteness and even industrial pertinacity differ from invention, though they may accompany it.

In Acetylene Illuminating Co. Ltd. v. United Alkali Co. Ltd. (1902),[1] the Willson patent for making calcium carbide was held invalid. Vaughan Williams, L.J., said " the only other suggestion that is made is that the former knowledge was the result of mere laboratory processes; that it would be a very expensive result to arrive at, and that up to that time there was nothing to show that calcium carbide could be produced for commercial purposes . . . there must be a new invention; there must be a new result or a new process and if neither of these are included it is not sufficient to say, ' in the case of my new process, which involves nothing that is scientifically new at all, I first

(1) 19 R.P.C. 213; 20 R.P.C. 161; 22 R.P.C. 145.

showed the world how this could be done on a large scale in the way stated.' "

But a word of caution is necessary because often when an experiment of purely philosophical interest is developed to give a process which works on the large scale, points of patentable merit are in fact discovered. The dictum only says that *mere* large scale operation is not patentable.

Again, in Gayley's patent, when the Court was considering a petition for prolongation, it did not pronounce on validity, but made the following interesting comment, which is of more general application.

"I do not for a moment dispute that the patentee has been a public benefactor, but it appears to me that the benefit he has conferred on the public is in the energy and perseverance which he displayed in urging his Company to give the refrigerating process a trial quite as much as, if not more than, anything which he disclosed by his specification."

(3) Very slight differences establish novelty if they prove of crucial importance. Variations in reagents, conditions such as temperature or pressure, or even sequence of operations, may all constitute novelty. Two subtle examples may be given.

In Leonhardt v. Kalle (1894),[1] the patent covered the production of an alkali-fast yellow-

(1) 11 R.P.C. 534; 12 R.P.C. 103, 306.

brown dye from *p.* nitrotoluene-sulphonic acid. It was known that this body gave a yellow dye on heating with alkali, and that treatment of this dye with zinc dust gave a leuco body. The patentee showed that by stopping the reaction at an intermediate stage, *e.g.*, using a very mild reducing agent, it was possible to obtain an alkali-fast dye. Even though the old reducing agent, zinc dust, could be used to obtain the new body, once the patentee had demonstrated its existence, it was held that the new process was clearly patentable, and not anticipated by the fact that it might have been formed, *though never isolated*, in the old process of reducing to the leuco body. In effect, it was held novel to stop an old reduction at a new intermediate stage.

In Badische Anilin und Soda Fabrik v. La Société des Usines du Rhône (1897),[1] the patentee claimed the production of anisolines by heating rhodamine hydrochloride with an alkyl chloride and alkali, *e.g.*, by methylation. A prior patent had described a two-stage process in which it was stated that the rhodamine hydrochloride was first heated with caustic potash to form a potassium salt, and this metallic salt was then heated with the alkyl chloride and alkali. It was shown that the potassium salt was non-existent. The first step was therefore entirely useless. The Court held that there was ample subject-matter in a

(1) 14 R.P.C. 875; 15 R.P.C. 359.

patent which told the public to omit the useless step and perform the alkylation direct on the rhodamine, contrary to the teaching of the earlier patentee. Here omission of a step, leading to a new and more simple process, was held to establish novelty.

But it is not sufficient merely to show that an earlier worker was misinformed. In Farbenfabriken vormals Friedrich Bayer & Co. v. Chemische Fabrik von Heyden (1905),[1] it was shown that a scientific paper by Kraut had described the manufacture of acetyl-salicylic acid by heating salicylic acid with acetyl chloride and then recrystallising the product from boiling water.

The plaintiff's patent was an argumentative document which referred to Kraut and stated that his product was not, in fact, acetyl-salicylic acid, but that the patentee had discovered that by treating salicylic acid with acetic anhydride it was possible to obtain acetyl-salicylic acid, which was recrystallised from chloroform. It was further stated that the new body could also be obtained by Kraut's method, if recrystallised from chloroform. At the trial, the plaintiff argued that Kraut produced an impure acetyl-salicylic acid which was destroyed on recrystallising from boiling water. The defendant showed that pure acetyl-salicylic acid could be obtained by quick recrystallisation from boiling water, and that Kraut's body

(1) 22 R.P.C. 501.

(before recrystallisation) only contained a little impurity. The plaintiff said that Kraut did not teach the method of obtaining the pure acid. The Court held that the claim was for the acid as a new body and not for the method of purification and that the patent was bad.

(4) Novelty is to be judged by a strict comparison as to adequacy of disclosure. A patent is not anticipated by mere vague statements, and in any case novelty, as distinct from subject-matter, is not negatived by an analogous suggestion or even a generic statement about a class of bodies of which the patent deals with one example. Further, while a patent may be anticipated by a number of separate documents, it must be remembered that novel combinations of old steps may be patentable as we shall see later. For the moment, we can see clearly that a novel combination is qualitatively different from its constituent elements or steps, old though these may be.

In von Heyden v. Neustadt (1880), James, L.J., said: " We are of the opinion that if it requires this mosaic of extracts from annals and treatises spread over a series of years to prove the defendant's contention, that contention stands thereby self-condemned. . . . And even if it could be shown that a patentee had made his discovery of a constructive process by studying, collating and applying a number of facts discriminated in the pages of such works, his diligent study of such works would still entitle him to the character of an inventor as the diligent study of the works of Nature would do."

Assuming, however, that novelty has been established, it is clear that something further is necessary to justify a patent monopoly. If a man could monopolise any variation of an existing process, merely because it had not been done before, industrial effort would be intolerably hampered since patents would exist and be supported for innumerable trivial details. If a process is known, the industrialist must be free to use his skill in the art in working it and modifying it, without having to pay royalties to the first man who happens to patent any trifling modification. On the other hand, real invention ought to be rewarded by a monopoly. How, then, are we to draw the line between improvements, which are novel but too trivial to justify patents, and inventions which are sufficiently important to warrant a monopoly in exchange for the really substantial benefit they bring. An improvement may be novel qualitatively, but this is not sufficient; the difference must be considered quantitatively, before we can say there is subject-matter for a valid patent. Many attempts have been made to define invention, but no definition has yet been framed which dispenses with the necessity of considering every case on its merits: after all, the problem is a practical one. We have to find some criterion by which to distinguish between trivial improvements and inventions worthy of patent protection. The Courts have gone on the principle that although *mere* novelty is not enough, a scintilla of ingenuity is sufficient to make a useful novelty into an invention. An antithesis is often propounded between inventive ingenuity and mere skilled workmanship, the result of which may be novel, but is not subject-matter for a patent.

The alleged invention is first examined qualitatively for novelty. If novel, one test of the *amount* of novelty necessary before an improvement rises to the level of an invention is to put the question : Did it involve ingenuity or was it obvious to a person skilled in the art? If it did involve ingenuity or if it called for more than what has been termed the " expected skill " of the hypothetical person familiar with the whole state of the art, the Courts consider it an invention.

In chemical patents I say emphatically that the standard set by the Courts is usually much lower than most chemists imagine. The Courts have realised the difficulty of prevision in chemistry, and have been very slow to hold that a novel step was obvious, no matter how small that step appeared. It has been explained in chapter two that the standard of the Patent Office is still lower. We can now appreciate that the British system is for the Patent Office to consider novelty only and to leave the quantitative study, *i.e.*

subject-matter, for the determination of the Courts. The decision on subject-matter sometimes depends largely on the success of the invention. If the small change produces very important or unexpected results, this is a powerful argument in favour of subject-matter. But such an argument can often be adduced only after the invention has come into practical use, *e.g.*, the flour oxidising process, and the dry blast.

Still, although the Patent Office will allow patents which in many cases have no subject-matter, it is always important to consider whether the patents will be valid as possessing "subject-matter," or invalid for "want of invention." There is really no objective standard, and an opinion on validity is an estimate as to the decision which could be obtained if the case were argued before the Court.

It would be tedious to classify all the possible types of chemical inventions and I propose instead to explain the all-important question of subject-matter by considering four types: (1) analogous and non-analogous substances and reactions; (2) variation in conditions in a process; (3) change of operations; (4) combinations.

This omits the pioneer inventions such as saccharin or viscose or rubber vulcanisation, as it is more instructive to consider closer cases.

(1) Analogy must often be considered in patent law. It is a general proposition that the *mere*

application of a known process or substance to an analogous purpose is not good subject-matter for a patent, unless there is invention in the transference from the old to the new purpose. It will be seen that such an analogous use is qualitatively novel, and the difficulty is to determine whether the amount of difference is sufficient to establish subject-matter. In chemical patents it is considered that very little evidence is sufficient to destroy the argument of anticipation by analogy, which is likely to fail if there is any difference in the mode of application of the old process or substance to the new purpose, or if the new use is sufficiently " out of the track " of the old use that it is not obvious to a person skilled in the art, or if any unexpectedly valuable results are obtained.

Thus in Badische Anilin und Soda Fabrik v. Levinstein (1883),[1] it was argued that the process of coupling diazotised alphanaphthylamine with naphthols to make dyes was not patentable because diazo compounds had been coupled with phenol. The House of Lords rejected this argument. The Lord Chancellor said:

" The chief reliance was placed on an argument as new as it is unsound, and for which I think there is not the least judicial authority. The argument may be stated thus: This thing is not new because things of the same sort in analogous chemical

(1) 2 R.P.C. 73, 143; 4 R.P.C. 449.

relations had been discovered; people ought to have discovered it or were on the brink of discovering it; therefore this true and first inventor only completed by one step the route to which chemical discoveries had been tending without his aid. Such a principle applied to patent law would be fatal to the rights of all inventors." And Lord Herschell said, in a famous passage, "It is suggested that even though the particular substance was unknown, similar bodies arrived at by similar processes were well known, and that chemical analogy would at once indicate the supposed invention. A complete answer is given to this argument by Dr. Griess, one of the highest authorities in this branch of chemistry. He says, 'In 1864, I distinctly state that by the combination of diazobenzol and phenol, dye was obtained, and if I had been a little cleverer, analogy would have induced me to prepare this very dye which is now under consideration. But analogy did not lead me to do that; analogy does not go a long way in chemistry.' "

In fact, the Courts have been thoroughly impressed with the limitations of chemical analogy as a guide to prediction, and have accepted a well-known saying attributed to Sir James Dewar: "There is no prevision in chemistry." Although this would be an exaggeration to-day, it still has value as an epigrammatic statement of the peculiarity of chemistry, in which experiment must be employed so early as a touchstone for the soundness of theoretical reasoning.

In Farbenfabriken vorm. F. Bayer v. Bowker (1891),[1] the decision turned on questions of isomerism and homology. It was old to couple tetrazo-diphenyl salts with naphthylamine compounds, but the patentee found that a specially good result was obtained by using the homologous *o.* tetrazo-ditolyl salts. These were novel, and the analogy was held not to destroy subject-matter, as improved results were obtained. It is interesting to note that in this case the patent originally described both ortho and para tetrazo-ditolyl salts; subsequently it was found that only the ortho compound worked and that the pure para compound was useless. The patentee therefore amended his specification by disclaiming the para isomer, and thus made his patent valid—an excellent illustration of the importance of checking the statements made in the specification.

In inorganic chemistry, the squirted tungsten filament is a good illustration of apparent analogy which did not destroy subject-matter. In Osram v. Pope's (1917),[2] the House of Lords held that the Just and Hanaman patent for the tungsten filament was not anticipated because of analogy between tungsten and osmium, for which substantially the same process had been proposed by

(1) 8 R.P.C. 389.
(2) 34 R.P.C. 369.

Welsbach. The osmium filament was not a commercial success: tungsten was a cheaper metal than osmium and yet Welsbach had not suggested it, so that the selection of tungsten was held to be meritorious and patentable.

Indeed the importance of judicious selection may justify patentability even when the patentee only proposes to take one of a large class of substances which has been proposed previously in general terms. The Just and Hanaman patent for tungsten would not have been anticipated by a general statement that highly refractory metals could be used for filaments. If a prior patentee had a valid patent for filaments of tantalum and refractory metals in general, the use of tungsten might have been an infringement. Nevertheless the selection of the successful metal tungsten from the broad class of refractory metals would justify patentability.

On the other hand, there are cases in which the analogy is so palpable that a novel process, *i.e.*, a process which is clearly distinct from the known processes, may be wanting in invention because of the existence of analogous processes. In Von der Linde v. Brummerstaedt (1909),[1] the patentee claimed distilling pyrolignate of lime with acids *in vacuo*. The pyrolignate of lime was, of course, made by the usual process of distilling wood.

It had been proposed to use a vacuum in the

(1) 26 R.P.C. 289.

original distillation of acetic acid and its subsequent purification, but it was novel to use a vacuum in the distillation of the mixture of acetate of lime and sulphuric acid, *i.e.*, no proposal to this effect was on record. This variation was held to represent a mere analogous use, as it was well known that the temperature of distillation would be lower *in vacuo*. But the patent might have been held valid if the patentee had originally realised the fact that the use of a vacuum lowered the temperature of distillation so much that the sulphuric acid no longer acted on the carbonaceous matter in the still to produce sulphur dioxide as an impurity, and if he had stated that by *slow* distillation *in vacuo* it was possible to prevent formation of sulphur dioxide. If the patent had given such instructions, the Court would probably have held that it could not have been predicted that sulphur dioxide could have been avoided, and therefore the process was not a mere application of the old process to another stage of acetic acid manufacture.

Again in Acetylene Illuminating Co. Ltd. v. United Alkali Co. Ltd.,[1] Lord Davey said : " You cannot have a Patent for a new use of an old machine or process unless there be some novelty or invention in the adaptation of the old process to the new use, or the overcoming of some difficulty which lay in the way of such application. One

(1) See page 118.

test which is often put as to whether such an application of an old process would be a good subject-matter for a patent, is whether it lies in the track of the old uses or not." In this case the patentee's method of making calcium carbide by passing the current through the materials themselves was held wanting in invention over his own prior patent which reduced metals in a similar manner.

But as I have said, analogy usually does not go far in anticipating a chemical patent. The Patent Office is bound to grant a patent for any novel process, whether analogous or not, as it rarely determines subject-matter, and if there is any difficulty in application of the old process, any modification necessary in such application, or any unexpected or very valuable result, the Courts are inclined to find subject-matter.

(2) Choice of conditions of reaction is patentable if the patentee's choice is not obvious, and leads to special results. In particular, selection of specific values or ranges of values of variables such as temperature or concentration may be patentable, if such values represent critical points or ranges on the curve which exhibits the result of the process, *e.g.*, the yield or purity, as a function of the variable. The application of the conception of functionality to the problem of subject-matter[1] is of somewhat academic interest, and it is

(1) See H. E. Potts, "An Application of Mathematics to Law"; *Nature*, 24th April, 1913.

sufficient to say that if results are expressed as functions of conditions, any discontinuity or critical value of the function may represent good subject-matter. This may be seen best by considering some examples.

Saccharin Corporation, Ltd. v. Anglo-Continental Chemical Works, Ltd. (1900)[1] dealt with a typical case. The patent related to the treatment of toluene with chlorsulphonic acid to give an ortho-para mixture of toluene sulpho-chlorides from which the ortho isomer was isolated for conversion into saccharin. A prior process gave a yield of about 50 per cent. of the mixed chlorides, ortho and para in equal proportions, and the remainder was converted into toluene-sulphonic acid. This result was obtained by using $2\frac{1}{2}$ parts of chlorsulphonic acid to 1 part of toluene. The patentee showed that by using $4\frac{1}{2}$ parts of chlorsulphonic acid and by cooling the reacting mixture to less than 5° C., a total yield of 93 per cent. could be obtained of which 60 per cent. was the useful ortho compound. This increase in yield from 25 per cent. to 60 per cent. was of great practical importance and the patent was held valid.

Considering conditions in detail, changes in proportion of ingredients may be good subject-matter in appropriate cases. Nobel's patent of 1888 protected the manufacture from soluble nitrocellulose plus nitroglycerine of a horny or

(1) 17 R.P.C. 307.

semi-horny explosive susceptible of granulation. In 1875, Nobel had previously invented blasting gelatine containing these ingredients in different proportions. The 1888 product could be used as a propulsive powder and was a different explosive altogether, so that it was not anticipated by blasting gelatine, although the inventive step was a change in the proportions of ingredients.

Change of temperature may be important. One of the Badische patents of 1898 for making sulphur trioxide by the contact process depended on performing the catalysis of sulphur dioxide and oxygen at a " regulated temperature." Previously it had been suggested that the platinum contact mass should be heated to a high temperature; Knietsch and his collaborators were the first to enunciate that there was an optimum temperature about 400° C. Below that temperature, the reaction velocity is too slow: above that temperature (or at any rate above 430°—450° C.) the equilibrium rapidly shifts in an unfavourable sense because the formation of sulphur trioxide is exothermic. On account of the heat of reaction, special means must be adopted to regulate the temperature of the catalyst. In 1898 the physical chemistry of this subject was not fully developed, as Knietsch's researches were fundamental. This patent was really a master patent in America, and it must have exerted a powerful influence in determining the evolution of the acid industry there.

As illustrating the importance of purity, we may cite Knietsch's patent for rigorously purifying the gases in the contact process to exclude arsenic.

Changes in concentration may be vital. The McArthur-Forrest process[1] of gold extraction depended on the use of a dilute solution of potassium cyanide which exerted a selective action on the gold. A concentrated solution failed because it dissolved the base metals. The claim for a dilute solution would have been valid even if a strong solution of pure potassium cyanide had been previously suggested. In actual fact, a mixture of potassium cyanide and ammonium carbonate had been proposed, without success: the Court of Appeal said: "In our judgment, the existence of a chemical patent, wherein the combined effect of two or more chemicals is claimed in order to bring about a desired result, does not by any means constitute an anticipation of a subsequent discovery that by the use of any one of the named chemicals the desired result can be attained, and *a fortiori* when the compound of the two or more has failed to do so."

In general, therefore, it will be seen that selection of any crucial condition of importance will probably provide subject-matter.

(3) Artifices are often patentable. In Thermit v. Weldite (1907),[2] the Court considered the

(1) 11 R.P.C. 638; 12 R.P.C. 232.
(2) 24 R.P.C. 441.

aluminothermic process. An 1894 patent of Vautin described the reaction between metallic aluminium and an oxide of a metal. The reaction was extremely and uncontrollably violent because the materials were placed in a crucible and externally heated. In 1896, Vautin patented the well-known process in which the reaction is initiated by internal heat. The patent covered the use of a special igniting mass as a fuse and also the use of a blow-pipe flame applied to one point of the mass itself.

It was held that there was ample subject-matter in substituting internal and local heating for external heating, since this made the reaction proceed much more smoothly.

Again, a single-stage reaction may be patentable over a two-stage reaction if advantages are obtained. In Gold Ore Treatment v. Golden Horseshoe (1919),[1] the Privy Council considered that there would be subject-matter in making cyanogen bromide in a single stage from potassium cyanide, a bromide, a bromate and an acid, although the two reactions between the bromide, bromate and acid, and between bromine and potassium cyanide were well known. The single-stage process had advantages, *e.g.*, it avoided the necessity of transporting bromine. The patent was held bad for anticipation by another document, but it illustrates the principle.

While a new test as such is not a " manner of

(1) 36 R.P.C. 95.

manufacture," a process which depends on such a test may be patentable, and this comes within the class of artifices. Thus in Badische Anilin und Soda Fabrik v. Dawson (1889)[1], the patent claimed the preparation of naphthol poly-sulphonic acids, and gave a new test which indicated when the reaction was so complete that the product could be nitrated without driving out all the sulpho groups. The patent was held valid.

(4) Combination patents are very numerous, and they may be valid even if all the component parts or steps are old. One test of a combination is that the result must not be a mere additive function of the results obtainable by the components, but that some novel result must arise from the combination. The difference between an aggregation of parts or steps, which merely contribute additively to the result, and a true combination of parts or steps, which give a new result more than the sum of the individual expected results, may be compared with the difference between a physical mixture and a chemical compound : it is the " chemical compound " type of combination which is patentably novel.

Thus a combination of peat and molasses has been held valid as a cattle-food, in Molassine v. Townsend (1906),[2] because the result is not merely additive; it was held that the humic acid of the peat offsets the injurious action of the potassium

(1) 6 R.P.C. 387.
(2) 23 R.P.C. 27.

of the molasses, so that an animal can be fed with three times as much molasses without injury. Here a new result flowed from the combination.

Again, mercerisation of cotton by the action of caustic soda and simultaneous stretching would have been clearly patentable over the individual steps of treatment with soda separately, and stretching separately, since even if these were old, the combination gave a much improved lustre.

In concluding the discussion of subject-matter, I would emphasise once more that the Patent Office and the Courts have different standards. The Patent Office grants patents for improvements which are novel; such patents may or may not possess subject-matter, which is not judged by the Patent Office, with very rare exceptions. Therefore any novel improvement can be considered with a view to protection by a patent. As regards subject-matter, the Courts will have to decide, and the tendency is to sustain any patent in which a substantial improvement is disclosed. Care should be taken in dismissing an improvement as unpatentable, merely because of some chemical analogy, or some vague adumbration of the successful idea. These principles apply to detail patents for increasing yield or purity, as well as to master patents protecting a new reaction.

The consideration of prior use has been purposely deferred. If secret, the clearest possible evidence will be required, and such use would have to be of a commercial as distinguished from an experimental nature. It has been held that an abandoned experiment was not an anticipation, even though it was practically identical with the subject of a subsequent patent. It is no anticipation of a patent to prove that some one else had found out the secret independently, but had not used it. The patentee must be the true and first inventor, but if there are several inventors, in the ordinary meaning of the word, the "inventor" legally is he who first files his application at the Patent Office.

It is also well settled that use or publication abroad will not invalidate a patent. If another person has worked a patented process abroad, and imported the product into this country, it may invalidate a patent, but on the ground of prior publication rather than prior use. Thus the Magnolia metal patent was held invalid because of the sale in England of the imported alloy; although it was not proved that anyone had analysed the alloy and observed its characteristic bismuth content, yet the possibility of such analysis was proved and this was equivalent to publication. This ruling was sustained in the cobalt steel case (1919),[1] where a British firm had manufactured and sold several small batches of cobalt steel before the date of the patent: the cobalt could have been discovered by analysis and the patent was invalid

(1) 36 R.P.C. 13.

for prior public use. But Hancock's patent for vulcanising rubber was not held invalid, although a sample from U.S.A. had been brought into this country: about 1840, it would have been difficult to ascertain the process by analysis of the product. In general, prior public use stands on much the same footing as prior publication.

A final word of caution is necessary. A prior use must be considered as it actually was, not as it might be modified if the patentee's secret had been known. And a prior published document must be read as it would have been read without the knowledge of subsequent researches, especially those of the patentee. It is unfair and unsound to re-read prior publications in the light of the information first imparted by the patentee. Once we know the secret, it is easy to find it foreshadowed in vague hints and obscure suggestions, but these must be rejected as anticipations. Thus Hogarth's alleged prior use of Andrews' flour oxidising invention was rejected,[1] because although Hogarth's apparatus *might* have been used to give nitrogen dioxide by a spark discharge, the evidence showed in fact that it *had* been used to give ozone by a brush discharge. And in Leonhardt v. Kalle,[2] the defendants argued that a patent for mild treatment of *p*. nitrotoluene-sulphonic acid with a reducing agent in presence of alkali to give a yellow dye was anticipated by a prior process in

(1) Page 45.
(2) Page 119.

which the *p.* nitrotoluene-sulphonic acid was heated with alkali alone, because, they said, if the heating were performed more thoroughly, a part of the raw material itself acted as a mild reducing agent. But the Court rejected this argument, since the suggestion to heat more thoroughly was only made after the date of the patent and there was no evidence to show that any one ever had worked the old process of heating with alkali in such a way that the new product was obtained.

In fact, as a Judge once said, you must not look at prior documents with an eye which has been sharpened by the patentee.

Again, Müller's patent (1907)[1] for a bath of sulphuric acid and a salt, for hardening threads of viscose, was upheld. The patent was held to cover baths containing sulphuric acid saturated with sodium sulphate: the sodium salt exerted a very useful effect. A prior patent mentioned a bath of dilute sulphuric acid alone, and it was argued that the bath would become progressively enriched with sodium sulphate by the action of the acid on the viscose. The Court held that Müller did not claim such a bath, and that the presence of sodium sulphate in the prior bath was only accidental, in the sense that it did not anticipate the *idea* of adding sodium sulphate to a bath of acid of a different and higher strength for a new and useful purpose.

In conclusion, then, it may be added that in

(1) 24 R.P.C. 465.

previous chapters we have seen something of the difficulties of chemical patents. As a compensation, we now see that as regards novelty and subject-matter the chemist is in an unusually favourable position, since he is less exposed to attack by analogy. It follows that the results of chemical research can usually be patented and that any research chemist working on certain lines will nearly always produce a whole series of patentable improvements. It would be true to say that almost every research chemist is an inventor in the legal sense, in that he is making patentable improvements. I have tried to show that the small improvements can be protected as well as the large ones, but it is difficult to cover the whole field in a single chapter. Dr. Ephraim, of Berlin, has written an 86-page monograph "Uber den Neuheitsbegriff bei chemischen Erfindungen" (1898), but it deals with examples from German practice which I have not used. Some further information as to British practice will be found in a short paper on "Prediction and Invention in Chemistry."[1]

These general and theoretical considerations are often difficult to apply to specific sets of facts, and it is best for the research chemist to fix his attention firmly on the fact that the Courts do endeavour to protect the majority of new and useful improvements, and any particular improvement can then be considered on its merits.

(1) H. E. Potts. *Journ. Soc. Chem. Ind.*, 1914, 392.

Chapter VI

THE DEFINITION OF AN INVENTION: THE PROBLEM OF LANGUAGE

We have seen that a patent may be regarded as a contract between the inventor and the public, by virtue of which the inventor gives sufficient information to enable a skilled person to put the invention in practice, in exchange for a monopoly for 16 years. The patent specification is written to discharge the obligation on the inventor by describing the invention fully and fairly. This is the obvious function of the specification and in previous chapters we have discussed the legal requirements very fully. But the specification has another and correlative function. Its disclosure of information is one side of the contract, namely, the consideration given by the inventor. The other side of the contract is the monopoly given by the public, and it is also necessary that this should be clearly defined. British Law lays on the patentee the burden of defining the extent or scope of the monopoly which he asks as a reward for his disclosure, since without such a definition, the public would not be aware how far his monopoly extended. It is the object of the " claim " of a patent to fulfil this second function. The description and the examples form the disclosure, which is the price paid by the patentee, while the claim shows what he is receiving in return, namely, the right to prevent others from using his invention.

The reason for the presence of a claim is that the public would be gravely inconvenienced if they were not in a position to see exactly what they are prevented from doing. In other words, the patentee must clearly " mark out the forbidden field."

If the patent merely contained a description of the invention it would be most difficult for rival manufacturers to tell whether similar processes would infringe the patent or not. Thus, if the patent claims the use of an alkali metal as a catalyst for a liquid reaction, it indicates that others are free to use other metals. Whereas if the patentee merely describes a process which uses sodium, and does not say whether he intends to monopolise other metals or not, it is difficult to say how far the protection of the patent may extend: it may be limited to sodium, or it may be extended to cover calcium as well as alkali metals. The system of inserting claims is an attempt to overcome this difficulty. The natural tendency of the patentee to claim too much is curbed by the fact that if he includes anything which is old or which will not work, that claim is invalid (though other more restricted claims may succeed).

The cases of Fabriques de Thann v. Caspers[1] and Fabriques de Thann v. Lafitte[2] illustrate the embarrassment caused by the absence of an adequate claim. The patent described the manufacture of artificial musk by treating toluene with butyl chloride by the Friedel and Crafts reaction, and nitrating the hydrocarbon so produced. The only claim was: "The process for producing artificial musk substantially as described." To determine the scope of this claim it was therefore necessary to consider the specification very closely. In the first action, the defendant treated toluene with butyl alcohol (and a little nitrobenzene, which did not react) in presence of sulphuric acid, to produce a sulphonated product which on nitration split off the sulpho group, giving a tri-nitrated product. It was held that the treatment with sulphuric acid followed by nitration was a chemical equivalent of the patentee's process in which the hydrocarbon was nitrated by treatment with a mixture of sulphuric acid and nitric acid; although the patentee never obtained the sulpho body, the final products were the same.

In the second action, the defendant applied the process of the patent to xylene instead of toluene. But the patent stated that the product obtained by treating toluene with butyl chloride was to be

(1) 15 R.P.C. 94. (1898.)
(2) 16 R.P.C. 61. (1899.)

distilled between 170° and 200° C. The Friedel and Crafts reaction gave a mixture of butyl-toluene (B.P. 186°), and butyl-xylene (B.P. 200°—202°), so that the distillate between 170° and 200° C. would certainly contain a percentage (say five per cent.) of butyl-xylene carried over with the butyl-toluene. Moreover, the defendant would obtain a certain amount of butyl-toluene in addition to the butyl-xylene which was his main product; this mixture was then nitrated. Hence the patentee's tri-nitro body would contain a small quantity of the xylene derivative and the defendant's tri-nitro body would contain a small quantity of the toluene derivative: neither of these bodies could be regarded as impurities since in each case the amount (though small) was useful for the purpose of artificial musk. The defendant was held to have infringed.

Obviously, it is most inconvenient for manufacturers to be left in a state of doubt as to whether modifications of this kind fall within the patent or not, and it will be agreed that it would be desirable for the patent to contain a clearer statement as to what the patentee desired to protect. In modern practice much more definite claims are usually drafted, and although the present British system is not perfect, it is probably better than the French system in which the scope of protection is not defined by a claim.

These cases illustrate a further point, that it is desirable that the claim should be distinct from the description of the invention in detail. On the one hand, the "disclosure" portion of the specification should be as detailed as possible. Specific temperatures, reagents, quantities and times of reaction should be stated. Yet if the patentee knew that he was limited to the optimum conditions he had disclosed, and that others could use the invention by varying them, it is clear that he would guard himself by carefully avoiding definite statements of this kind. The only way, therefore, to secure that the patentee can give optimum conditions without restricting himself to them, is to extend the protection beyond the detailed examples he has given. It cannot be too strongly emphasised that this is possible in British practice, because the details in the disclosure are regarded as useful but not essential features of the real invention which is to be found in the claim.

Accepting, therefore, the fact that the scope of protection is determined by the claim, we must consider the method of definition adopted. Our object is to find a verbal formula which will exclude everything that is old, or will not work, and will include as many variations of the invention as possible. There are two mental operations which shade into one another because language and thought are so closely intertwined.

The first operation is that of generalisation, as described in chapter three. It is necessary to compare the invention with the state of the art, to seize the salient features of difference, and to apply the methods of induction and deduction, to expand the inventive conception to its fullest extent.

The second operation is to clothe these results in language, and in practice the two operations are performed in parallel. We have already considered the first, however, and it is now necessary to discuss the problem of language. It will be evident that we must find a set of words which will serve as a basis of definition or classification, namely, to define the new class of processes to which the invention belongs.[1]

A class, or a genus, is a group of individuals all of which possess some common property. We can split up this genus into species each of which contains individuals possessing some further common property. Thus metals form a class or genus, distinguished from the non-metals. Within this genus there are the species of alkali metals, alkaline earth metals and so on. A genus may be split up in different ways, depending on the property we choose as characteristic. Thus the magnetic properties can be used to divide metals into dia-magnetic and para-magnetic, and this classification will not coincide with the previous classification by the periodic table. Or we could

(1) The reader is recommended to consult W. S. Jevons, "Principles of Science," or some similar work, *e.g.*, on scientific method, in which the general problem of classification is discussed.

form the species of " volatile metals," or " metals soluble in hydrochloric acid."

Each of these species can be considered as a genus and split up into further species, *e.g.*, " metals soluble in hydrochloric acid " can be further classified by the fact that some of their chlorides are hydrolysed by water (distinction between $NaCl$ and $SbCl_3$, etc.).

Thus a species differs from a genus in that all the members of the species possess some characteristic property not shared by the other members of the genus. This applies to processes as well as to substances. " Oxidation by nitric acid " is a species of the genus " oxidation," and applies to all processes of oxidation in which the use of nitric acid is a common feature.

This leads to a further point which is the crux of the whole matter. The set of words which defines a species is more detailed than the set of words which defines the genus, because the definition of the species contains the defining property or limitation common to the members of the species, and to them only. Thus " aliphatic hydrocarbons," is a species of the genus " hydrocarbon." The number of individuals included in the species is, of course, smaller than in the genus. Therefore, each fresh word included in the definition decreases the number of individuals covered by it. *The scope of a claim is inversely proportional to the number of limitations contained* *in it.* The addition of the one word "aliphatic" to "hydrocarbons" at once decreases the scope of the definition by excluding whole classes of hydrocarbons which are not aliphatic. If we add the further limitation, "unsaturated," we obtain a more precise definition, but a more limited one.

Thus the precision in detail, which is necessary to define optimum conditions in the practical examples, would be fatal in the claim, since each fresh detail would limit the scope of the claim.

The preparation of a claim therefore depends on economy of limitations. All unnecessary limitation should be avoided so as to express the invention in its widest terms. The task is to differentiate from the known genus the novel species which has been invented and this species may contain a whole series of modifications all of which possess some common feature of novelty. Sometimes there are several independent species based on separate novel features.

In attempting to draft claims in practice, we are often met with the difficulty of selecting the important feature which distinguishes the new species, since the detailed example given by the inventor may differ in numerous respects from the state of the art. Thus in the musk case, it had been suggested previously to prepare a musk-like substance by nitrating propyl-toluene; the essential novel feature was the use of a butyl derivative, and not a difference in the mode of producing the hydrocarbon, or in the particular method of nitration.

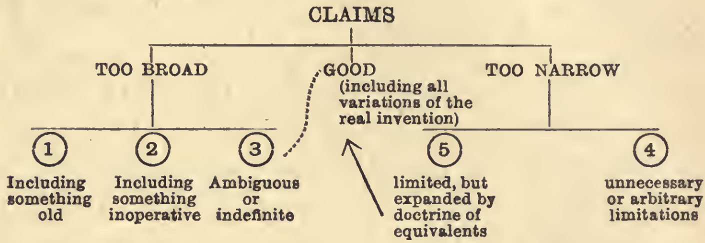
The fundamental secret of drafting good claims is to seize upon *relevant* distinctions between the invention and what has gone before. This is not always easy, because it is often possible to define a species by purely arbitrary features. Thus in the classification of metals in groups in qualitative analysis, each group forms a species, but the common property is arbitrary, not relevant, *i.e.*, it has no necessary significance with reference to the other properties of the metals. The insolubility of the sulphides of metals of group two in hydrochloric acid is only chosen for purposes of convenience, not to enable us to bring together the metals which are most closely allied. On the other hand, the classification of elements by the periodic system is based on a relevant property, which brings together the elements having similar general properties.

A striking example of relevant distinction is to be found in comparing various clouding agents for enamels. Stannic oxide is particularly suitable, and Haber has given a brilliant analysis of the reason for this suitability, namely, exceptionally high refractive index: Haber showed how this explained the value of zirconium oxide as a clouding agent. Without this explanation it would be most difficult to define the species to which zirconium oxide and stannic oxide belong, and to find the property which distinguishes them from other oxides. Purely chemical properties are irrelevant, whereas by aid of this relevant feature, high refractive index, it is possible to predict that titanium oxide will be a clouding agent (although it is not so good because of the yellow colour it imparts to the enamel).

Zirconium silicate has a high refractive index, but without this theoretical guidance it would not be obvious as an equivalent for zirconium oxide.

A further difficulty in drafting claims arises from the fact that it is almost impossible to frame any set of words which will not be ambiguous when subjected to hostile criticism. This ambiguity is largely due to the continuity of natural phenomena. We find that in Nature, there are few sharp boundaries, and that one class or species tends to merge imperceptibly into another. Everyone would agree that spindle oil is a " thin " oil and that cylinder oil is a " thick " oil, but no sharp line can be drawn (except by arbitrarily fixing a limit of viscosity) between thin and thick oils, and it will be hard to place oils of intermediate viscosity in either category. " Acid " and " alkali " seemed definite enough opposites to an older school of chemists, and yet we now consider there is a gradual transition from one class to the other through the amphoteric substances: the term " metal " is similarly ambiguous. Although this may seem a philosophical difficulty, it is a very practical one when we are attempting to draft claims.

At this stage of the discussion it will be advisable to refer to the following chart, which shows the different possibilities in drafting claims.



This chart shows that a claim may be bad because it includes something old, *i.e.*, it may be anticipated, either for want of novelty or subject-matter; it may be bad because it includes something inoperative, *i.e.*, an example which will not work. Or it may be bad for ambiguity or indefiniteness.

A good claim excludes the variations mentioned above, but includes all variations of the real invention. Sometimes an apparently ambiguous claim may be valid in view of the context, so a dotted line has been inserted on the chart to link ambiguous claims with good ones. A claim which is too narrow may be valid, but will fail to protect the invention because it contains unnecessary or arbitrary limitations. Sometimes, however, the doctrine of equivalents may extend the scope of a narrow claim, so that an arrow has been inserted on the chart between one class of narrow claims and the good claims, to indicate that occasionally the unduly narrow claim may be good.

Let us now illustrate these possibilities by examples.

(1) A claim is invalid if it includes anything old. This does not mean that the anticipation must be exactly the same as the invention, since we have seen that the claim covers a species consisting of the invention and allied variations. If one of these variations included within the species happens to be old, the claim is bad. Thus, if we describe a process of preparing a dyestuff by condensation of an intermediate by a copper salt, but claim condensation by heavy metal salts in broad terms, the claim will be anticipated by a prior process describing condensation by aluminium chloride: we have chosen to attempt to cover the whole field of heavy metal salts, but in so doing we have been obliged to run the risk of invalidity if one of such salts is old. In practice we should insert a second claim specifically covering copper salts, and this second claim might be valid in spite of the prior use of aluminium chloride. Broad claims are termed "generic," because they cover a wider area than "specific" claims (such as for copper salts). Obviously generic claims are more valuable, but they are also more liable to be invalid and therefore it is usual to insert both generic and specific claims.

The leading case on this point is Kynoch v.

Webb,[1] in which the House of Lords considered Webb's patent for an apparatus for concentrating sulphuric acid on the cascade system. The inventor described and illustrated a series of open glass vessels with spouts, placed on steps in a heating chamber with a closed top; each vessel contained a loose glass tube so arranged that the hot acid flowed from the spouts of the vessels down the tubes to the bottom of the next lower vessels. The acid fumes were drawn off through pipes.

The claim was as follows: "For concentrating sulphuric acid, a series of glass vessels placed on steps in a heating chamber, each of these vessels being made with an overflow spout and having placed in it a glass tube reaching down to its bottom from the spout of the next higher vessel, arranged and operating substantially as herein described."

This claim was in much wider language than the real invention, since it did not specify that the vessels were uniformly heated in a closed chamber from which the acid fumes were removed by pipes.

A previous specification of Chance showed a series of retorts arranged on steps in a heating chamber, with fixed overflow spouts and tubes. Although only the bottom portion of each retort projected into the heating chamber, the claim of Webb applied verbatim to this previous apparatus, except the words "substantially as herein

(1) 17 R.P.C. 100.

described." Webb's claim did not bring out the distinctions, *e.g.*, that he used open vessels, uniformly heated, inside a closed chamber, and although his apparatus gave much better results, his patent was invalid because the words of his claim covered something old.

This distinction would have been brought out if the claim had been drafted in another way. Note that there is no necessity to limit the claim to vessels of glass.

"An apparatus for concentrating sulphuric acid comprising a series of *open* vessels of acid-resistant material arranged on steps within a heating chamber and *totally enclosed thereby*, in combination with a series of loose tubes to convey acid from the spouts of the vessels to the bottom portions of the adjacent vessels, substantially as described."

This claim differs from Chance by the words in italics; this difference is not arbitrary, since when the open vessels are totally enclosed by the heating chamber it is possible to heat up the beakers more uniformly, thus reducing the danger of breakage. The water vapour can be freely removed by evaporation, whereas Chance stated that his retorts were to be heated till the acid was in gentle ebullition.

The idea of using open vessels totally enclosed in a heating chamber was not new, but the combination of this feature with the tubes (which were not new, except in so far as they were loose), formed a novel and useful apparatus. But the House of Lords held that Webb's claim was not limited to this combination and that therefore his patent was invalid since his claim included the known apparatus of Chance. It is not sufficient, therefore, for a patentee to disclose a new and useful apparatus or process: his claim must specify the novel combination he desires to protect.

(2) A claim is invalid if it includes anything inoperative. This has already been discussed in general terms in chapter four, but we will refer again to one example which shows two claims.

In Cassell v. Cyanide (1895),[1] the Court of Appeal considered the McArthur-Forrest process for the extraction of gold from ores by the use of a dilute solution of potassium cyanide. It was novel and valuable to use a dilute solution which exerted a selective action on the gold in preference to the base metals; a strong solution did not exert this selective action.

The claims were as follows:

" (1) The process of obtaining gold and silver from ores and other compounds, consisting in dissolving them out by treating the powdered ore or compound with a solution containing cyanogen or a cyanide or cyanogen yielding substance, substantially as described.

(2) The process of obtaining gold and silver

(1) 11 R.P.C. 638; 12 R.P.C. 232.

from ores and other compounds, consisting in dissolving them out by treating the powdered ore or compound with a dilute solution containing a quantity of cyanogen or a cyanide or cyanogen yielding substance, the cyanogen of which is proportioned to the gold or silver or gold and silver, substantially as hereinbefore described."

It will be seen that claim one was a broad or generic claim, covering all cyanide solutions, while claim two was a narrow or specific claim, covering dilute solutions only. The Court held that claim two was patentable, but that claim one was invalid, since it was so broad as to cover the strong solutions in which the desired selective action was not obtained. The decision illustrates the danger which may be met if claims are thoughtlessly multiplied in number, since claim one was interpreted in the light of claim two and thus it had to be read as covering something more than claim two. If claim two had stood alone, the patent would have been valid; even if claim one had stood alone, the Court might have construed it as limited to dilute solutions.

Still, unless one is certain that the generic claim is useless, it is wiser to insert both types of claim, since the generic claim can be removed by amendment if it is found later that it is too wide, whereas if we start with a specific claim only, it is never possible to widen its scope by amendment, which must always restrict and not expand the patent.

Further, the new Patents Act provides that under certain conditions the Court may grant relief in respect of valid claims (*e.g.*, claim two) in spite of the invalidity of other claims.

It is therefore advisable to draft a series of claims of graduated breadth, so that if the broadest fail, it is still possible to secure a monopoly of the restricted field. Thus, if claim one of a patent covers amines, claim two aromatic amines, and claim three secondary amines, we can attempt to cover all amines, and yet we may still have a sound claim two, if it is found that dimethylamine is old, or a sound claim three if aniline is old; it may happen that methylaniline and its homologues are the only amines of commercial value. By inserting three claims, we cover all amines, but we reserve the possibility of cancelling claim one and relying upon either of the narrower claims.

(3) If a claim is couched in such ambiguous or indefinite language that the public cannot determine whether they are infringing or not, the patent may be held invalid. Thus in British Thomson-Houston v. Corona,[1] the Court considered the patent for Langmuir's invention of the gas-filled tungsten lamp. It was found that the introduction of an inert gas into the bulb had the effect of reducing the difficulty caused by volatilisation of tungsten, but the gas also caused losses of heat by conduction and convection. Langmuir

(1) 37 R.P.C. 277 (1920).

observed that these heat losses did not increase in proportion to the size of the filament; therefore, by increasing the size of the filament it was possible to arrive at a point beyond which the increase in luminous efficiency far outweighed the loss of heat by convection. Claim one read as follows: " An incandescent electric lamp having a filament of tungsten or other refractory metal of large diameter or cross-section or of concentrated form and a gas or vapour of low heat conductivity at relatively high pressure, the combination being such that the filament may be raised to a much higher temperature than is practicable in a vacuum lamp without prohibitive vaporisation or deterioration or excessive shortening of useful life, substantially as set forth."

The Court of Appeal held that the word " large" was not sufficiently defined in the specification, and that the lamp-maker would therefore be forced to experiment to determine whether a proposed type of filament would be an infringement or not. The patent was therefore held invalid for indefiniteness. While deliberate ambiguity is to be deprecated, I suggest with respect that it is to be hoped that objections of this kind will not be pressed too far against valuable patents in the future.

However, the gas-filled lamp was an exceptional case and usually it is possible to avoid the objection of indefiniteness. The serious difficulty in most patents is to avoid drafting the claim so broadly as to include something old and inoperative, remembering that if the claim is unduly restricted, rivals will be able to imitate with impunity. This leads to a discussion of the claims which are too narrow —claims which have been restricted too much either through over-caution or perhaps more often through failure to appreciate the full scope of the invention or failure to express in language the distinctions which may or may not have been fully appreciated.

(4) Nobel's patent of 1888 contained the following claim: "The manufacture from nitroglycerine and soluble nitro-cellulose, of a horny or semi-horny explosive compound, susceptible of granulation, substantially as and for the purposes herein described." It was known that nitrocellulose existed in two forms, the soluble and the insoluble. The Director-General of Ordnance Factories made cordite for the British Army, by using nitro-glycerine and the *insoluble* nitro-cellulose, whereas it will be seen that Nobel's claim was limited to the *soluble* variety. Although it was shown that each variety of nitro-cellulose contained a small percentage of the other variety, the House of Lords[1] held that Nobel's claim must be limited to the use of the soluble variety. There were indications in Nobel's specification which definitely pointed away from the insoluble variety; as the existence of this variety must have been known to

(1) 12 R.P.C. 164 (1895).

Nobel, it was held that he had definitely excluded it by his claim and that the insoluble variety could not be regarded merely as a chemical equivalent of the soluble variety. In the High Court, Romer, J., said "It must be established that the alleged infringer . . . . is taking the invention claimed by the patent; not the invention which the Patentee might have claimed if he had been well advised or bolder, but that which he has in fact and substance claimed on a fair construction of the Specification." In this case, Nobel's invention really stopped at the explosive from soluble nitro-cellulose and further work was necessary to make cordite from insoluble nitro-cellulose, but this quotation illustrates the danger of undue limitations in the claims, whether inserted from excessive caution, from lack of imagination to realise the scope of the invention, or simply because sufficient research has not been done to justify the wide claim (*e.g.*, for the use of nitro-cellulose broadly).

(5) But sometimes the doctrine of equivalents is applied to extend the scope of a claim which does not cover an infringement when read literally. In Benno Jaffé v. Richardson (1894),[1] the patentee had discovered that an unguent (which he termed lanolin) could be prepared from wool fat or the waste liquors from wool washing. Previously it had been proposed to acidify the waste liquors,

(1) 11 R.P.C. 93 and 261.

giving a wool fat containing cholesterol and fatty acids mixed with impurities. The fatty acids caused rancidity.

The patentee found that if the wool-washing liquors, *while still alkaline*, were treated to separate the constituents by their specific gravities, it was possible to obtain the cholesterol fats free from fatty acids (present in solution as soaps) and dirt. The purified (cholesterol) wool-fat was then kneaded with water to give lanolin.

The claim described this process in broad terms, except that it specified a centrifugal separator for effecting the separation :

" The herein-described improved manufacture of fatty matter termed ' Lanolin ' from wool fat, by first treating the waste liquors of wool washing works in a depositing centrifugal machine, then purifying the raw Lanolin so obtained and converting the same into wool-fat, and if necessary, purifying the wool-fat by means of ether or other solvents or by operating upon the same when heated in a centrifugal machine, and lastly converting the wool-fat into ' Lanolin ' by treatment with water."

The defendant made the same product by the same process, except that he substituted gravity separation by sedimentation for separation by a centrifugal. The Court held that the patent was broadly novel as the only serious anticipation alleged was a publication in which an unsatisfactory ointment called oesypus was described 1,800 years ago by Dioscorides! Accordingly, the defendants had infringed because they took the essence of the invention; gravity separation was a well-known equivalent for centrifugalisation.

The last two cases dealt with the doctrine of equivalents. It may be added that this is a difficult subject. Much depends on the magnitude of the invention. Claims to a pioneer invention will be construed much more broadly than claims to a mere improvement in detail.

Also, if the alleged infringement is an improvement on the patent, the Court will tend to construe the claim more narrowly than if the infringer is making a clumsy variation, as in the lanolin case. Thus, in Berlin Anilin v. Levinstein[1] it was held that the use of the sodium salt of dinitrophenol was not chemically equivalent to the use of dinitrophenol in the manufacture of a black dye by heating with sulphur and an alkali sulphide. The patent was of great commercial value, but of very limited scope: the reaction was known and the patentee had merely substituted a boiling process for a melting process. Further, the use of the sodium salt could hardly be regarded as obvious since expert witnesses did not suspect that the defendant was using it, although this sodium salt is an intermediate product in the manufacture of dinitrophenol from dinitrochlorbenzene.

(1) 31 R.P.C. 177; 38 R.P.C. 277.

It is not safe, therefore, to rely overmuch on the doctrine of equivalents, but if the procedure outlined in chapters three and four were more generally adopted, there would be less need for what is termed " benevolent " interpretation by the Courts.

We have now considered the theory of claims, and the results of drafting them in too broad and too narrow terms. How are we to avoid these dangers in practice?

(*a*) The first great essential is to grasp the invention thoroughly, and to study it—

(i) in its relation to the state of the art, to avoid invalidity;

(ii) in its possible future evolution, to prevent infringement.

(*b*) Full play should be given to the scientific imagination; the result should be checked by experiment, or against available data; and the conclusions should be skilfully expressed in language.

(*c*) The widest possible claims should be drafted consistent with possible validity. All unnecessary limitations should be avoided.

(*d*) If a process differs from the prior art in two or more features, care should be taken to eliminate mere accidental differences. If a certain reaction proceeds in presence of baryta solution, whereas strong caustic soda is a known failure, the invention may be the use of a *dilute* alkaline solution, not the use of baryta. In other words, the limitations in a claim should not be arbitrary.

(*e*) A series or " ladder " of claims is often advisable, so that if the broadest is subsequently found to be invalid, protection will still be obtained for the narrower claims. Thus, in the Lanolin case, claim one should have covered any form of separation by specific gravity, and claim two should have covered separation by a centrifugal. If, then, gravity separation had proved to be old, it might still have been contended that claim two should be sustained since centrifugal separation gave superior results.

(*f*) If several independent inventive ideas are present, independent claims should be drafted. If a reaction between a solid and a gas takes place at a certain high pressure in presence of a certain liquid, it may happen that each of these features is independently new and of value. If we claim—

(i) high pressure;

(ii) a process " as in claim one " using a solvent (dependent or subsidiary claim);

we shall obtain little or no protection for solvent apart from the use of high pressure. But if we draft independent claims—

(i) high pressure (broadly);

(ii) solvent (broadly);

we shall obtain broad protection for each feature. The Patent Office will probably object on the ground that the patent covers two inventions. If we cannot remove this objection by argument, we shall have to limit our claim for one or the other feature, to cases in which it is used in conjunction with the other feature; the latter can be protected independently and broadly. Or, if the features are equally important, we can " divide " the patent application, and proceed with two applications, one covering each novel feature.

(*g*) If a claim does not distinguish sharply from the state of prior knowledge, the Patent Office often allows the claim if a " disclaimer" or statement of prior knowledge is inserted in the specification. While this clumsy method of definition is the sheet-anchor of the incompetent draftsman of claims, great care should be taken in using it. It is often inadvisable to state that " it has previously been proposed to . . . ". Still greater danger may result from thoughtless use of the formula: " This invention relates to apparatus of the known type in which . . . ", since such a statement may prevent the Court from expanding the scope of the claim by the doctrine of equivalents. These legal points are of somewhat technical interest, and will not be discussed further.

(*h*) We should remember that obscurity of language often implies confusion of thought. As studied ambiguity may invalidate the patent, we should therefore aim at lucidity in expression—and if we are doubtful about the facts we should seek for fresh facts instead of using ambiguous language!

Let us conclude by considering briefly the correlative aspect of claims, their interpretation. The preparation of claims and the filing of patent applications is the offensive element in patent policy. But the defensive element is also important. The research department will often desire to avoid patents held by others, and to do this it will be necessary to interpret the claims of these patents. This is an intricate problem, but a few general considerations may be added.

(1) The Court begins by construing the specification in the light of prior knowledge. Often a claim is open to a variety of constructions. Thus in British Ore Concentration v. Minerals Separation (1910)[1] the House of Lords considered the Elmore patent for adding acid to improve the selective action of oil in flotation of ore. The specification did not mention the amount of oil used, but Lord Atkinson stated that the inference was that oil was added in considerable quantity. The bulk flotation process is one in which, say, 1-3 tons of oil are added per ton of ore; the defendants used the froth

(1) 27 R.P.C. 33.

flotation process, in which only 2-3 pounds of oil are added per ton of ore; did the froth process infringe the following claim :—

" The method herein described of promoting the separation of mineral substances by the selective action of oil, by adding to the mixture of ore, water and oil, a proportion of acid "?

Lord Atkinson observed that three constructions were possible.

(1)	(2)	(3)
The addition of a relatively small quantity of acid to a mixture of powdered metallic ore, oil and water, irrespective of the relative quantities or consistency of these component parts, or any two of them, and irrespective also of the consistency of the mixture itself.	The addition of a similar quantity of acid to a mixture of pulverised metallic ore, water and oil of any consistency, irrespective of the proportion in which the oil may be present relatively to the other ingredients, *provided only that the water and oil, or water, oil, and ore, whichever it may be, have been reduced to a "freely flowing pulp."*	The addition of a similar quantity of acid to a mixture of powdered ore, oil, and water, *the quantity of oil not being infinitesimal but so large* that owing to some obscure chemical law or affinity, seized upon the minute metallic particles of the powdered ore in preference to the earthy particles, it, by its own buoyancy, floats the former to the surface.

It will be seen that No. 1 is the broadest construction and No. 3 the narrowest. No. 1 includes bulk flotation (buoyancy of the oil) and froth flotation, but also includes an old process of Everson, in which the quantity of water was so small that a stiff paste was produced instead of the freely flowing pulp which is necessary for success.

No. 2 includes both bulk flotation and froth flotation, but excludes the stiff paste of Everson.

No. 3 is limited to bulk flotation and excludes froth flotation.

Lord Atkinson accepted construction No. 3, and the House decided that the froth flotation process did not infringe the Elmore patent.

(2) Apart from possible alternatives as above, there is an inherent ambiguity in language which makes it very difficult to construe. In Roger v. Cochrane (1909),[1] the House of Lords held that a golf ball having a core of gelatine *jelly* was an infringement of a patent which claimed a golf ball having a core of " incompressible *fluid* "—mentioning water or other liquid or semi-liquid.

This ambiguity is increased by the continuity of natural phenomena and properties. One of the Elmore patents for oil flotation claimed " an oil of the type described." The specification referred to " a thick, tarry residue of mineral oil after some of the volatile constituents have been distilled off." The Court held that the claim was limited to a " thick " oil. But it will be realised how difficult it is to draw the line between thick oil and thin oil. However, the defendants were held not to infringe. If Elmore had realised the breadth of his invention, he might not have inserted the limitation to " oils of the kind described," but as that limitation was inserted, the patent was construed accordingly.

(3) In important inventions, Courts may read claims very broadly while still taking the literal sense of the words employed. The Just and Hanaman patent was construed as limited to tung-

(1) 26 R.P.C. 591.

sten filaments decarbonised by heating in "an atmosphere of steam and hydrogen" as stated in the specification. But these words covered a surprising area. In Osram v. Z. (1912)[1] the defendants decarbonised filaments in an atmosphere of hydrogen dried by calcium chloride. But the plaintiffs proved that such hydrogen still contained moisture (not removed by calcium chloride, and present on the walls of the bell-jar used for the operation) so that the Court held that the defendants were using "an atmosphere of steam and hydrogen."

And in Osram v. Pope's (1917),[2] the defendants introduced really dry hydrogen, but even then did not escape, since a certain amount of water was produced from the reduction of the tungstic oxide by hydrogen, and thus the House of Lords held that although steam was not added *ab extra*, it was added *ab intra* (*i.e.*, from the filaments) and that the defendants were therefore decarbonising in "an atmosphere of steam and hydrogen."

(4) But the Court often shows a disconcerting, though perhaps salutary, tendency, to qualify the language of the claim by statements in the specification and, in general, to approximate the scope of the claim to the real invention made by the patentee at the time of the patent. Thus in Maxim v. Anderson (1898),[3] the patentee claimed :

(1) 29 R.P.C. 401.
(2) 34 R.P.C. 369.
(3) 15 R.P.C. 421.

" An explosive compound consisting essentially of gun-cotton or pyroxyline mixed with nitro-glycerine, nitro-gelatine or similar material and with castor oil or other suitable oil, for the purpose above specified." Verbally, this claim appeared to cover cordite, consisting of 58 per cent. of nitro-glycerine, 37 per cent. of gun-cotton, and 5 per cent. of vaseline. But the House of Lords construed the claim by the statements in the specification, which indicated that the real invention of Maxim was an explosive whose main ingredient was gun-cotton, with only a limited amount of nitro-glycerine; on this construction, cordite was not an infringement.

(5) Lastly, there is the possibility that the Court may apply the doctrine of equivalents.

All these considerations indicate that a claim must not be regarded as a sharply defined area with rigidly fixed boundaries. It would be more accurate to compare a claim to a shadow, in which the umbra represents the field which is obviously protected; the illuminated area outside represents the field which is free to the public; and the penumbra represents the fringe of marginal interpretation open to argument. The magnitude of this penumbra depends on the importance of the invention, the state of the art, and the language used in the specification.

We are driven to the conclusion that whether it is desired to draft claims to protect an invention broadly, or to construe claims in existing patents, it is essential to understand the invention fully, to know as much as possible about the state of the art, and to be familiar with the practice of the Patent Office and the decisions of the Courts. In other words, the chemist and the patent agent must co-operate to the fullest extent. In so doing, I can testify from my own experience that the patent agent will experience a keen intellectual pleasure in following the course of research work. The chemist may also gain by free discussion of his work with one who is professionally bound to secrecy, but is able to take a detached view because of his position outside the industry.

Chapter VII

PATENTS IN OTHER COUNTRIES

A British patent extends to Great Britain and Ireland and the Isle of Man. It does not cover the British Empire or foreign countries except indirectly to the following extent:

Importation.—A patented machine cannot be imported into England without infringing the British patent. Again, if a British patent protects a process, it is not legal to import products which have been made abroad by the patented process, even though there is no novelty in the products as such, apart from the history of their production. This principle is not based on direct infringement of the claim, since if this is for a process only, the infringer is not working it in the United Kingdom. It is based on the terms of the letters patent which give the patentee the sole right to " make, use, exercise and vend " his invention; if an infringer could import goods made abroad by the patented process, the patentee would not have the sole right to " vend " his invention.

Thus, if a new process of making sulphuric acid is patented in the United Kingdom, the patentee will be able to bring an infringement action against the importer of sulphuric acid made by his process in Germany; though in this particular example it may be difficult to adduce proof of the method used.

Further, it has been held that if a person makes saccharine abroad from an intermediate which has been made by a patented process, the importation *of the saccharine* is an infringement of the process patent for making the intermediate: the infringer has used the invention for profit, although he has disguised this use by converting the intermediate into a final product instead of importing it direct.

Exportation.—A British patent will be infringed by use of the patented process in England to make goods which are sent abroad for sale, and this prohibition cannot be evaded by selling the goods c.i.f. instead of f.o.b., in the hope that a sale c.i.f. to some port abroad will be regarded as a transaction consummated abroad. The act of infringement consists in using the invention in the United Kingdom for present or future profit.

Thus, if a British patent is obtained, manufacturers abroad will be able to use the invention freely except for the British market, unless foreign patents are also obtained. It is true that, as British patents are usually not published till about 15 months after the application date, the patentee will have a certain time in which to work in comparative secrecy with safety. But if the invention is important, it is often advisable to obtain foreign patents, which may be used to safeguard markets, to control competition, to be exchanged for the British rights in inventions made abroad, or to be licensed or sold. The possibilities of control or exchange may be more important to firms having international connections, while development syndicates may be more interested in agreements for sale or licence under royalty.

Care should be taken in selecting countries in which to apply for patents. The following points are important. A few examples are given merely as illustrations :—

(*a*) We should review the chief countries in which the process can be worked, or the machine or product made, *i.e.*, the chief producing countries. Thus, the U.S.A., Mexico, and various other countries would be important for a process of refining hydrocarbon oils. An apparatus for glass manufacture would be important in Belgium, Czecho-Slovakia, and other countries.

(*b*) The chief consuming countries are sometimes important also. Example: China and British India are important markets for dyes.

(*c*) Local conditions of all kinds should be considered.

(i) It would not be advisable to apply for a patent for a rail chair in U.S.A., because the rails are usually secured by spikes. A patent for a process of making beer could hardly be enforced in U.S.A.

(ii) Processes for refining crude rock phosphate would be important in countries such as Tunis and Morocco. A process for the treatment of rock salt might be valuable in Poland.

(iii) Processes for organic syntheses from acetylene should be considered in Scandinavia, Switzerland, and other countries where cheap water power would reduce the price of calcium carbide.

(*d*) Legal peculiarities of various countries must be considered, *e.g.*, Denmark refuses patents for foods.

(*e*) It will be necessary to consider the cost of obtaining protection, and also the cost of upkeep of the patents in renewal fees, annual or otherwise. In many countries it is necessary to "work" the patents within a certain term of years. If actual manufacture cannot be effected, notarial or tentative working can be arranged by patent agents in various countries as a partial substitute.

After considering these and other relevant points, *e.g.*, the importance of obtaining protection in countries in which the patentee has business interests or associates, it will usually be necessary to file foreign applications before publication of the invention has occurred, or else to file within twelve months of the British filing date and to claim priority under the International Convention. It is not always safe to rely absolutely on the International Convention, as certain difficulties may arise, so that, if possible, foreign applications should be filed before the British application is published.

The effect of the International Convention is that the foreign application receives the priority of the British filing date, with certain reservations. In some countries, *e.g.*, Italy and Argentine, it is possible to obtain " patents of importation " at any time during the life of the British patent, but with these exceptions valid foreign patents cannot usually be obtained after one year from the British filing date if the invention has been published in print.

Foreign patents may be grouped, roughly, into two classes. Some countries make an examination for novelty; others do not. Many English-speaking countries, Germany, Holland, Scandinavian countries, etc., examine for novelty; the Latin countries do not. In all of these countries the Courts determine subject-matter on more or less the same general principles.

A few remarks may be added on peculiarities of some of the important countries.

(1) Australia, New Zealand, India and South Africa have patent laws on the same general lines as the British law. Many Crown Colonies allow

the British patent to be extended there at any time during its life. Canadian law has features in common with the laws of both Great Britain and U.S.A. The Privy Council is the final Court of Appeal for patent cases all over the British Empire.

(2) The United States of America has an intricate and characteristic patent system. The law is based on the right given to Congress to grant to authors and inventors a monopoly for a limited period of time. The general principles largely follow those of British cases. The American Courts give their decisions on case law, and the decided cases form precedents, as in England. It will be found that the American Courts take substantially the same view of patentable novelty as British Courts. American patents need not necessarily be for a manner of manufacture, and this somewhat widens the scope of patentable invention.

The most striking difference between British and American practice is in the procedure before the United States Patent Office at Washington. For many years the leading decisions of the Commissioner have been printed, and there is an extremely complex procedure which governs the examination and prosecution of patent applications. A few striking features may be briefly considered.

(i) The Patent Office is supposed to make as exhaustive a search as possible throughout the literature of the world and, further, it is supposed to pronounce on subject-matter in addition to novelty. It is true that the American Office frequently cites German, British and French specifications as well as American ones, and it is common in chemical cases to be met with citations from chemical literature. Also claims are frequently rejected by the Office for want of invention, even when they define something which is qualitatively different from the state of the art.

At the same time, however, in practice the standard of the American Patent Office is not so high as that of the American Courts. It is unfortunate that the salaries in the Patent Office are far too low, and therefore the staff changes very rapidly. This seriously impairs the efficiency of the examination, and it is considered that the search is not so exhaustive as it used to be. Still the fact remains that much argument will often be required to obtain claims of the desired breadth, because of the wide field of potential anticipations and the difficulty of proving that a given process is patentable over an apparently analogous prior process.

(ii) The American patent system allows a bewildering multiplicity of claims, and it is usual to insert claims which define the invention from various angles, together with a series of narrower claims which cover every possible combination of potential value. It is necessary to obtain the broadest possible generic claims, because the American Courts are stringent in restricting the patentee to the literal scope of his claim, and they are usually reluctant to apply the doctrine of equivalents, although striking exceptions are on record. It is essential to remember that the American Courts will usually strictly hold the patentee to every limitation he has inserted in his claim, whether wisely or not. If a claim specifies aromatic hydrocarbons as one of the features, it will not avail the patentee to say that aliphatic hydrocarbons work in exactly the same way when he finds that someone is obtaining similar results by their use; the Court will construe the claim with all the limitations inserted by the patentee. The difference between American and British practice is only a matter of degree, since, apart from the doctrine of equivalents, the British Courts take the same view, but it should be noted that this difference in degree does exist.[1]

One reason for the excessive number of claims in American patents is that a patentee can sue on any claim he considers valid, irrespective of the invalidity of the remaining claims. Claims are therefore multiplied without fear of destroying good claims by the presence of invalid claims.

(iii) There is a highly technical and at first sight

(1) A useful digest of cases on the Breadth and Scope of Chemical Cases is given by C. H. Biesterfeld, *Journal of the Patent Office Society*, August, 1920, pp. 598-608.

artificial system which governs the drafting of claims. The requirements of the American Office are sometimes criticised as pedantic, but, speaking generally, it may be said that while the layman finds a set of American claims to be a labyrinth of involved verbiage full of tiresome iteration of the same thing in different words, the expert in construction will find that this set of claims is really much easier to construe than those of a French or German patent.

(iv) It would carry us too far to discuss the requirements in detail, but one difficulty may be mentioned. A patentee is allowed to have claims for a genus and for one species of that genus, but he is not allowed to insert claims for species of the same genus which are alternative to each other. This requirement may be explained by an example. Suppose that it is desired to claim a process in which either formic or acetic acid gives certain results. The inventor would be allowed one generic claim for fatty acids and a specific claim for *either* formic acid, or the alternative species, acetic acid. The choice of a species may need very careful consideration, because if we decide to cover fatty acids by claim one, and formic acid by claim two, and it subsequently happens that butyric acid is shown to be old, we should obtain no protection at all for acetic acid, even if it gave much superior results, because the generic claim for fatty acids is anticipated by the fact that butyric acid is known. Yet when the claims are being drafted, it may be very difficult to say which of the specific forms of the invention is most likely to be valuable; in the example we have considered, if claim one had covered fatty acids, and claim two had covered acetic acid, we should still have been protected even if butyric acid were old, provided that acetic acid gave better results.

If each of the alternatives is of great importance, it might be advisable to file a separate application to claim the alternative which is not covered specifically by the main patent.

The objection to alternatives goes so far as to exclude the use of the word "or" in claims, with very rare exceptions. It is, therefore, necessary to find generic expressions which will include all the alternatives we desire to protect. If the invention is a process in which an acid or an alkali is one of the features, we can insert two claims, one for an electrolyte or some similar generic expression, and a second one for an acid, *or* an alkali, whichever is more important.

(v) The American claims must distinguish sharply from the state of the art without the necessity of qualification by statements of prior knowledge, *i.e.*, disclaimers, in the specification. It is thus necessary in drafting American claims to bring out very sharply the new combination of features. Difficulties are often met in chemical cases because the Office usually objects to negative limitations, *i.e.*, limitations in which something novel is defined by *excluding* something old instead of by using words which specifically include something new. If it was known to oxidise toluene to benzoic acid by a certain process, and an inventor discovered that it was possible to oxidise naphthalene to phthalic anhydride by the same process, the Office would object to a claim :—

> " A process of oxidising aromatic hydrocarbons except toluene which comprises . . ."

This would be a negative limitation, but the objection would be overcome by drafting the claim as follows :—

> " A process of treating hydrocarbons containing at least two aromatic nuclei which comprises oxidising them by . . ."

On the other hand, negative limitations are sometimes almost essential. If it was discovered that a certain reaction could be performed *in vacuo*, in steam, or in nitrogen, but not in air, the broadest claim could not mention these alternatives but might specify " with exclusion of free oxygen." This should be regarded as a positive step, although expressed in negative language.

(vi) The Office rejects " functional " claims, *i.e.*, claims which define the invention solely by a function or a result. Thus if it is old to obtain a fusible resin by condensing A with B, the Office will reject a claim reading :—" A process of condensing A with B so as to form an *infusible* resin," although a claim for an infusible resin might be allowed for the new *product*. The process claim would have to define the new step necessary to obtain the new infusible resin instead of the old fusible resin.

Functional claims are not allowed for apparatus, but in practice very wide claims can be obtained for new apparatus " comprising the combination of means for performing the operation X with means for performing the operation Y."

The wide use of the generic expression " means for . . ." is a valuable feature of American practice in apparatus patents. This is often important in drafting claims for new types of chemical plant.

(vii) An American claim for a process gives no protection whatsoever for the product. Further, an American patent for a process of manufacturing saccharine would not be infringed by importation of saccharine manufactured abroad by the same process. It is therefore advisable to obtain claims for chemical products, and American practice places no restriction on such claims, provided that they are defined by their final properties and not by the history of their preparation.

The discoverer of a new dye could claim the new chemical body as such and restrain others from making it by his own process or by any other process.

If it is discovered that a known substance can be obtained in a much higher state of purity by a new process, the American Office will allow claims for the substance of a specified novel degree of purity, provided that this appears of importance. Thus if it is found that an organic ester can be obtained of a boiling-point 10° higher than was recorded in the literature, by using a process which is not obvious at first sight, *e.g.*, by distillation over a certain reagent, and if this difference in boiling-point is of commercial importance, it will be possible to obtain a claim for: "An ester of boiling-point of at least 5° to 10° above the ordinary boiling-point."

The Office would, however, reject a claim based on the history of the substance, *i.e.*, a claim which specified the organic ester as prepared by distillation over a particular reagent. Definition should, when possible, be effected by specifying the final properties of the substance.

In concluding these remarks on American practice, two important features should be mentioned. The applicant for an American patent must be the actual inventor, and the patent application is not anticipated merely because he has published the invention broadcast shortly before his application. Contests of priority between rival inventors are determined in the Patent Office by Interference Proceedings in which the date of application at the Patent Office is not conclusive evidence of priority as in England (except in cases of fraud), as it is also important in America to determine the date of conception of the invention and its reduction to practice. American inventors should therefore remember that in England they ought to file a patent application before making any disclosure to anyone, since British law differs from American law so vitally in this respect.

If a British inventor wishes to obtain a patent in the United States of America, he should apply within twelve months of the date of his British application, in which case he obtains a certain priority under the International Convention. If the American application is filed more than one year after the British application, *whether the British application is published or not*, it will be a statutory bar to the grant of a valid patent in the United States of America, *unless* it is possible to accelerate the American application, so that it is allowed and issued before the British patent is sealed. Such acceleration is difficult, but often possible.

Another characteristic feature of American law is the possibility of expanding the scope of the patent after it has been granted; broader claims can sometimes be obtained by " re-issue " of the patent.

(3) The German system is an attempt to make the Patent Office fulfil the functions of the Courts. The German Office makes a very thorough search

among German and foreign patents and considers whether the claims possess subject-matter: it is not sufficient merely to define something novel, since to obtain a German patent the Office must be satisfied that the Court would probably find subject-matter. Further, in opposition procedure the German Office can consider prior use by others.

Hence, once a German patent is allowed, its position is perhaps stronger than that of patents in other countries; after five years have elapsed, the validity of the patent cannot be challenged for want of subject-matter.

The German Office usually requires claims to be drawn in a stereotyped form, in which the first part of the claim recites the nearest known genus, and the second part recites the logical "difference," *i.e.*, the limitation which defines the new species. In other words, the German practice is based on the Aristotelian theory of definition.[1] Thus a claim for producing a dyestuff C by condensing two known intermediates A and B in presence of a new condensing agent X, when other condensing agents had been proposed previously, would read: "A process of producing a dyestuff C by treating A and B with a condensing agent characterised by the feature that the condensing agent X is employed."

(1) As to recent tendencies and the bearing of modern logic on these problems, see Potts, *Trans. of Chartered Institute of Patent Agents*, 1917-1918, page 65.

The claims can be drafted in a more functional manner than in U.S.A. and the whole tendency is to make the set of claims as perspicuous as possible. The Supreme Court at Leipzig at present interprets claims very broadly, and the doctrine of equivalents is applied far more generously than in the United Kingdom. Indeed, if a patentee claims the combination of the features A and B, the Supreme Court might give independent protection to the feature A when unaccompanied by B. German interpretation is thus broader than British. It is not wise, however, to draft unduly narrow claims in Germany, especially since the practice of the Supreme Court might change, when it would be very inconvenient for the patentee to find his claim construed with American stringency. And, in any case, it is always easier to prevent infringement if the actual wording of the claim is broad enough to cover what the infringer is doing, without calling in the doctrine of equivalents.

The German Office is often impressed by arguments of a theoretical nature, and it is always desirable to bring out any points tending to indicate that the process gives results which would be unexpected. Hence the common use of the words " The surprising observation has been made that . . ." in German patents. Sometimes the results of practical tests by experts are useful. Pre-war German patents were valuable as affording a "certificate of validity" which indicated that the invention probably contained novel features. Post-war practice indicates a certain relaxation of the standard of patentability.

Claims for chemical products are not allowed, but process claims protect the direct result of the process.

Further information on German practice will be found in the monograph of Ephraim, mentioned in chapter five.

(4) The law and practice in Holland, Sweden, Denmark and Norway closely follows that of Germany. The examination system in Holland is particularly thorough; the procedure is tedious and protracted. Much difficulty is experienced in Japan in chemical cases and it is to be hoped that the new Japanese law will be interpreted to assist the applicant.

(5) French patents contain no binding claim at all. The usual *résumé* is not a claim and the Courts read the whole specification in the light of the prior art and give the inventor the benefit of what novelty may be present. This is excellent for the inventor from one point of view. But it is highly inconvenient for the public who are left in total uncertainty as to the scope of the patent: the resulting distrust of the value of patents is not in the interest of the patentee. No examination for novelty is made.

The law is similar in Belgium, Italy, Portugal, Spain, etc., except that claims are inserted in these countries.

It follows, therefore, that while it is easiest to obtain patents in countries of group five, it is better to apply for British, German and American patents first to obtain the results of the Official examination. After the reconsideration of the essential features of the invention which is necessary to overcome the official objections, it is possible to draft the specification for other countries in a stronger form. It is better for the inventor to arrange for a thorough search to be made before filing foreign applications anywhere.[1] This is a feature of American practice which might be followed more generally in this country. Two examples may be given from personal experience in U.S.A.:

(i) One chemical firm stated that in important matters they arranged for four separate men to undertake a search before planning their research programme. The results of the search were then considered by their patent adviser. If possible, research was directed along lines not impeded by hostile patents.

(ii) Another firm applied to chemical consultants to devise a new product. The consultants surveyed the whole field of literature,

(1) Searching is a difficult art which requires much experience: (see "Investigations of the Chemical Literature," by F. E. Barrows, *Chemical and Metallurgical Engineering*, 1921, vol. XXIV, pp. 423, 477 and 517). Special care is necessary for searching for legal purposes.

selected promising areas not protected by patents, carried out investigation on these lines and solved the problem. The report on the solution was placed in the hands of a patent attorney with instructions to protect the results thoroughly by patents. Enquiries by the patent attorney on difficult points were met by submitting further experimental data.

SUBJECT INDEX

(*See also Summaries of Chapters in Contents, and Index of Cases.*)

INDEX OF CASES CITED

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