6 Mobilising Resources Through Texts

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In the preceding chapters it has been argued that texts are powerful in science. This is because they have the capacity to act at a distance through the presentation of a carefully structured actor-world. They signpost the passageways that interested readers should follow, and they make these signposts forceful by providing traces that lead the reader both to the laboratory and to other scientific articles. Readers who wish to deconstruct the text – normally other scientists working in the same area – have to retrace the passageways provided in the paper and remake the publications and laboratory findings depicted therein in a different way.

Scientific articles are not the only texts that emerge from laboratories. Funding applications constitute an obvious example of another kind of text written in the laboratory and patent applications are becoming increasingly important to universities. These texts are intended to mobilise financial resources rather than scientific credit. Legitimation in the eyes of a broader public also counts as an important resource. This may be achieved through press releases, public presentations and, on a larger scale, through policy-oriented reports on research areas and disciplines. These latter kinds of texts will be discussed only in passing. In this chapter we shall focus on funding applications and patent applications, both because they are important and interesting, and because we shall have occasion to come back to them in Part III of this volume.

When texts go to audiences that are not solely composed of competing colleagues, the forces that operate at the point of reception are different. In order to work upon these forces and create obligatory passageways the text has to recognise the particular requirements and interests of the

audience while continuing to function as the emissary of the laboratory. Thus the means by which the actor-world is built up have to be adapted. For one thing, the readers are not in general able to go back to laboratories to check or deconstruct the actor-world they are being invited into. Nor do they want to. Funding agencies and their review panels and assessors judge a funding application in terms of agency goals and criteria. The text thus has to build a bridge between a branch of scientific inquiry on the one hand, and the concerns of the agency on the other. Again, in the drafting of patents, a bridge has to be built between a particular claim and the requirements of patent law and jurisprudence, while policy-oriented reports have to link the concerns of a particular discipline to prevalent social concerns and images of science.

While the scientific article has to work upon the interests of a reader in order to persuade him/her to read the article and pass through the laboratory, the problem confronting those who write the kinds of texts discussed in this chapter is rather different. Readers confronted by a patent or a grant application are normally already interested. The problem of the writer now becomes primarily that of marshalling a set of forces that will withstand sceptical scrutiny. Thus a funding application generally argues that if the funding agency wants to attain some of its objectives, then it has to pass through the research being proposed. A patent assumes that there is an economic interest in its content and sets out both to offer the possibility of exploitation to licencees and to protect its property rights. Texts written for broader publics carefully select material and style in order to reach their audience while convincing it, in the same movement, of the indispensability of science to progress. One could say that in all these cases it is the laboratory that has to displace itself in order to translate successfully.

FUNDING APPLICATIONS

Although the format and rules of funding applications differ in detail between agencies and countries, they nevertheless share certain general features that are connected with the necessity to persuade an external audience both that the proposed research is worthwhile in their terms, and that the applicant is the best person to perform the research. It is thus a matter of *interessement* (see Chapter 5): the text has to come between the agency and its indifference to the proposed research or its attraction to the proposals of other research groups. At the same time it has to muster and array its forces in such a way that an obligatory

passageway is constructed that leads the funding agency through the laboratory of the applicant – to the conclusion that money and other resources should go to him rather than to other researchers in the area.

In order to illustrate this let us take a concrete example which is drawn from the French Action Concertée on fuel cells and the electric vehicle that was discussed in Chapter 2. We are at the stage just before Electricité de France makes its bid for power and presents the actor-world of the future in which urban traffic problems will be solved through the use of electric buses and cars. The original interest in fuel cells is still visible, but this is no longer the exclusive focus of attention. There is also concern to improve the performance of conventional lead accumulators. Now the director of a CNRS Electrolysis Laboratory submits a grant application¹ for one million French francs (anno 1969) to the Délégation Générale à la Recherche Scientifique et Technique (DGRST), the government agency that funds and coordinates the Action Concertée.

The application is for a three-year institutional grant, and sets out a plan of work for the laboratory that is presented as broadly relevant to the Action Concertée. The general structure of this application is one that is found in most such texts. Thus, after the title, the name, and the institutional location of the applicant and a summary of the application, there follow three sections:

- (a) a justification for the proposed research and general objectives;
- (b) a plan of work, including a list of staff and a budget request;
- (c) appendices containing a list of publications and patents that have issued from the laboratory, plus a scientific note on a new development that provides the basis for part of the proposal.

The first section is designed to translate the agency and to link its (presumed) goals and priorities to particular points of passage – the research projects to be undertaken by the Electrolysis Laboratory. It is not, however, a matter of bridging a gap between two given entities. As will be shown below, the research is rearranged to fit with the (supposed) interests of the agency. But the priorities of the DGRST will also be changed when it accepts the application and incorporates the claims being made into its plan.

The second section shows little visible interest-work. The listing of research tasks details and extends the logic of the proposed projects, but there is no further argument about why it is important to do it in this way. The specifications of the personnel of the laboratory and of the

budget add to the impression that the second section provides the necessary bureaucratic accountability. It is only because of this that it helps to strengthen the chain of forces: our laboratory is not a phantom, and if your money is spent on us you will get something in return.

The third section is an essential part of the array of forces that is brought to bear on the agency. The fact that it is called 'Appendices' should not mislead the reader for it is necessary to further strengthen the walls of the passage. It is designed to prevent escape by countering the suspicion of those who might feel that the laboratory was not doing anything useful, that its work was scientifically inferior or otherwise unpromising, or that its personnel were inferior and unable to undertake the research in question. Since the text has to stand by itself *all the forces of intersement have to be presented explicitly*.

Let us now turn to a more detailed discussion of the text of the first section of the application. First it should be noted that, as is the case with scientific articles, the forces that are arrayed are heterogeneous in nature. This is particularly obvious here since the policy goals of the agency and the scientific concerns of the laboratory need not mesh. The specific links that have to be made are already revealed in the title: 'Fundamental studies to achieve (1) new batteries and reversible electrochemical cells; (2) fuel cells using hydrocarbons directly.'²

In the main body of the text the applicant makes a further attempt to solve his problem: that of showing the technological relevance of his research to the funding agency while simultaneously remaining true to the basic science approach required of those employed by the CNRS. Thus the development of new batteries is not in his brief ('it is not the mission of the Electrolysis Laboratory to develop pilot models, and neither is it competent to do so'), but for precisely this reason it is extremely desirable to collaborate with the laboratories of the CGE (a subcontractor to Electricité de France): 'this is the only way to obtain convincing pilot systems (embodying new battery technologies) within a reasonable time'. The DGRST is assumed to be interested in having working batteries available in the not too distant future, and the applicant creates an organisational and scientific network with himself at a strategic location which will purportedly make this possible.

In fact the problem for the applicant is yet more complicated. Under the influence of EDF, the DGRST has distinguished long-term goals (the construction of vehicles using fuel cells) from short-term possibilities (the design of vehicles using more efficient lead accumulators). The laboratory has thus to insert itself into two different hierarchies of problematisation. It fits itself into the short-term one (short-term

transport policy—electric vehicle—rapid development of more effective lead accumulators) by proposing to work on a new type of electrode (with a 'dispersed structure') that may also be used in existing lead accumulators. At the same time it continues to insert itself into the long-term hierarchy of problematisations (long-term transport policy—electric vehicle—ultimate development of fuel cells) by further work on the behaviour of the components of fuel cells. Thus the general objectives of the research are specified in the following way:

- a. The continuation of studies on the direct electrochemical oxidation of hydrocarbons on platinum surfaces.
- b. Fundamental studies of different systems in which one or both electrodes have a dispersed structure.

Consider the first of these: here the long-term hierarchy of problematisations has been further extended. The problem is now more specific and technical: an analysis of the way in which electrochemical oxidation takes place on platinum surfaces. 'An original method' (the monotubular electrode, see Callon, 1980b) has made it possible for the laboratory to isolate and study most of the phenomena that occur in the electrode. This translation that has been the backbone of the earlier research of the laboratory on fuel cells, now will be further extended. In this way a complete picture of the mechanism of electrochemical oxidation will be obtained. This, then, is the final step of the long-term hierarchy of problematisations – the 'bridge of interests'. It is through the monotubular electrode that those wishing to improve the performance of the fuel cell must pass:

It is only through the complete scheme of this reaction that one might envisage the means enabling the speed-up of the slow steps in the reaction mechanism, and might define the catalysts best suited to promote these reactions.

A complete series of translations thus transmits the agency from its long-term policy concerns to the reactions of electrodes on platinum surfaces via the laboratory that will undertake the work in question.³

The second research objective presents another hierarchy of problematisations. The proposed work, on systems with 'dispersed' electrodes, is a new venture. Earlier in the application it was noted that the laboratory had recently been experimenting with different electrode structures, and in particular dispersed structures. The applicant notes

that 'In fact, analysis of the difficulties encountered by industry in producing fuel cells has led us to consider electrode structure from a new angle.' Having positioned himself as a spokesman for industry, he then derives a number of conditions from the requirements of the industrial production of fuel cells, and suggests that dispersed electrodes meet these conditions. While first attempts produced mediocre results and did not meet theoretical predictions, with a special cell the results have been much more promising. This 'early promise' is outlined further, and the text then concludes:

These results show the interest of continuing such studies, which have been purely exploratory until now, and at the same time of extending the domain of the application of dispersed electrodes to generators that are either new systems that cannot be created in any other way or would otherwise give disappointing results, or to traditional systems (e.g. lead accumulators) whose performance is still susceptible to considerable improvement. It seems clear that such a study – which will, in the long run, contribute considerably to second generation fuel cells – will in the short term lead to interesting and directly exploitable findings in the domain of batteries and reversible cells.

This translation follows the same general pattern as that on the direct oxidation of hydrocarbons. Again, links are made between both the long- and short-term goals of the agency in order to present the proposed research as being of unique relevance to the latter. There is a relationship between the two hierarchies of problematisation: improvement to existing batteries and accumulators arises out of problems encountered with fuel cells and their 'second generation' improvement. However, the work will contribute to the efficacy of first generation accumulators even in the absence of subsequent fuel cells. In fact, in the work plan the main thrust is in research for applications in lead batteries and accumulators. Fuel cells appear only when a study of electrode mechanisms for dispersed electrodes is envisaged.

Overall, however, there is explicit reference neither to the changes in goals of the Action Concertée nor to the scenario specified by EDF. This is partly because the applicant assumes that the background is known to all concerned. It is also, however, a matter of tactics. The director of the laboratory has designed in his proposal an actor-world that may link up with not only the new but also the original goals. To associate the problematisations too closely to the one would risk dissociating it from the other.

In the particular text studied here the difficulties of identifying the goals and priorities of the agency and presenting research as a means to those ends – i.e. creating a map of the world of the future with which the agency is willing to go along – are very visible. However, the hedging of bets is very common in funding applications. To maximise relevance, and therefore the chance of being funded, research is presented as a potential means to as many ends as can plausibly be invoked. Therefore, expected outcomes are not specified in any detail, particularly in more fundamental research. Since the reader does not have to follow any particular one of the specified itineraries, there is a loss of obligatoriness. The overall effect may still be an impression that there will be a general return on the project in question.

Finally, let us consider some of the similarities and differences between funding applications and scientific articles. In the course of the above analysis we have talked of ‘hierarchies of problematisation’ and the way in which these hierarchies are generated by successive applications and scientific articles. Thus, in Chapter 5, it was argued that the ‘funnel of interests’ is the characteristic form of translation adopted by the scientific article. Such a funnel selects and chains terms that will (it is hoped) be treated as forces by the readership and hence will lead the latter to an obligatory point of passage. For the scientific article the reader is, of course, the specialist. In the case of funding applications the readership is equally clear. The problem is to assemble and array terms that lead from the goals and priorities of the agency to the particular research being proposed.

It is much more difficult, however, to prevent the sceptic from escaping in the case of the grant application. This is because the doubting grant agency, unlike the doubting scientist, is not being challenged to read all the references cited and replicate the work in question if it wants to challenge the actor-world that is being created. All it has to do is to reject the application by giving a small number of general reasons – it does not have to engage in close argument with the proposer. Accordingly, the author of the grant application reacts by writing in a different manner. As already noted, the tactic of multiplying the relevance of the proposed project may be adopted (with, however, the danger of becoming too vague or grandiose and losing force as a consequence). A complementary tactic arises out of the fact that the agency forms part of a political world and is involved in struggles outside the direct control of any laboratory. The tactic involves (consider Pasteur as discussed by Latour, 1983) presenting research in as ‘black boxed’ a manner as possible. Thus, instead of asking the reader to

consider (for instance) the intricacies of rat yolk sac pinocytosis (see Chapter 5), textual work is directed instead at showing the general relevance of the research programme (and hence its funding) to the agency. In this respect, then, a funding application is like a company share prospectus. Interestment occurs, if it occurs at all, by appealing to past results, anticipated trends and projections of activity.

However, it is important not to exaggerate. It is necessary to supply enough details to make 'early promise' or 'future promise' plausible and to create confidence in the competence of the applicant. The text of the funding application thus has to build a 'bridge of interests' between science and politics, worlds that are generally held to be separate. In the case under discussion here, the applicant generated a document which sought to link the Action Concertée and its interested parties (see Chapter 2) on the one hand, with the scientific research of his laboratory on the other (see also Callon, 1980a, 1980b, 1983).

A corollary to this analysis of the funding application as a 'bridge of interests' is that the reduction of the text to a string of forceful words does not lead to the same sort of result as in the case of scientific articles. In the latter the full force of a text can be captured by a string of words (see Chapters 5 and 7). For funding applications the key-words which represent objects and methods of research may be used to map the world of science that they trace out. However, the words related to the specific structure of means-relevant-to-ends are too local to be used as a basis for maps.⁴

PATENTS

In the texts of patent applications the science is even further displaced than is the case for scientific articles or funding applications. This is because there is a wide range of legal requirements that has to be satisfied, and the applicant has to guard against loopholes and eventual litigation. For this reason, patent applications are often written by specialist patent advisers and not by scientists themselves. Patents are still arrays of forces that are designed to oblige the reader to follow certain itineraries. The itineraries are traced out more explicitly because they are legal documents and not simply texts emanating from a laboratory.

There are three different kinds of readers that have to be led through the text: the officials of the Patent Office, who have to grant the patent; the competitors in the area who are eager for information about new

products and processes; and potential licensees who have to be interested in what the patent offers. Thus a patent application is a compromise between different strategies of enrolment. In addition, the application, if granted, becomes a legal document conferring rights on the patentee: it transforms an invention into intellectual property. For this reason, the text as it stands becomes much more important than in the case of scientific articles. Mistakes will often be irreparable. Before considering examples of the strategy and tactics of patent application, we note some general features that stem from the constraints related to the different audiences that have to be managed.

First, the world of science is treated as far as possible as a black box.⁵ The patent application is about the uses that a given invention may have, and there is no reason to divulge the know-how to anybody able to read the application in the Patent Office. Patent law, however, requires a description of the invention to guarantee 'enablement': the reader must be able to make and use the claimed invention without undue experimentation. One reason for this clause in patent law is to make it possible for other workers in the area to recognise when they are potentially involved in infringement; the other is the disclosure of the technical advance in return for the protection of intellectual property rights for a limited period of time – in general between fifteen and twenty years. Although patentees may value the patent system in general, in writing their own application they will try to keep the box around their own invention as black as possible while still satisfying the enablement requirement. Penetrability is not in their interests.

The attempted black-boxing of the invention leads us to the second general feature of patent applications: the way in which they map itineraries for the reader to follow. The description of the invention and its uses creates itineraries but adds toll-booths to them. The road to the profitable use of know-how is signposted, but barriers are constructed through patent protection (provided the patent stands up against litigation). Only licensees who pay the toll are able to proceed and allowed to try to reap some of the profits.

Thus the readers are not sucked in by a funnel of interests. Instead, they are challenged by a domain claim in which an interesting area of exploitation is simultaneously indicated and fenced off. Potential licensees have to pass through the toll-booth and pay their dues if they want to gain access to, and obtain a detailed map of, the inside of the black box. Perhaps it would be best to characterise the rhetorical structure of patent applications as a 'fence of interests'. In fact, many patents are taken out not to protect rights to an intellectual product or

process, but rather simply to ward off the activities of others in a particular domain.⁶

What are the arrays of forces that are assembled and put together in order to oblige (or forbid) certain passageways? First there is a very common feature derived from the expectation that legal suits will be brought. This is to start with a broad claim that prohibits a wide range of itineraries, but which runs the risk of not being accepted by the Patent Office or of being unable to stand up under later litigation. After this first claim there follow others which are narrower and are accordingly easier to defend, but which bring less profit. To take an example from biotechnology:

Application N. 008378 of Jackson, Theriault, Sinclair, Fager, and Karwowsky . . .

Claim 2: A process for producing the antibiotic AX-127B-1 which comprises culturing a micro-organism belonging to the species *Micromonospora pilospora* having the ability to produce the antibiotic AX-127B-1 in a nutrient medium including a carbon and nitrogen source and accumulating the antibiotic in said medium.

Claim 3: A process according to claim 2 wherein said micro-organism is selected from the group consisting of *Micromonospora pilospora* NRRL 11415, *Micromonospora pilospora* NRRL 11416, and *Micromonospora pilospora* NRRL 11417, and mutations thereof.

The code numbers after the *M. pilospora* varieties in claim 3 refer to the deposits in culture collections. Such deposits are often made in biotechnology, since the way of isolating ('producing') the micro-organism necessary for a process or product cannot be described exhaustively, and 'enablement' has to be guaranteed by providing a specimen that is publicly accessible.

In this example, claim 2 was rejected by the Patent Office because it held that undue experimentation would be needed for a claim that encompasses unisolated species. However, claim 3 was allowed (Adler, 1984, p. 360). It is not uncommon for scientific articles to present broad claims that are more interesting than the findings on which they are based, but which subsequently have to be retracted as a result of criticism. In this patent application example, however, the breadth of the claim is not related to the interest of the scientific findings but rather to the domain of exploitation. Retraction does not change the science but

instead has an influence on the amount of resources that can be mobilised by the text.

Competitors and potential licensees have an active interest in the validity of the patent. If they can show that some passageways are not prohibited (for instance because of insufficient specification), or passage through the licensing toll-booth is not obligatory (for instance because of an earlier publication of the process or product), it will save them money and effort. Accordingly, the attempts to dissociate the forces arrayed in patent applications are often intense, especially when an invention may be very profitable. In order to illustrate this we shall briefly discuss the famous Cohen–Boyer patents that claim to cover the basic recombinant-DNA technology, worth perhaps a billion dollars in licence royalties over its seventeen-year lifetime (even with the liberal licensing policy of their holder, Stanford University). The first patent was applied for in 1974. It was entitled ‘Process of Producing Biologically Functional Molecular Chimeras’ and described what we would now call recombinant-DNA technology. The patent was issued in 1980 (US Patent 4237 224) after careful consideration by the US Patent Office.

A big problem with this patent is that it is about a process, so infringement of the patent is difficult to trace, and even when its occurrence is suspected, patent law makes it well-nigh impossible to recover damages. Stanford University lawyers had recognised this problem, and therefore filed a second patent, now on a product, the plasmid pSC 101, containing a manipulated DNA. Let us quote a representative claim from this patent application (US Patent Application No. 959 288):⁷

As a composition of matter, a biologically functional recombinant plasmid capable of selection and replication in a unicellular micro-organism cell comprising:

a first DNA segment containing an intact replicon recognized by said cell derived by cleaving a virus or plasmid compatible with said cell at other than the replicon site, which segment is covalently joined *in vitro* at its ends to the complementary end of a second DNA segment foreign to said cell having at least one intact gene, said second DNA segment derived from a source which does not exchange genetic information with said cell.

Since infringement of this claim would be directly detectable, this patent is the really valuable one. If it were granted it would force a large number

of actors to pass through Stanford's Patent Department and apply for a licence before they could continue with their work on recombinant-DNA technology.

Because of its potential value, this patent application was screened very carefully by the Patent Office. Though the text of such pending applications is kept secret by the Patent Office, Stanford University decided, for a time, to open its patent file to interested parties. This was, in part, a public relations tactic, but it was also a way of finding out about potential weaknesses at an early stage instead of having to go through costly litigation later on. The invitation to attack the fences of interest and try to bring them down was taken up by at least one recombinant-DNA technology user who had not arranged for a licence with Stanford University. A patent attorney at Exxon published a review article, 'Patenting the Results of Genetic Engineering Research: an Overview', in an academic volume. Knowing that the Patent Examiner in charge of the Cohen-Boyer patent could read the paper, he used footnotes to present information that might lead to rejection of the patent application.

One potential objection arose from the fact that a publication about the plasmid had appeared in the *New Scientist* more than a year (i.e. more than the 'period of grace' allowed by US patent law) before the patent application was filed. To the relief of science journalists and others who were expecting molecular biologists to become even more close-mouthed than had previously been the case, this objection was waived by the Patent Office. The second potential objection hinged on a technical point: the application should describe the 'best mode', but Cohen had noted, in a later publication, both that the plasmid as described would not do what it was claimed it could do, and that he had not, at that time, deposited the plasmid.

Consider the way in which the Exxon patent attorney (Halluin) attempted to dissociate Cohen and Boyer's array of forces at this particular point. After making a general remark in the main text to the effect that developments may prove an original procedure to be inoperative in producing the desired plasmid, he footnotes the sentence with a lengthy discussion of the Cohen-Boyer patent. Part of the text, with the comments of Goldstein (1982) that highlight some features, is given below:

It is interesting that such a revised interpretation has occurred with respect to the origin of plasmid pSC 101 [citing a Cohen and Chang 1977 article in *J. Bacteriology*]. In this article, Cohen *et al.* state that

the original belief that pSC 101 was formed by recircularization of a fragment of R6–5 DNA was incorrect. This observation is particularly interesting [note how ‘interesting’ makes its appearance once again: a lawyer’s way of saying, ‘Hey! Something funny is going on!’] in view of Dr Cohen’s statement in his article in *Scientific American* (Cohen, 1975) which reads: ‘For a time after our initial experiments the pSC 101 plasmid was the only vehicle known to be suitable for cloning DNA in *E. coli*.’ . . . It is noteworthy [!] that Dr Cohen did not deposit pSC 101 with the ATCC (37032) until June 25, 1981 (pers.comm. B.A. Brandon, of the ATCC).

Although Halluin purportedly only makes interesting observations, he is in fact saying that the patent may not enable the best mode. On this and other grounds the US Patent Office withdrew the case in 1982. Stanford University lodged a rebuttal, and most objections were met or judged insufficient. The Patent Office granted the second patent in September, 1984. Even so, the reopening of the patent file has revealed that the 1977 paper by Cohen only became known to the Patent Office as a result of Halluin’s article. This was in violation of proper procedure and, despite the granting of the patent, suggests that the latter may prove difficult to enforce in practice.

What concerns us here is how patent law and jurisprudence set the scene for interessement and counter-interessement: enablement, publication problems, ‘best mode’ and so on, these lay out a scenery of forces that are used by the different parties to erect fences or to take down the fences that constitute their opponents’ claims. In the particular example discussed here, Exxon attorney Halluin, in trying to influence decisions of the Patent Office, not only shows how the forces of the world of patent law are borrowed to change passageways – if Halluin’s views are upheld by the Patent Office, Exxon need not pass through Stanford University to use a convenient plasmid. It also shows how scientific developments, with their own dynamics, interact with the world of patents. Thus, even if science is black-boxed in a patent application, the box may be prised open, and the content of scientific articles may be used by patent attorneys to bring about their counter-interessement.⁸

In conclusion we note that the texts of patents are structured according to patent law, jurisprudence and litigation, but borrow some of their force from science, and the invention (assumed to be science-based in our discussion) has to be detailed sufficiently to meet the requirement of enablement. This part of a patent text can be reduced to a

string of key-words, and form the basis of scientometric analysis (see Chapter 10). However, as with funding applications, such a string of key-words does not cover the full force of the patent text. To trace the 'fencing of interests' a separate analysis of each patent and its context is necessary.

CONCLUSION

The question as to how texts mobilise resources cannot be answered in a general way. However, the analysis offered in this chapter, although preliminary, already reveals some interesting features and suggests that the approach is fruitful.

It is striking that science cannot normally just claim resources and expect to receive them. Rather, it has to orient to given arrays of forces – those of funding agencies or patent law – and build obligatory passageways by modulating them. This is clear in the means–ends rhetoric of funding applications. Similar rhetoric can be found in a more diffuse and indirect form in prospective reports, where the general utility and/or fundamental importance of whole disciplines is argued. Because public legitimation and a favourable climate in government agencies is sought, the argument has to accommodate itself to prevailing opinion and images of science – a diffuse but very real requirement. Since the audience is undefined, the rhetoric is not very tight or directed. One may speculate, however, that the demands of science policy and the need for legitimation will lead to further articulation and specification.

Patent applications have a different shape because the resources they mobilise benefit science only indirectly. They have to follow legal requirements in order to realise property rights based on science. The 'fences of interest' that they erect lead to specific and explicit strategies for the construction and deconstruction of arrays of force. In the course of these struggles scientific findings may become involved.

An interesting aspect of patent applications is that when the patent is finally issued the text, as such, certifies legal rights. Its array of forces is declared durable by the Patent Office and stands between the new process or product and potential users. Therefore the details of the text become much more important, because irreparable, than is the case for scientific articles. Legal battles may now be fought about interpretations of words or sentences.

In general, the texts sent out by laboratories to external audiences have to stand by themselves. The particular power of scientific articles,

their links to the laboratory and to other articles, can be exerted only sparingly. Policy-makers, patent officials, grant-awarding bodies, these work primarily with the text that is submitted to them. Deconstruction of the assembled forces follows political, legal, or bureaucratic lines. The scientific component of the text has to meet minimal requirements but is not a direct object of criticism.

Although we have emphasised that science has no direct power and has to insert itself in an external world, it would be wrong to picture it as a beggar or a suppliant, satisfied with the crumbs that fall from the tables of princes. The texts are able to present science as an obligatory passageway for government and industrial firms. The 'palace' and the 'firm' are interested in the 'laboratory'. There is, then, something of a paradox here: science is inevitable and indispensable in contemporary societies, but when it mobilises resources it cannot use its power to command them.

In order to see how power struggles between the 'palace', the 'firm' and the 'laboratory' are conducted it is not enough to look at the structure of texts. In our study of the workings of laboratories we argued that it was first necessary to follow the actors, and only subsequently consider the working of texts as one of the instruments used by the actors in their struggles. The same approach will be necessary for what used to be called the external relations of science: we are in need of ethnographies about funding agencies, patent offices and committees on the public aspects of science. Only then will we really begin to understand how the texts sent to them by scientists are able to mobilise resources.

NOTES

1. 'Recherches fondamentales en vue de la réalisation; premièrement de nouveaux accumulateur et piles réversibles, deuxièmement de piles à combustion directe des hydrocarbures' (Laboratoire d'Electrolyse du CNRS, 1969).
2. All translations from the French original are by Arie Rip.
3. But, lest the DGRST escape, a secondary interestment is advanced: if one is interested in widely usable fuel cells then the direct oxidation of hydrocarbons constitutes the only really acceptable solution. Alternative developments that lead to application in a nearer future need extra parts and will therefore not be widely used. For good measure it is noted that 'The same assessment has been made by experts of the US Army'.
4. Unless, of course, one were particularly interested in the way the world of an Action Concertée was mapped in funding applications, and also prepared to draw up a special set of key-words and a coding procedure to this end.
5. Many patents are not science-based, but we limit our discussion to those that are.

6. In some countries this strategy is counteracted by requiring actual application of the invention for the patent to be upheld.
7. The patent claims are quoted after Goldstein (1982).
8. Earlier in history, the interaction between scientific developments and patent cases was much more direct as, for instance, in the early dyestuff chemistry studied by Van den Belt and Rip (1984). Advances in science could even lead to modifications in patent law (routinisation of innovation in the case of azo dyes), as is now happening again in at least some countries for the patenting of engineered organisms, see Adler (1984) and Huni and Buss (1982).