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[See table of contents](#)

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THE STEACIE MYTH AND THE INSTITUTIONS
OF INDUSTRIAL RESEARCH*

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National policy usually claims to be based on a true and comprehensive perception of national history. A Canadian peculiarity is that an admired and politically influential body of science policy literature appeared in 1960-75, before professional historians had begun to grapple with the history of science in Canada, or at least published much. Science policy analysts, so far as they felt obliged to provide historical reasons for their judgments, were forced to improvise their own historical narratives and interpretations. In the last ten years, because of the lack of textbooks, some of these policy documents, notably Volume 1 of the Lamontagne Committee's *A Science Policy for Canada*, have been taken up by historians' curricula. They are used *nem. con.* because no one, except obviously partisan defenders of a discredited past, has challenged their accuracy. Thus these policy analyses have become as influential in history as in science policy.

The practical influence of the Glassco and Lamontagne Reports is not to be denied; and they are therefore important for students of history as well as of political science or economics. But this importance does not bear upon the accuracy of their historical narratives or the validity of their interpretations. Historical integrity can be maintained only by the canons of historical scholarship, to which both Reports appeal, in the case of the Lamontagne Report quite explicitly:

The present state of Canadian science policy is largely a result of the past and cannot be really understood without reference to its historical background ... The danger arising from the re-constitution of an historical record has been described by Fischer as the *pragmatic fallacy*; one can fall into this trap by selecting facts in the service of a cause. In choosing its material, the Committee may have had its perception coloured by its preoccupation with the problems of present-day science policy. To guard against such bias, the Committee has asked some knowledgeable persons to read and comment on those historical chapters.¹

* This paper was begun under the auspices of an extramural stage of the Institut d'Histoire et de Sociopolitique des Sciences, Université de Montréal at the National Research Council. An earlier version was presented to the Montreal/Toronto Project in Industrial History in 1982.

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This claim is not, explicitly, to have followed scholarly historiographic methods, but must be read as an assertion of accuracy and comprehensiveness sufficient to the document's purpose. My present theme is that in its account of Canadian science 1945-62, particularly in its treatment of governmental programmes in support of industrial science and research, the Lamontagne Report is fatally defective.

There is a variety of reasons for this, ranging from the Senate Committee's uncritical acceptance of equally-flawed historical material in non-historical documents -- notably the Glassco Report of 1963 -- to its own 'Guide for Submission of Briefs and Participation in Hearings,' which expressly excluded from formal consideration all events prior to 1962.² Most specifically, the Committee, and its chairman in particular, appears to have been biased *a priori* by the 'Steacie Myth,' which the Report ultimately offered as both the ideology and the management practice of government institutions for industrial research.

The Steacie Myth is named for E.W.R. Steacie, president of the National Research Council from 1952 until his death in 1962. Because of both his charismatic personality and his public offices, Steacie was unquestionably the leader of the Canadian scientific community in the decade. He represented the ideals of science to his fellow professionals and the power of science to his fellow administrators in government, over whom he presided as chairman of the Advisory Panel on Scientific Policy, a committee formed by Order in Council in 1949 as a surrogate for the Privy Council Committee on Scientific and Industrial Research.

The Steacie Myth in the Lamontagne Report is both a characterization and a conclusion. The characterization, five pages long in a narrative of eighty pages covering sixty years, is of Steacie's personal commitment to the ideology of pure science and unrestricted research. This is well documented by thirteen references to a posthumous collection of Steacie's *obiter dicta*.³ The conclusion drawn by the Lamontagne Report was that Steacie's administrative policies and influence in national science policies were determined by his 'high science' ideology. Thus, for example, in managing the NRC Laboratories' many responsibilities, from a national academy to a state laboratory, 'Dr Steacie solved this difficulty by assuming in practice that NRC was mainly a university laboratory of basic research.'⁴

The only material evidence cited in support of the Lamontagne conclusions about the development of Canadian scientific institutions in the postwar years is as follows:

The application of NRC's model is illustrated by the evolution of the council's budget from 1952 to 1962, the years of Dr. Steacie's presidency. According to Thistle, the council's expenditures on university support increased tenfold: \$36 million was expended on additional NRC laboratories, and the operating expenditures of these laboratories rose three-fold. NRC's support for industry

began in 1962 when half a million dollars was provided for research performed by the private sector.⁵

Both these inferences are consistent with Steacie's ideology of pure research, as copiously demonstrated, as well as with the general science policy doctrine of his day. But they are indirect rather than direct evidence; and they are flatly contradicted by other evidence before the Lamontagne Committee.

Asked in 1960 by a parliamentary committee about the relative strengths of pure and applied science in Canada, Steacie replied:

For example, in our own (NRC) lab, although our basic function is as an applied lab, we are doing something in the neighbourhood of 20 per cent of our effort in pure science.⁶

The figures of NRC expenditure cited by Lamontagne are formally accurate: but not his interpretation that 'support for industry began in 1962' with extramural grants to industry. The vast bulk of the \$36 million spent on NRC Laboratories was for divisions with an obviously industrial function, such as Building Research, the National Aeronautical Establishment, Radio and Electrical Engineering, etc. It is notorious among administrators of science that applied and engineering research is more expensive, in equipment and manpower, than most branches of pure science.

Two concealed assumptions lie within the 1970 Lamontagne account of events prior to 1962. One is that 'industry' means essentially manufacturing or secondary industry, which has never constituted more than a third of Canadian economic activity, however specially important that third may be. Secondly, 'support' is equated with direct cash grants of public funds which is, it must be admitted, only one form of 'support'. At least up to about 1960, the NRC had, while accepting specific tasks assigned by governments or requested by industries, pursued a reasonably clear long-term policy of building up a national infrastructure for science: first a corps of trained men from the universities, then a national standards and research laboratory, the intellectual apparatus -- such as scholarly journals -- needed by an active research community and so on. The (admittedly indirect) benefit of such an infrastructure to the economy was the main reason politicians were willing to pay for it.

The aforementioned assumptions or ellipses may be permissible and normal in documents in economics or public administration. Under the rubric of history, however, they are illegitimate. In particular, they obscure the ideological revolution which took place between 1956 and 1962 in the political propriety of, and rules for, making cash grants to private, profit-making industry.

To illustrate, when the National Research Council first convened in 1916, one of its earliest and easiest decisions was

that the best way to initiate or encourage research at universities was to pay for it. Thus began the university grants programmes that continue to this day.⁷ It seems noteworthy that the Council felt free to act on its own in this respect, without first submitting its plan to the government for approval.

By contrast, it took more than forty years before either politicians or scientists dreamed of making similar cash grants to manufacturing corporations. The initiative was actually taken by the Defence Research Board, following cancellation of the Avro Arrow programme in 1959, to keep Canadian high-technology firms in business until they found new markets. The precedent was developed and generalized by the Advisory Panel for Scientific Policy, and recommended in 1961 to the Treasury Board and Cabinet. Their approval led to announcement of the Industrial Research Assistance Programme (IRAP) in 1962 (*i.e.* the half-million dollar expenditure cited in the Lamontagne passage quoted above.)

The elaborate process of planning and documentation, including comparative studies of Canadian, American and British industrial research spending, a review of Canadian tax incentives for industrial research, and the need perceived in 1961 to secure Cabinet approval for the IRAP grants programme, demonstrate its importance as a political precedent.⁸ It was in fact a revolutionary change in ideology. At the end of the Second World War, by contrast, elaborate plans had been made for the government to direct the post-war industrial economy. Nearly all of the apparatus for such direction was dismantled in 1947-49, much to politicians' relief, because of its daringly interventionist character. But nobody in 1945 had even hinted that the government could or should simply give cash to manufacturers (or farmers, or anyone else.)

IRAP was a small programme when first offered in 1962. The Advisory Panel asked the Cabinet for \$10 million, was happy to get \$1 million, and in fact spent less than \$600,000 in the first year. Nevertheless, it bulked large among total federal government subsidies to industry which, at their lowest, in 1959, had been less than \$20 millions. By 1970, when the Lamontagne Committee was at work, such subsidies exceeded \$350 millions.⁹ In other words, cash payments to industry had become politically normal and acceptable, rather than rare precedents. The Lamontagne Report's neglect of the character and scale of this change in political ideology is one of the characteristics which, though perhaps normal in economics or political science, impeaches its value as history.

Remedying this would, however, leave unaltered the Steacie Myth, *viz.* the general judgment that Steacie's policies as a public official were governed essentially by his personal ideals as 'the scientist's scientist,' and the specific statement that 'NRC's support for industry began in 1962' with the extramural grants programme. The myth stands to this day, having entered the received wisdom of Canadian history, for two reasons. The eager defenders of the NRC's good name -- and their dead friend's reputation -- such as Gerhard Herzberg

and J.D. Babbitt chose to argue on an ideological plane rather than cite historical facts the Lamontagne Committee might have neglected. Historians of contemporary science are familiar with the process of 'fundamentalization' in large scientific organizations such as CERN and AECL and expect to find it in any other such as the NRC Laboratories, so that they are predisposed to take the Lamontagne Report's ideological explanation of *why* it happened at the NRCL for an historical demonstration *that* it happened.¹⁰

What is missing, up to now, is a systematic presentation of the actual policies and programmes for industrial support implemented by the NRC in 1945-62, in the context that shaped them. The context is of essential historical importance, as suggested above in the case of cash grants to industrialists, because it sets the limits of what may be planned or attempted, and these limits may change over time. For ten years after the war, for example, there was an acute shortage of scientific manpower in Canada, so that all would-be employers had to seek staff overseas, especially in Britain. Examples included Avro Canada Ltd., the NRC, the Department of Mines and several universities. It must be recalled that Canadian universities in 1950 were in 'a financial crisis so great as to threaten their future usefulness' and only by 1960 constituted 'a well-organized system with all the facilities needed to fulfill its national, regional, provincial, and community roles.'¹¹

The shortage of scientific staff in the post-war years was a chicken-and-egg problem. Not only were there too few qualified scientists and engineers to do what was judged necessary or desirable, there were not enough posts in industry and universities to support the nationally needed. Although everyone agreed (e.g. in 1956-58 when the 'brain drain' became a political issue) that Canada was not supplying its own intellectual needs, many of the best young graduates were leaving to pursue better careers in the USA. The question for the National Research Council was: where is it possible to act -- on the chicken or on the egg? Its scope to influence industry was strictly rhetorical, the 'power' of persuasion. But it could influence universities directly from a position of authority, to the extent that Council membership represented the academic elite, and by funding university research and research training. Accordingly, its policy of increasing extramural grants to university science, trebling them between 1952 and 1962, as the Lamontagne Report noted, was not, or not exclusively, an ideological preference. It was a response to a demonstrated national need, further reinforced by conformity to the NRC's politically-defined sphere of action. After the fact, the policy of building up university science was explicitly adopted by the new Diefenbaker government of 1957. Before Sputnik, the government had planned to freeze NRC extramural appropriations as part of a general economy drive. After Sputnik, the government authorized an increase from \$3.5 million to \$6 million for university science over two years, and promised further increases to \$14 million over the next four years.

Science policy scholarship tends to assume that a prerequisite of rational and effective policy decision is a recognized and explicit institution for formulating policy. If it is true, as Glassco and Lamontagne concluded, that Canada had no such institutions in the 1950s, the effect of Sputnik challenges the principle that policy institutions are prerequisite for real policy. But, in my opinion, there were effective policy institutions in the 1950s, of two orders, formal and informal. Informal institutions include the consensus about what is politically permissible, cash grants to industry providing a clear example. Prior to 1957, when the Industrial Foundation for Education first suggested that the state should fund corporate research, it was nearly universally regarded as improper that governments should give money to corporations to advance their private interests. Different people may have had different reasons for judging thus: the point is that cash payments to private firms were beyond the pale, except for specifically-defined public purposes. As a potential tool of science policy, cash grants were beyond the range of the possible, as determined by society's informal institutions.

Formal science policy mechanisms also functioned in the fifteen years after the war, in three successive institutions. Initially, in 1945, the government made elaborate plans to control and direct the post-war industrial economy through the Department of Reconstruction and Supply. State science was incorporated in these plans through the NRC president's becoming simultaneously Director-General of the department's Research and Development Branch. Since the post-war economy turned out to be an unprecedented boom, rather than the slump so many politicians had feared, the control apparatus was dismantled between 1947, when the R and D Branch was transferred to the NRC, and 1949, when the Economic Research Branch was dissolved. This decontrol was *prima facie* a return to the ideology of free enterprise.

State science was not, however, set free from political supervision. The statutory Privy Council Committee on Scientific and Industrial Research was reconvened (twice) in 1944 for postwar planning, and met a dozen times between 1944 and 1949. Politicians also intervened directly, for example instructing the NRC in 1947 to create a Maritime Regional Laboratory to 'match' that for the Prairies,¹² authorized after a scientific planning conference in 1944; or, in 1958, to increase enormously the Department of Agriculture's research staff as part of a new government's staples-based economic policy.

In 1949, the Privy Council Committee formed, by order-in-council, an Advisory Panel on Scientific Policy, explicitly to act as its surrogate. The Cabinet Committee did not meet thereafter until reconstituted by the new Conservative government in 1958. The Advisory Panel comprised a dozen deputy ministers and departmental research chiefs, under the chairmanship of the NRC president, with a secretary from the Privy Council Office. On the Advisory Panel were devolved both the Committee's general responsibility for policy and its specific functions, e.g. annual review of the science budgets of government departments, required by order-in-council since

1947. The Panel met sixteen times over the next twelve years, twice in 1961 to prepare the IRAP plan for the Treasury Board and Cabinet.

The practical consequences of these changes in administrative mechanics was that the men who actually directed state science, though not cut loose from political supervision, were allowed more discretionary freedom than envisaged in 1945, when the Department of Reconstruction was the seat of economic authority. In one sense, the Advisory Panel was only a formal institutionalization of a pre-existing tiny group of powerful scientists, who already knew each other intimately after intensive collaboration in wartime. But it also had formal responsibilities and, through its members, direct access to half-a-dozen Cabinet ministers and the government's central agencies, including as it did the Secretary of the Cabinet and the Secretary of the Treasury Board, the only non-scientist members. Under the Advisory Panel, although state science was partly 'decontrolled,' like the productive economy, it retained strong horizontal, collegial links and vertical links with both political authority and economic doctrine.

If state science was freer than before, to follow either its own intellectual interests -- as the Steacie Myth would have it -- or the real economic interests of the country, it is that much more important to clarify what the policy ideas of its ruling elite really were, and what industrial policies and programmes were actually attempted.

NRC president C.J. Mackenzie summarized in a speech in early 1944 the NRC's basic doctrine on 'industrial research in post-war Canada.' He outlined a three-tier 'national research structure,' founded on the universities as the source of intellectual 'capital' and of trained men. Government laboratories (e.g. the NRC, Mines, Agriculture) constituted a second tier, for long-term research 'on a high scientific plane' and capable of organizing work on special problems such as 'building research, road research, cold weather problems, industrial utilization of agricultural crops' etc.

The third unit in the research structure should consist of the numerous laboratories, small and large, which are needed to deal with the immediate problems of individual industries. The need for this block in Canada is very great and apart from several outstanding exceptions there is ... an appalling lack of real research work supported directly by individual companies or associations of allied industries.¹³

Government agencies such as the NRC were bound to support industrial research by providing free information and a variety of institutional models for research from contracts at government laboratories, like the NRC's magnesite project, or joint research pools such as the Pulp and Paper Research Institute. It now seems significant that Dr Mackenzie spoke almost exclusively in terms of government's duty to support industry's

demands and initiatives. He nowhere suggested that, beyond a general exhortation to industry to avail itself to the opportunities available, government either could or should attempt to lead or control the technologies adopted by manufacturers, or that government could perceive industry's long-term interests better than could firms actually in business in the marketplace.

Mackenzie's 1944 speech appears to have been the focus of the NRC's post-war planning for industrial research, as promulgated in several Council publications in 1943-47, including statements in the *Canada Yearbook*. In detail, a subcommittee of Council of the NRC presented in 1944 an inventory of fifty-three fields of postwar research.¹⁴ Several of its recommendations were carried into immediate action, with the formation of the Prairie Regional Laboratory and a Division of Building Research. Others were explored but abandoned if necessary industrial partnership was not forthcoming: the 'big three' Detroit automobile firms' refusal effectively vetoed an NRC proposal to take up highway vehicle research. The Avro CF-100 and Orenda engine projects were cases of successful partnership, in which government -- essentially C.D. Howe -- played a leading role and the NRC a supporting one, by deliberate policy. In these cases the NRC's aeronautical laboratories were reorganized under newly-recruited staff in support of Avro during 1946-48, and its jet engine laboratory, formed in wartime as a separate Crown corporation, was sold to private industry with all but one of its staff in place.

So far as the internal management of the NRC Laboratories was concerned, the Council left matters in the hands of the president, C.J. Mackenzie. Administration was an obvious problem in 1945. The NRC staff now numbered 600 researchers (half in the atomic project at Chalk River), compared with fewer than 100 in the prewar years. Aside from the difference in scale, neither the NRC's prewar traditions from the 1930s nor its wartime improvisations, governed by immediate needs of the military or war industries, suggested models or precedents plausible in the post-war world.

The internal reorganization of the post-war NRC Laboratories was approached in three ways. Management consultants from New York were brought in to advise on both the organization of the atomic research project and the NRC's general administration in Ottawa. As a consequence, new vice-presidential posts were created for these two responsibilities. Secondly, as mentioned above, new applied or engineering divisions were formed: the Prairie Regional Laboratory in 1944, Divisions of Building Research and Radio and Electrical Engineering in 1948, and later others such as the Atlantic Regional Laboratory, National Aeronautical Establishment, Divisions of Applied Chemistry and Applied Physics.

These reorganizations did not address the more general task: how to maintain scientific quality in a government context. It was in this connection, at the end of the War, that E.W.R. Steacie, then Director of Chemistry, emerged as a figure of NRC-wide and later national importance, as the chief planner

of the post-doctoral fellowship system and the legitimator of pure scientific research as a proper activity of the state laboratories.

The NRC's problems, as analysed by Steacie, were both intellectual and social, and each reinforced the other. As a governmental institution, the NRC no longer faced the obvious goals which had kept it intellectually agile for the past fifteen years, viz. surviving the Depression and winning the war. Thus, like others before it, it was in danger of turning bureaucratic and declining in intellectual productivity. Secondly, the senior staff were all men of middle years (born 1900-1910). Most of them had been too busy for the last ten to twenty years to keep in touch with current research outside their own fields of applied science. As they aged, the likelihood of their re-establishing personal contact with new research would diminish rather than increase; but these men represented the brains of the NRC.

To solve these problems Steacie proposed a certain proportion of self-directed 'frontier' scientific research, enough to be self-sustaining and enough to leaven the lump of the whole NRC corps. To bring in 'young blood,' a system of post-doctoral fellowships, open to PhDs from every country in the world, would bring to Ottawa for one to three years (with no commitment of employment thereafter) the NRC's own selection of recent graduates in at least some of the newest scientific fields. This system functioned simultaneously as a model and as a source of staff for Canadian universities.

After approval by the Council, Steacie's proposals were implemented on trial in his own division, which functioned from 1946 as two branches, initially called Fundamental Chemistry and Chemical Engineering. The latter included the bulk of the prewar division's staff and functions. The former included about a dozen sections, most of them comprising a single, newly-hired scientist and a couple of post-doctoral fellows. In the 1950s the post-doctoral fellowship system was widely adopted throughout the NRC Laboratories, even including the engineering divisions, and other government agencies. Pure science was explicitly recognized on the NRC model in the departments of Agriculture and of Northern Affairs and Natural Resources in 1958, in small nuclei embedded in a large range of applied science activities.

The foregoing summarizes how pure research was introduced into the NRC Laboratories for the formal purpose of assuring the long-term intellectual vigour of the organization as a whole.¹⁵ Without accepting this justification at its face value, we should not be naive about pure science having transformed the NRC into an ivory tower. Politicians demonstrated as clearly in 1970 as in 1920 what bothers them most about scientists on the public payroll. If public servants actually enjoy the work they are paid for, it seems, there must be something horribly wrong. The pleasures and privileges of pure research were available to barely 100 of the NRC's 600 researchers, most of these temporary post-doctoral fellows, by Steacie's estimate in 1960, and these researchers were in no sense

unrestrained. Divisional directors retained authority over their staff and, by their edicts, certain fields of fundamental research were developed and others left to other institutions. The NRC failed to develop theoretical physics, for example, because the director of Pure Physics declined to hire more than one theoretical physicist, who resigned, after some years, finding that one was not nearly enough for a quorum.

Under the post-doctoral fellowship system, the number of NRC staff in certain divisions actually declined in the years of post-war expansion. Steacie's own Fundamental Chemistry Branch had twenty-seven researchers in 1946, all 'tenured' NRC staff. In 1960, in the Pure Chemistry Division, there were sixty-five researchers, forty-nine of them fellows and only sixteen permanent members of the NRC staff. More than one of Steacie's junior colleagues has suggested that his plan was too successful. In addition to invigorating the NRC in general, he had hoped to provide a model of the research career that Canadian universities would be tempted to adopt because, in the late 1940s, they had only students and teachers, for whom research was still an 'optional extra'. More jobs and more research jobs did in fact open in the universities in the post-war years, but conditions at the NRC were still so far superior, at least for the privileged, that researchers were unwilling to leave the NRC and accept teaching posts. It was former fellows rather than NRC staff who eventually manned Canadian science faculties in the 1950s and 1960s.

Two other forms of institution-building were wholly within the NRC's control, albeit on a national scale, in the post-war years: the expansion of university science, referred to in the Lamontagne Report, and the development of the information infrastructure needed by an up-to-date national research community. These tasks had begun in the NRC's earliest years through associate committees that institutionalized and funded the 'old boy networks' known to be part of the social structure of science. Another early step was the creation of the *Canadian Journal of Research* in 1937 and its subsequent reorganization and fission in the post-war years into a dozen disciplinary journals in science and engineering.

Another component of a national information system is a national library. Canada managed without one for its first ninety years, except for the Library of Parliament. The only earlier attempt to form a national library was that of the Royal Society of Canada, which was glad to give up in the 1920s, and hand over its scientific collection to form the nucleus of the NRC Library. The NRC Library became the National Science Library in 1957 and has discharged that function ever since, despite initial opposition by NRC staff who feared service to them might suffer as service to the whole national community increased. This does not appear to have happened, and the institution is now reckoned one of the best half-dozen science libraries in the world in English or French, perhaps the second best in North America, after the New York Public Library.

The NRC institution-building innovations of 1945-57 differ from the specifically industrial programmes listed below in

two respects. They were intended to benefit industry, but in a general way, through their relationship to the national intellectual community as a whole. The measures were designed to strengthen the foundations of industry rather than to control or alter its architecture. Secondly, the foregoing measures were more or less wholly within the NRC's power to act unilaterally. There was no need to obtain political permission beforehand or to negotiate the assent of supposed beneficiaries in order to take action.

Most of the specifically industrial programmes of 1945-62 did require such assent in order to succeed, and sometimes to get started. They may be briefly listed as follows:

1. Technical Information Service for small business (1945);
2. Tax incentives for industrial research;
3. Canadian Patents and Developments Ltd. (NRC Act, 1946);
4. Pilot-scale industrial plants to develop NRC processes or inventions (NRC Act, 1946);
5. Various forms of contract research:
 - by industry-paid staff on NRC premises, and
 - by NRC staff, funded by industry;
6. Cash grants to firms for corporate research (IRAP, 1962).

Not all these initiatives of the NRC succeeded. Canadian Patents and Developments Ltd., if not a complete failure, obviously disappointed the hopes expressed for it in Parliament in 1946. The pilot plant model of development, also specifically authorized by Parliament, turned out to be a disaster, at least in financial terms. But the general point is that, contrary to the Steacie Myth, a large array of industrial programmes were initiated by the NRC in the years 1945-62. They were consistent with both current economic policy about the state's role in the economy and the best available doctrines of 'science policy,' about how knowledge and technology functioned in the marketplace. They were specifically approved by political authority and enacted by NRC staff for their promise of contribution to the national economic welfare, rather than motives of high ideology, personal aesthetic taste and the other elements of the Steacie Myth as promulgated in the Lamontagne Report.

The Technical Information Service (TIS) was the only lasting element of the Department of Reconstruction's Research and Development Branch. It was modelled on the US Technical Advisory Service set up in 1943 and manned in 1945 with staff from the NRC's Information Division, which had been answering enquiries from individuals and small businessmen since the 1930s. The TIS differed from the NRC's earlier activities by planning a staff of sixty-five in the field: in offices in twenty Canadian cities and about thirty in Ottawa. The prewar NRC Information Division had had fewer than thirty staff, all in Ottawa. The TIS would both preach the gospel of 'research,' then not terminologically distinguished from up-to-date technology, and collect technical enquiries originating in firms. TIS staff in Ottawa would both answer those technical enquiries

and compile a Handbook of Industries, summarizing the technology of thirty-two industries, from machine shops to baking. Begun in 1947, the handbook project was not abandoned until some date between 1949 and 1963. However, the TIS still publishes its own series of Technical Notes on a variety of industrial processes.

The Department of Reconstruction's Research and Development Branch numbered only fifty-three, including TIS staff, when transferred en bloc to the NRC in 1947. In the 1950s, the TIS was left very much to its own devices; it did not expand proportionately with its potential client community. The 1960 Commons Committee on Research recommended expansion and, coincidentally, TIS that year acquired a new chief, visibly more dynamic than his predecessor, who introduced new services, such as free engineering consultancy and NRC-paid work by student engineers, supervised by their professors.

Tax incentives were recognized by legislation at the end of the war as politically acceptable and an effective instrument of economic growth, initially through accelerated capital depreciation allowances. The corporate income tax act was amended in 1948 to make current research costs a deductible business expense. Capital expenditures were allowed as a deduction in 1962. By that date, according to an NRC staff study which formed part of the dossier recommending the IRAP proposal to the Cabinet, Canadian tax incentives for industrial research and development were as good as or better than those in Britain and the United States.

It seems unlikely that the exact roles of the NRC and the Advisory Panel in the tax policy system will become clear until an official history of the Department of Finance is published. At a lower level, it is known that the NRC's legal staff routinely vetted corporate income tax returns that claimed deductions for research. So far as policy is concerned, Robert B. Bryce, Secretary of the Treasury Board 1947-53, Secretary of the Cabinet 1954-63 and a member of the Advisory Panel 1949-53, said in 1981 that Steacie must have been consulted and was probably influential, for example, with the tax amendments of 1961 to provide for capital deductions. Steacie had been personally active among business economists since at least 1955, when he reviewed industrial research before the Canadian Council for Economic Studies; he had hired the NRC's first staff economist in 1957.

Canadian Patents and Developments Ltd., an NRC affiliate, was provided for in the NRC Act of 1946, to administer all industrial patents owned by the Canadian government. From the beginning, there was a conflict between its two political aims: protecting the public from unscrupulous businessmen who might seek to control inventions in order to suppress them, and promoting the licensing of state-owned patents in the general public interest. The organization had no more than half a dozen professional staff, some of these part-time (e.g. the NRC's two staff lawyers) who were also obliged to act as patent agents for the NRC and the Chalk River Nuclear Laboratories. Not until 1954 was a specialist promotion

officer hired, and for a decade he worked practically alone. In retrospect, it seems fatuous to hope that one man could efficiently market thousands of Crown patents, ranging from medical instruments to bulk chemicals production, to the whole industrialized world. But one can see how, at the time, hiring one specialist was a visible improvement over what had gone before.

Canadian Patents and Developments Ltd. failed as a commercial agency; it did not even earn enough in licence royalties to cover its own costs, let alone provide a fund for investment in development. When first formed, it was endowed by the NRC with more than \$150,000 capital -- the profits from the NRC's successful prewar patents on the ceramic magnesite. Within a decade, however, the NRC had resumed control of this capital and spent it on the NRC share of the costs of an experimental ethylene oxide production plant in the USA, in partnership with the Firestone company, to develop an NRC-invented process to commercial scale. The product failed to match current prices for ethylene oxide, so the development was abandoned, and with it disappeared Canadian Patents and Developments Ltd.'s risk capital.

The other commercial innovation of the NRC Act of 1946 was authorization to enter the marketplace by building and operating pilot-scale industrial plants. There were half-a-dozen such ventures over the next decade, notably a butadiene fermentation plant in Ottawa, the ethylene oxide venture mentioned above, and a 'straw-board' mill at Saskatoon. When the NRC put up a new building for Applied Chemistry in 1952, it was engineered to provide for temporary pilot plant structures along one wall, equipped with the requisite power and chemical 'plumbing' supplies.

Parliament's motives in encouraging the NRC to undertake pilot plant development at its own discretion appear to have been twofold: fear of capitalists controlling and suppressing the taxpayers' intellectual property, and a generalized faith in 'chemurgy,' the power of science to transform valueless materials into valuable ones. Expectations of chemurgy appear in the NRC Act of 1917, which specifies a duty to find commercial uses for agricultural and industrial wastes. It is much easier to speculate about these motives than to find out exactly what the NRC did, and what economic benefits resulted. The butadiene project, developed on a crash basis during the war, never found a market because it had been designed to supply synthetic rubber feedstock from surplus wheat. After the war, there was no shortage of natural rubber and no surplus of wheat either, since with Marshall Plan funds Europe could buy all the wheat Canada could ship. The ethylene oxide venture was such a financial disaster that it was deliberately forgotten. The likeliest candidate as a success was the plank mill at Saskatoon, where a commercial partner was found who founded and maintained a new industry. The technical problems of using straw to make chipboard were solved, but not the financial problems of collecting, in a few months, a year's supply of straw from an area of many square kilometres. The mill became a commercial success only after it was converted to use waste wood fibres as its raw material.

Contracts with industry for research had begun in 1933, when H.M. Tory submitted the first such contract to the Privy Council Committee for approval.¹⁶ Later in the decade, Imperial Oil Ltd. provided funds to the NRC to hire an extra chemist, to work on problems defined by the company. Both forms of industrial contract were maintained by the NRC after the Second World War. Industries were invited to place their own staff in the NRC Laboratories and the NRC accepted contracts for its staff to carry out work for corporations or industrial associations. There were cases of both -- Shawinigan Chemicals maintained a couple of its chemists at the NRC Laboratories for thirteen years -- but not many. The impression is clear that what the NRC preferred was the 'fellowship' model, of accepting an industrial employee, because this obviated disputes about proprietorial knowledge and the public interest. Most firms, especially smaller ones, would probably have preferred the contract model, with its simpler seller-buyer relationship and no need to find a place in the factory for a scientist, once his years with the NRC were over.

In 1919-20, the NRC told Parliament that contract research, on the model of the Mellon Institute, was much needed in Canada and would account for much of the NRC Laboratories' work. When the Laboratories were actually created, just at the start of the Depression, no such demand was found. In consequence, instead of a single preponderant model, as at the Mellon or Battelle Institutes, the NRC developed a variety of forms of collaboration with industry, as it thought appropriate to the structure of Canadian industry, from associate committees to the Technical Information Service. It was learned in the 1930s, and confirmed by the TIS, that the vast majority of Canadian manufacturers did not need 'research' so much as state-of-the-art technical information. Where genuine industrial research was required, the NRC Laboratories were inhibited in two respects. Government officials were apprehensive about complaints, actually made in Parliament from time to time, that even industry-paid research carried out in state laboratories conferred an 'unfair' advantage on participating firms over their competitors. Secondly, there was no clear doctrine on payment: whether the NRC was supposed to make a profit on its industrial contracts, or simply cover its costs, or charge less than the actual costs, as an incentive to other firms to commission research. The two reasons combined to encourage the NRC to prefer as clients not firms or even groups of firms but whole industries, such as aviation or railways, where the national interest was unchallengeable.

Not the least consideration was the small number of NRC men available for contract research. NRC research scientists and engineers numbered about 600 in the late 1950s, 500 of them in the applied science and engineering divisions. At least 300 of these 500 were fully occupied in long-term research, ranging from plant breeding to secret military radar, from fire safety standards for buildings to the design of harbours or the life of railway lines. The number available for contract research must have been fewer than 100. Since Canadian industry then employed at least 2,500 researchers of its own, the NRC's available manpower appears quantitatively

insignificant.¹⁷

It thus seems plausible that the first cash grants by government to industry for research (DIR grants in 1961 and IRAP in 1962), as well as a political precedent of the first magnitude, were inspired partly by recognition that the government's own research staffs could do very little more than they were doing already. If industry needed more research or more researchers, and if the state could not provide the information or the men, yet felt it owed industry a boost, it made sense to give industry the money to buy what it needed.

The origins of IRAP in the Advisory Panel, its need for political approval and the consequent growth of direct cash subsidies to manufacturers have been alluded to above. In detail, what IRAP offered was to pay half the cost of a firm's increased research activity above an agreed datum (which could be zero) for up to five years. Half the total costs represented personnel costs, as established by the first grants of the Defence Research Board. IRAP funds were awarded for specific projects, of the applicants' choice, and the unconcealed aim was that firms should maintain at their own expense research teams initially assembled with IRAP aid.

Not for ten years did IRAP's appropriations grow to \$10 million, the sum initially proposed by the Advisory Panel. But, by 1972, there was a large number of other channels for direct cash subsidies, such as the Programme for the Advancement of Industrial Technology, Industrial R and D Incentives Act, etc.

Only one more point needs to be mentioned before returning to the Lamontagne Report and the Steacie Myth. By an unhappy coincidence, the Glassco Report, although published in 1963, was written in 1961 before IRAP was announced. Extra paragraphs were added to an appendix to cover IRAP, but the main text stood intact, with its charges that the Advisory Panel never introduced any innovative policies and that the NRC had 'turned away' from its duty of promoting industrial research. One of the two authors of the Glassco Report's review of government science has told me that he had no advance knowledge of IRAP's drafting and that he did not appreciate its significance as a precedent.

To whatever extent the Lamontagne Committee took the Glassco Report as a reliable source document, it was thus misdirected in its assessment of IRAP, both intrinsically and as a straw in the political wind. However it was an article of faith of both the Glassco and Lamontagne staffs that a special decision-making mechanism could be found to optimize science policy, not least by freeing it from 'political' bias. This may explain the paradox that, reviewing essentially the same factual evidence, the House of Commons Committee on Research and the Glassco Commission staff arrived, in 1960 and 1961 respectively, at fundamentally opposite conclusions. It is noteworthy that, while the later Lamontagne Report included in its evidence material from a similar Commons Committee of 1956, it made no reference to the more recent parliamentary committee.

This brief outline of NRC's structural policies and specific programmes for industry in 1945-62, most with visible relevance to a manufacturing economy, establishes *prima facie* that the historical record of those years, as presented in the Lamontagne Report, is grievously incomplete.

The constituent ideas of the Steacie Myth, about the logical primacy of fundamental scientific knowledge, the importance of the individual genius and his need for freedom to follow his own curiosity, and the baneful effect of all bureaucracies, are perfectly real. But the equation of this ideology with the actual administrative record of the state institution over which Steacie presided is a romantic fallacy.

The reasons why the Lamontagne Committee made the historical judgments it did are too ramified for examination here. They range from the literary convenience of the book of Steacie speeches to the *sub rosa* competition for prestige between NRC scientists and NRC engineers. Our concluding point is that the basic canons of historiography, to which the Lamontagne Report made an appeal, were obviously ignored. The evidence adduced was almost exclusively ideological rather than factual in character. The inquiry made no attempt to review primary historical records and it either suppressed or ignored evidence in public secondary sources that conflicted with its conclusion, that Steacie's 'high science' ideology determined all his administrative conduct.

In science policy, the Steacie Myth is probably insignificant today. It provided political sanction for changes that both politicians and intellectuals were impelled towards by rapid and large-scale changes in the economic environment. It is this contemporary environment that influences both science and the economy today, far more than possibly can the ideas, real or imaginary, of a man, even a genuine charismatic hero, dead more than twenty years now.

It is as history that the Steacie Myth is positively vicious, in both its method and its conclusions, by displacing attention away from evidence and towards ideology. The Pragmatic Fallacy cited in the Lamontagne Report was described as 'selecting facts in the service of a cause.' If for 'facts' we read 'evidence,' this document stands self-condemned. But the real fallacy at issue in the debates *ca.* 1970 about the justice of the Lamontagne Report's condemnation of Steacie was a different one, the Intentional Fallacy.

In debate, Lamontagne attributed all the significant events in Canadian science from 1952 to 1962 to the Steacie Myth and, citing for example indicators of appallingly low levels of industrial research and Canada's deficit balance of trade in high-technology goods, judged it a Bad Thing. Opponents such as Gerhard Herzberg agreed in attributing everything to Steacie and, citing various intellectual and engineering successes, judged him a Good Man. Both parties were united in their attribution to Steacie's intentions, almost exclusively, the events they cited.

Neither party appears to have considered the possibility that Steacie may *not* have intended what happened, for example, that industrial research should have lagged behind levels in other countries, or how to test the possibility. And neither party suggested that the historical record of state intentions and state actions in industrial support was anything other than complete and accurate, or how this premise could be verified.

The burden of this study is that much more happened in specific attempts to support or promote industrial science and technology in the post-war years than there was room for in any faction's folk memory or social-scientific categories. The materials cited above suggest that this aspect of Canadian history has hardly yet been touched by historians. Until the theme is explored in detail and placed in context in its contemporary Canadian environment, material and political, both scholarship and current science policy might benefit from a moratorium on the Steacie Myth.

NOTES

1. *A Science Policy for Canada. Report of the Senate Special Committee on Science Policy* (Ottawa, 1970), I, 19-20, [hereinafter cited as *Lamontagne Report*].
2. Canada, *Senate Proceedings of the Special Committee on Science Policy*, No. 3 (23rd October, 1968), 74-80.
3. *Science in Canada: Selections from the Speeches of E.W.R. Steacie*, J.D. Babbitt, ed. (Toronto, 1965).
4. *Lamontagne Report*, I, 68.
5. *Ibid.*, 71.
6. Canada, House of Commons, Special Committee on Research, *Minutes of Proceedings and Evidence* (9th June, 1960), 92.
7. Until the 1950s the bulk of NRC grants for 'assisted researches' at universities were made through associate committees, and were thus tied to those committees co-ordinated research programmes, rather than by the interests of the individual applicant.
8. The subcommittee of the Advisory Panel included NRC president E.W.R. Steacie, his predecessor C.J. Mackenzie (president 1939-52), A.H. Zimmerman, chairman of the Defence Research Board and J. Lorne Gray, president of Atomic Energy of Canada Ltd. The economic documentation included reviews of GERD, FERD, and corporate R and D expenditure in Canada, Britain and the USA and a comparative assessment of Canadian tax incentives to industrial research. It was prepared by G.T. McColm, first incumbent of the NRC's Office of Economic Services (created 1957).

9. Michael Jenkin, *The Challenge of Diversity. Science Council Background Study No. 50* (Ottawa, 1963), 152.
10. Industrialists' 'lack of interest in research created conditions favourable to the "fundamentalization" of Canadian science, that is, a steady shift from the postulated goal of applied research to fundamental science;' and the NRC's creation of a post of Vice-President (Scientific) 'does not seem to have resulted in any identifiable shift of the Council's emphasis away from basic research to technological development.' Y.M. Rabkin, 'Trans-national invariables in science policies: Canadian and Soviet experiences,' *Canadian Public Administration* 24:1 (1981), 24, 30.
11. The former quotation is from the Massey Report: Royal Commission on National Development in the Arts, Letters and Sciences, *Report* (Ottawa, 1951), 141, and the latter from Robin Harris, *History of Higher Education in Canada* (Toronto, 1977), 603.
12. W.H. Cook, *My Fifty Years with NRC, 1924-1974* (Ottawa, 1977), 189.
13. 'Industrial Research in Post-War Canada,' speech of 11 February 1944, in *The Engineering Journal* (March, 1944), 139.
14. Wilfrid Eggleston, *National Research in Canada: the NRC 1916-1966* (Toronto, 1978), 261-2.
15. Although steeped in the theme, the selected Steacie speeches in *Science in Canada* (1965) include no systematic exposition of Steacie's doctrine of scientific quality and how to maintain it. Such an account can be found in Steacie's evidence to the House of Commons Committee on Research in 1960 (*Minutes of Proceedings*, 99 ff. and Cook's *My Fifty Years with NRC*, 261 ff.).
16. *Minutes, Privy Council Committee on Scientific and Industrial Research, Meeting no. 11* (7 April 1933).
17. Figures in the text are derived from the following:
 - a) Industrial research costs, as presented by Steacie to the Canadian Council for Economic Studies in 1955, were \$150,000 to \$20,000 for the smallest effective IRD laboratory, with ten staff scientists: i.e. \$15,000 to \$20,000 a head (current costs);
 - b) Actual Canadian R & D expenditure in industry was \$92.7 million in 1960 (c.f. \$140 million in 1957 and \$140 million again in 1962) according to the *Lamontagne Report*, I, 127, table 4;
 - c) NRC costs per research officer in 1960-61 were computed at \$30,800 by the *Glassco Report*, IV, 314, table 7. Calculations from figures in the *NRC Review* (Ottawa, 1961) suggest \$38,000 is a more realistic figure. Depending on the divisor chosen from a) or c), IRD expenditure of \$92.7 million appears to imply a research staff in industry of 2,500 to 4,500 in 1960.