Rhetorical Invention in the Discovery of Insulin

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Le présent essai étudie deux articles clés portant sur la découverte de l'insuline, le premier de Banting et Best et le second, un texte collectif présenté par leur directeur de laboratoire, J. R. Macleod. Par l'explorationde la nature de la découverte dans les écrits scientifiques, il vise à montrer la mise en œuvre d'une construction rhétorique. L'échec du premier article relève non seulement de l'insuffisance des preuves expérimentales fournies, mais aussi d'un manque d'ingéniosité sur le plan de la rhétorique. Par contre, le succès remporté par le deuxième article résulte d'une combinaison de collaboration et de conflit, ainsi que du recours à des outils rhétoriques au moment de la présentation de la découverte auprès du public scientifique. Quant à la découverte elle-même, son statut dépend de l'interaction de divers éléments et son succès se mesure en fonction de sa réception et de l'acceptation qu'elle trouve au sein de la communauté scientifique.

The discovery of insulin is unquestionably one of the greatest achievements in Canadian medical history. While tradition attributes this discovery exclusively to Frederick Banting and Charles Best, tradition is romantic and shortsighted. Banting and Best's first paper on the extract subsequently named "insulin" was wholly unsuccessful. It took a later, more broadly collaborative paper — under the direction of John James Richard Macleod — to establish the discovery of this extract. Significant progress in the refinement of the extract was made between the two papers, but the success of the second paper cannot be accounted for solely on the basis of this refinement. Therefore, through a close analysis of both papers, I explore the construction of discovery in scientific writing as a product of rhetorical invention; in this case, contingent on its presentation as a collaborative achievement unmarked by signs of intrinsic conflict.

Controversy surrounded the discovery as the research effort expanded from two scientists to an eventual seven. Conflict over contribution and proprietorship both marred and facilitated the discovery process; however, no evidence of this conflict is apparent in either publication.

In order to provide a detailed and insightful account of this controversial discovery, this paper will move through four sections. The first section consists of an analysis of Banting and Best's paper, "The Internal Secretion of the Pancreas"; the next section explores the scientific and collaborative developments leading up to the preparation of the collaborative, Macleod-controlled paper; the third section consists of an analysis of that paper, the paper which effectively marked the discovery of insulin; and the fourth section considers the role of audience in the construction of discovery.

Staking a Claim

The first publication on the research that led to insulin — according to Best, the first publication on insulin (1963, p. 42) — was "The Internal Secretion of the Pancreas," by Frederick G. Banting and Charles H. Best, delivered at a meeting of the University of Toronto Physiology Journal Club on November 14th, 1921, and published shortly thereafter in *The Journal of Laboratory and Clinical Medicine.* Banting and Best based the paper on experimental evidence they obtained while working on an extract ("degenerated pancreatic tissue") to counteract the effects of diabetes. As Best later characterized their attitude and expectations about this paper, "It seemed to us then and subsequently that this was the essence of the discovery of insulin" (Best, 1963, p. 42). However, nobody outside their lab took much notice of their work, and the paper fell very flat.

In *A Rhetoric of Science,* Lawrence Prelli develops an elaborate matrix of stasis-interactions for scientific argumentation.[1] According to this scheme, the superior stasis of Banting and Best's paper is evidential, the subordinate conjectural. That is, the main function of Banting and Best's paper is to provide evidence of a discovery, and the stance it takes is conjectural, a question of fact: is there enough evidence to make the case? As Prelli frames it, such a configuration occurs "whenever there is ambiguity about the availability or reliability of evidence" (1989, p. 148). Stases have the important attribute of backwards entailment (e.g., a stasis of definition entails granting the stasis of fact; a stasis of value entails granting both fact and definition), and the conjectural stasis logically precedes stases of definition (what does the evidence mean?) and of quality (what judgements does the evidence warrant?). Since the ultimate point of Banting and Best's paper was to demonstrate that islets in the pancreas produce an internal secretion capable of lowering the blood

sugar levels, what Prelli terms "a point of stoppage" occurs at this level within the paper. Banting and Best's paper stalls at the first stasis. Questions of fully evaluating the evidence and supporting claims on the basis of that evidence cannot advance.

The paper opens with a brief discussion of how the hypothesis for the experiments was formulated, with credit explicitly taken by Banting. Although Banting came to the hypothesis while reading an article on diabetes (Moses Barron's "The Relation of the Islets of Langerhans to Diabetes with Special Reference to Cases of Pancreatic Lithiasis"), the idea is awarded to him; in the scientific code for inspired invention, the hypothesis is said to have "presented itself" to him (Banting & Best, 1922, p. 43). This use of the passive voice is broadly characteristic of scientific discourse. Its "effect ... is to suppress human agency, to imply that what are essentially rhetorical acts — arguing, showing, demonstrating, suggesting — can be accomplished without human volition" (Halloran, 1997, p. 43). That is, the very hypothesis driving Banting and Best's paper is given its own agency. A piece of the empirical world — a fact — presses on the scientists, compelling them to act on its behalf. This argument structure results in the uncomfortable but familiar rhetorical confluence of objective fact and proprietary scientist: the hypothesis is a product of the cold, hard, empirical world, yet it belongs to Banting, who is sharing it with Best. The work of other researchers leading up to its formulation by Banting and Best is essentially dismissed. Banting's new hypothesis purports not only to solve a critical problem, but also to subsume all previous research; according to the introductory paragraph of the paper, "The failures of other investigators in this much-worked field were thus accounted for" (Banting & Best, 1922, p. 43).

The argument pursued in the paper can best be described as "problem-solution," that is "used to establish (or disestablish) firm connections between observational or theoretical claims and what is accounted for by accumulated data or theory" (Prelli, 1989, p. 186). In adopting this line of argument, Banting and Best are able to make full use of prior work in the field while strategically situating their own research as the natural culmination of that work. Their argument advances very methodically, along a standard four-stage path: introduction, method, results, and conclusions. Each section follows conventional practices of scientific writing, with the greatest attention given to the results. As Bazerman has shown, this structure bears powerful rhetorical implications — emphasizing the importance of facts expected to serve as unequivocal evidence that the results provided actually occurred as a consequence of the documented experiments.[2]

The introduction of the paper describes the hypothesis and the context of its formulation, as well as briefly reviewing related work in the field. The methods section is straightforward, with Banting and Best careful to include an account of

how the pancreatic extract used in their experiments was prepared. This account is particularly significant in light of later modifications to the extract, as well as to disputes over intellectual ownership. By describing its preparation, Banting and Best are essentially staking a claim to the discovery of the extract (retroactively, of insulin). While some details are given, the description is sufficiently vague that it is unlikely the extract could easily be replicated. Consequently, they establish their priority to the discovery while allowing themselves space and time to refine it.

Banting and Best do not attempt to disguise the difficulties faced in attempting to depancreatize the dogs for the purpose of their experiments. They acknowledge that, "Fortune favoured us in the first experiment. In subsequent attempts we were never able to exhaust the gland sufficiently to obtain an extract free from the disturbing effects of some constituent of pancreatic juice" (Banting & Best, 1922, p. 46). Although such candor may serve to bolster perceptions of scientific ethos in the eyes of some readers, it may also be perceived as a form of experimental incompetence.[3] By placing the success of their first attempt in the hands of "fortune," Banting and Best may inadvertently undermine the appearance of their own skill as scientists; thus, their ethos as well as their logos.

In the results section, Banting and Best provide the details of six experiments and devote seven pages to charts. The motive behind such assemblages of data is copia, to highlight and reinforce the importance, as well as the reliability, of experimental results. But Banting and Best strangely leave most of the induction to their audience. They appear reluctant to assert directly the significance of their findings. The results section, in fact, begins with a strongly hedged claim: "The experiment is not conclusive but is interesting to us at least, since we administered the first dose of extract of degenerated pancreas to this animal" (Banting & Best, 1922, p. 47). The general stance here is familiar in scientific discourse. Merton, who identified it to be especially at play with respect to priority claims, termed it "humility" (1973, pp. 293-305). But Banting and Best — "interesting to us at least" — are somewhat extreme on this count. Again, the reader may be forced to question the ethos of the scientists involved, who seem to exude an almost damaging degree of humility.[4]

Banting and Best go on to point out possible criticisms of this experiment. By acknowledging these points of vulnerability, Banting and Best are demonstrating their objectivity — the Mertonian term is "disinterestedness" — but again their case is somewhat undermined. The phrase with which they introduce the discussion does not add much confidence: "The interesting features, which gave us great encouragement are ... "(Banting & Best, 1922, p. 47). Here too, they seem hesitant to assert the virtues of their experiments beyond their own personal attitudes; further,

neither their (negligible) reputations nor the ethos they build in the paper gives the audience any particular confidence in those attitudes.

Towards the end of the results section, Banting and Best include a paragraph that Best later called "one of the most satisfactory comments which we made" (Best, 1963, p. 42). It reads:

> In the course of our experiments we have administered over seventy-five doses of degenerated pancreatic tissue to ten different diabetic animals. Since the extract has always produced a reduction of the percentage sugar of the blood and of the sugar excreted in the urine, we feel justified in stating that this extract contains the internal secretion of the pancreas (Banting and Best, 1922, p. 59).

This statement is the most direct assertion in the paper of the implications and consistency of Banting and Best's results. Their stated belief that the extract does contain the internal secretion of pancreas is the most important criterion for a claim to the discovery of insulin. The results section concludes with the admission that the extract is not yet ready for clinical use.

Their conclusions are neatly summarized into seven points, categorizing their knowledge to date and serving as principles to guide future work. Banting and Best conclude this section, and the paper, by thanking Professor Macleod "for helpful suggestions and laboratory facilities" (Banting & Best, 1922, p. 60).

Collaboration and Compromise

The work leading up to the publication of the first paper was done almost exclusively by Banting and Best, despite taking place in Macleod's lab and under his general direction (he had assigned Best to Banting, for instance). Upon the failure of their first paper, and a second one with equally inconsequential effects, research into the nature of the extract became a more broadly collaborative effort.

Acceptance of the first paper's claims to a significant discovery would have been premature for several reasons. For one thing, according to Michael Bliss "the article contains minor factual errors. Figures given in the text and charts sometimes disagree with each other and/or with figures in the notebooks" (1982, p. 94). The experimental competence of Banting and Best, then, was up for question not just at the level of their tone and their almost crippling humility, but for careful readers, at the level of accuracy and consistency. More substantially, Bliss also suggests that Banting and Best had misread the significant earlier work of Paulesco, arriving

thereby at a faulty hypothesis (1982, p. 88). With respect to the direct assertions in the paper later cited by Best as proof of the discovery of insulin, Bliss remains skeptical. He states:

> That summary is inaccurate, representing enthusiasts' tendency to put a totally favourable gloss on their results. It was simply not true that Banting and Best's extracts had always produced a reduction of the percentage sugar of the blood and of the sugar excreted in the urine. Sometimes the extracts had not worked at all; other times their effects had been inconclusive; a few times the necessary tests had not been done (Bliss, 1982, p. 94).

In light of these inadequacies, it is clear that Banting and Best worked from a general pattern or trend in their data, a pattern much less definitive than they represent in the paper.[5] (While obviously the "discovery of insulin" cannot unproblematically be assigned to the first paper, the contribution of this work to the whole cannot be ignored and should not be diminished. While the tangibility of the results in Banting and Best's paper may be questionable, their significance is not.)

Advancing the state of knowledge to this particular point, Banting and Best now faced "two great pressures," as Best put it:

> One was exerted by the diabetics who needed insulin ... The second pressure was exerted by senior and more experienced investigators, who had not invested an hour's work before the discovery but who were now more than anxious to appropriate a share of it (Best, 1969, p. 5).

As citizens, as well as scientific researchers, Banting and Best were charged with the moral and social responsibility of providing relief to diabetics as soon as was feasibly possible. However, as entrepreneurs and scientific pioneers, they were reluctant to share their work. The fact that they had reached a stasis point in the evidence informing their own argument, however, forced them to accede to these pressures and enter into broader collaboration.

In the process of enlarging the team, significant influence was exerted by Macleod, and by James Bertram Collip, a visiting biochemist Macleod had assigned to the project. Although Collip's assistance was welcomed by Banting, Best was not so accepting, saying later "I was opposed to Collip's participation in our work for obvious and selfish reasons" (quoted by Bliss, 1982, p. 98). Collip's technical contribution to the effort came as a refinement of Banting and Best's original pancreatic extract. A gifted biochemist, Collip was able to make the necessary improvements quickly and thereby greatly enhance the existing extract. But this expertise was not without some hubris that contributed to internal strife. Collip was so confident of

the significance of his contribution, in fact, that, as Best later recounted it, "[he] announced to me that he was leaving our group and that he intended to take out a patent in his own name on the improvement of our pancreatic extract" (Bliss, 1982, p. 204).

Neither Banting nor Best was eager for Macleod's involvement, and it seemed to serve primarily to stimulate internal conflict. Nor did Macleod enjoy his involvement. "If every discovery entailed as much squabbling over priority etc. as this one has," he recalled later, "it will put the job of making them out of fashion" (quoted in Martyn, Bliss, and Vranic, 1996, p. 33). However, while neither Banting nor Best relished the addition of Macleod's name to the work subsequent to their first publications, they could not dispute the implications of his name to its reception. As the Director of the Physiological Laboratory and Associate Dean of the Faculty of Medicine, the author of several important papers and monographs, a Fellow of the Royal Society of Canada, and the owner of an international reputation, Macleod exuded a degree of prestige and credibility that outstripped Banting-Best's by several orders of magnitude. By the Matthews Effect alone, Macleod was guaranteed a stake in the discovery.

Constructing Invention

Only six months after Banting and Best's initial paper on insulin, "The Effect Produced on Diabetes by Extracts of Pancreas" was written and delivered at the meeting of the Association of American Physicians in Washington. Seven authors were listed, and J.J.R. Macleod delivered the paper on behalf of the group. This paper was constructed and represented as a collaborative effort; however, neither Banting nor Best were involved in its preparation, or even consulted about it. Although it is the clearest published nexus for the discovery of insulin, Best left it out of the collection of his own papers, commenting that "[s]ince neither Banting nor I had been consulted about the plan to give the paper and since we had no part in its preparation, it will not be included here" (Best, 1969, p. 101). As an extension of the initial work done by Banting and Best, this paper's significance lies predominantly in the reception it received. Unlike the previous paper by Banting and Best, this paper was quickly and widely heralded as marking the discovery of insulin.

As in the earlier paper, the primary issue is the establishment of priority to the invention of an extract containing pancreatic secretions capable of reducing blood sugar levels in diabetics. Although Banting and Best believed their paper contained evidence of this discovery at the time of its preparation, in retrospect it became apparent that their evidence or presentation was not sufficiently convincing to produce the desired impact. Consequently, the Macleod-controlled paper responded

to stasis questions that had yet to be answered in order to advance related scientific discussion. While obviously the issues remain the same, the later paper provides more conclusive evidence, as well as offering a refinement of the methodology used to prepare the extract, and perhaps most importantly, proposing the use of the name *insulin.*

Similarly, the line of argument employed is again problem-solution; however, the collaborative paper goes further by establishing experimental and observational competence, as well as experimental originality and explanatory power within its argument. Consequently, the discovery itself is at least partially attributable to rhetorical invention in the writing of science. The relevant data are partially constituted in the development and refinement of the argument presented in this paper.

Unlike the Banting-Best paper, this paper does not adopt the genre of a scientific report, allowing for a less constrained argumentative structure, and resulting in a degree of coherence not apparent in the other paper. The results are stated more explicitly, there is no reliance on charts, and, as a whole, the paper is much more elegant and direct. Few claims are hedged.

The opening — with a careful acknowledgment of the significance of work done by other scientists in the field — contrasts dramatically with the opening of the Banting-Best paper. Where Banting and Best dismiss the work of other "observers," this paper indebts itself to Hedon and Lepine for their work on a possible internal secretion of the pancreas. It carefully situates itself within pre-existing scientific knowledge before acknowledging the shortcomings of prior investigations. Even then, the shortcomings are presented positively, as contributions to the pool of knowledge undergirding the work reported in this paper:

> In spite of the failure of these investigators to demonstrate that the diabetes which follows pancreatectomy is due to the removal of some pancreatic hormone that is essential for proper utilization of carbohydrate, the belief has steadily grown that such is really the case, and every now and then a paper appears in which attempts are described to demonstrate its presence (Banting, Best, Collip, Campbell, Fletcher, Macleod & Noble, 1922, p. 338).

Therefore, the authors recognize the contribution and necessity of prior work on diabetes rather than simply professing to account for failures with the development of a new hypothesis, as Banting and Best do.

In so accounting for the previous work in the field, the paper identifies the issues by locating ambiguities and exigencies. The paper suggests that:

> In none of the researches referred to ... is there any indication that sufficient attention was given to the possibility that the uncertainty of the actions of extracts might be due to the fact that these must usually contain powerful proteolytic enzymes which could digest or destroy any internal secretion also present (p. 338).

This possibility forms the stasis they can now address. The paper continues: "One of us (F.G.B.), impressed with this fact, undertook to reinvestigate the problem by using extracts in which the proteolytic enzymes were reduced to a minimum" (p. 338). The passive is gone (in the matrix clause), and Banting's individual, significant contribution is thus acknowledged without delineating his work as distinct or separate from that of the other collaborators. The addition of new researchers to this project is neither mentioned nor accounted for.

Almost as an extension of the literature review, the paper mentions the two prior papers of Banting and Best. The sentence reads:

> In two papers Banting and Best have described in detail the effects which are produced on the metabolism of sugar in completely depancreated dogs by administration, subcutaneously and intravenously, of extracts of the residue of the degenerated gland made at ice-cold temperature with either isotonic saline or weak acid (Banting et al., 1922, p. 339).

Banting and Best are represented as collaborators whose work has been important within the project, but not sufficiently so as to warrant them individual or joint credit for the discovery itself. The paper briefly outlines the results and observations noted in these papers, but concludes the section with a reference to a need for further work on the longevity of dogs treated with the extract; notably, the word *insulin* is not used in connection with this research.

The work reported by Banting and Best is recognized as fruitful,[6] encouraging the team "to seek for methods by which the destructive action of these enzymes could be circumvented in extracts prepared from slaughterhouse material" (pp. 339-40). Soon after this statement, the paper acknowledges Collip's role in the development of insulin. His contribution is depicted as taking place simultaneously to those of Banting and Best — "At the same time" (p. 340) — further highlighting perceptions of the collaborative nature of the work on insulin. The time specification moots questions about what happened first, and whether credit had perhaps been misattributed. Suitably, the line of argument concerning Collip involves experimental competence, and it is here that the extract gets its famous label:

> Working with small quantities of gland one of us (J.B.C.) succeeded by this method in preparing highly potent extracts that contained a low concentration of inorganic salts, no fats, only small amounts of protein, and were sterile bacteriologically. The clinical cases to be referred to later were treated with this extract which we propose to call "insulin" (p. 340).

Like Banting, Collip is referred to only by his initials. His contribution alone does not constitute propriety, despite the fact that it is mentioned simultaneously with a proposal to use the name "insulin." The "we propose" quickly and firmly reasserts the team over the individual achievement; Carol Reeves suggests that, "Rhetorical ownership implies the authority to name, define, and describe the phenomenon and control its public interpretation" (Reeves, 1997, p. 161). By both inventing and applying the name *insulin* to their extract, the authors effectively equate their name with a solution to the problem of diabetes. Similarly, upon establishing this priority, the authors go on to control the release of information. The reasons given for withholding some information are twofold:

> It is partly because we desire to determine as accurately as possible the dosage necessary to cause these effects and partly because we wish to furnish the description of a method for the production of the extract in bulk and of constant potency that further details of this part of our work are at present withheld (p. 340).

Rhetorically, this is a very astute move, as the authors establish and maintain priority over the discovery while also securing time to make revisions and refinements to the extract itself, all in the name of greater good, as opposed to priority. The discovery has been invented and established rhetorically, and consequently, becomes a reality to the addressed audience.

Experimental competence is further established as the paper extends its discussion to the treatment of clinical diabetes. Again, acknowledgment is given to specific parties by way of initials. Individual contributions are not at stake in this paper; rather the paper attempts to gain a type of monopoly on diabetes research by covering the most relevant territory. The paper further specifies the effects of insulin in relation to four additional subcategories of application, thereby highlighting the thorough nature of the research and anticipating possible points of contention. These four categories function as copia, simply reiterating the nature of the results and almost guaranteeing their reliability. Reference is made to "123 observations" (p. 342) to further establish the significance of the experimental results.

Having established priority and demonstrated evidence proving the consistency of results, the paper concludes strongly; no hedging here, despite ending with a note of mild humility:

> While these observations demonstrate conclusively that the pancreatic extracts, which we employed, contain some substances of great potency in controlling carbohydrate and fat metabolism in normal and diabetic animals as well as patients suffering from diabetes mellitus, we cannot as yet state their exact value in clinical practice (p. 344).

By directly stating the value of their work, they demonstrate their experimental competence and instill the audience with a sense that they have, indeed, found a viable solution to the problem of diabetes.

A Receptive Audience

While all discourse is arguably addressed, its reception is the key to success or failure. In the case of scientific discourse, the audience must consist of a group of knowledgeable peers capable of assessing the immediate or potential value of any contribution. As Michael Overington has argued, "scientific knowledge ... depends upon an audience for whatever epistemic status it achieves" (1977, p. 153).

Although Banting and Best's first paper was presented orally and later published, there is little evidence of the response of either audience. The obvious significance of their work came retroactively, in the wake of the later collaborative, Macleod-sponsored paper. Prelli admits that "Scientific audiences, as 'gatekeepers,' can grant the reasonableness of claims — can appreciate an investigator's claims — without believing the claims constitute final, scientific truth" (1989, p. 112). Although the value of Banting and Best's initial claims was obviously appreciated by Macleod and several others, the earlier papers did not persuade the scientific community in November of 1921 that Banting and Best, alone, had made a discovery of any particular moment.

The type of proof necessary to legitimate a claim to the discovery of insulin hinges on convincing an audience that an extract did contain internal pancreatic secretion (Martyn, Bliss, & Vranic, 1996, p. 33). Bliss identifies two problems with the Banting-Best paper as constitutive proof of the discovery: first, "lack of evidence that others found Banting and Best's work convincing"; and second, "the fact that other researchers, notably Paulesco and Kleiner, had previously done as much or more with their extracts as Banting and Best did" (Martyn et al., 1996, p. 33). Consequently, any claim to the discovery of insulin exclusively by Banting and Best

would be unacceptable, even in retrospect. What remains questionable, however, is exactly how much the later reception was a consequence of empirical work and how much depended on rhetorical effectiveness.

While it is necessary to acknowledge advances in the status of knowledge and experimental evidence prior to the preparation of the later paper, it is also important to acknowledge the role of rhetorical invention in both the preparation and delivery of that particular paper. Inventing scientific discourse is critical to the success of its reception:

> Rhetorical communication is thus intimately involved in the assessment of discoveries. An audience of scientists must be induced to attribute the qualities of "discovery" to a claim. A scientific rhetor making a claim to discovery will attempt to constrain the audience's judgments through a series of selected items of information and argument that together make up an announcement — a major claim (Prelli, 1989, p. 99).

In the discussion following the delivery of the paper, its success is obvious, as are the values of the community addressed; it was a smash. Here is a sampling (all from Banting et al., p. 346):

> This study so careful and comprehensive, this work so thorough in its execution and so clear in its presentation, may justly be called epoch-making (Dr. S. Solis-Cohen).

> Having heard what Dr. Macleod has had to say of this work in the meeting and out of it, I am convinced that he and his associates have actually had extracts containing the active principle of the internal secretion of pancreas, and I think that this work marks the beginning of a new phase in the study and treatment of diabetes (Dr. R.T. Woodyatt).

> Undoubtedly we are all agreed in congratulating Dr. Macleod and his collaborators upon their almost miraculous achievement (Dr. F.M. Allen).

The extent to which the discovery became primarily Macleod's in this context is remarkable. Again, while Banting does have senior authorship on the paper, Macleod's ethos vastly outstripped everybody else's on the project. And Macleod was the orator on this occasion. The commentators after the paper repeatedly aver to him, congratulating "Dr. Macleod and his collaborators" (Banting et al., 1922, p. 346), thereby investing Macleod with a substantial role in the discovery itself. In the minds of the

audience, J.J.R. Macleod would undoubtedly be remembered for years to come, for his vital role in the discovery of insulin. When the Nobel prize was awarded for the discovery of insulin in 1923, it was awarded jointly to Banting and Macleod.[7]

Conclusions

The contribution of both Frederick Banting and Charles Best to the discovery of insulin is irrefutable; however, their initial paper failed where the later, collaborative, Macleod-driven paper succeeded. It is arguable that only in retrospect did Banting and Best become fully aware of the implications of the statements made within their paper, and thereby realize the significance of the paper itself. Regardless, without the support and recognition of the audience addressed, new claims to knowledge cannot advance. In this instance, the discovery of insulin was the product of appropriately constructed and addressed scientific discourse. Despite arguments for a possible imbalance in the level and quality of the contributions made by each member of the collaborative group, Banting and Best alone were unable to persuade their first audience that the discovery belonged to them.

Recognizing that all discourse is addressed is the first step in creating a place of value for rhetoric in science. Persuasion need not be perceived as deceptive, but rather should be acknowledged as the end goal of communication, especially in science, where even discovery can be advanced or constrained by rhetorical invention.

Notes

1 Stasis theory goes back at least as far as Hermagoras of Temnos, in the second century B.C.E., and concerns the issue(s) at stake in an argument, and the stances taken towards them. For instance, to take the four classic stases, someone brought up on charges of blocking traffic might argue (1) she didn't do it (a question of fact); (2) she did something, but it wasn't really "blocking traffic" (a question of definition); (3) she did it, but it didn't have any ill effects (a question of value); (4) she did it deliberately, but she is a diplomat and this court does not have jurisdiction (a question of procedure). A good modern treatment that brings stasis theory to bear on scientific discourse is Fahnestock and Secour (1988), who claim that the four classic stases "represent a full set of possibilities from which an author, in a particular rhetorical situation, under a particular exigence, addressing a particular audience, select" (p. 430). Prelli identifies four superior stases of scientific discourse as evidential, interpretive, evaluative, and methodological, and maps them off against subordinate stases include conjectural (fact), definitional, qualitative (value), and translative (procedural).

2 (Bazerman, 1989, pp. 171).

3 Prelli suggests that, "Experimental competence is an especially important problem-solution topos. The topos suggests lines of argument that attack or defend data and claims on the grounds of perceived competence of experimenters as well as the quality of experiments" (Prelli, 1989, p. 186).

4 See Prelli on Merton's scientific norms (Prelli, 1989, pp. 83-119). Also see Halloran, who attributes Oswald Avery's lack of success in claiming the discovery of DNA to his modesty in presentation (Halloran, 1997, pp. 44-8).

5 This sort of (apparently unwarranted) optimism is not unusual in science, even to the point of cooking the data to go in the "right" direction. See Holton's fascinating account of Millikan's Nobel-winning oil-drop experiments (1978, p. 61ff).

6 Prelli suggests that "Fruitfulness is a topos that suggests premises from which to argue that a claim will be productive of new findings, will expand existing theory, or otherwise make for progress" (Prelli, 1989, p. 204).

7 Banting was incensed at sharing this award with Macleod and divided his half of the prize with Best. Macleod, in turn, divided his share with Collip. (Martyn et al., 1996, pp. 35-6)

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