

## Special Communication

# When Authorship Fails

## A Proposal to Make Contributors Accountable

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A published article is the primary means whereby new work is communicated, priority is established, and academic promotion is determined. Publication depends on trust and requires that authors be held to standards of honesty, completeness, and fairness in their reporting, and to accountability for their statements. The system of authorship, while appropriate for articles with only 1 author, has become inappropriate as the average number of authors of an article has increased; as the work of coauthors has become more specialized and relationships between them have become more complex; and as both credit and, even more, responsibility have become obscured and diluted. Credit and accountability cannot be assessed unless the contributions of those named as authors are disclosed to readers, so the system is flawed. We argue for a radical conceptual and systematic change, to reflect the realities of multiple authorship and to buttress accountability. We propose dropping the outmoded notion of *author* in favor of the more useful and realistic one of *contributor*. This requires disclosure to readers of the contributions made to the research and to the manuscript by the contributors, so that they can accept both credit and responsibility. In addition, certain named contributors take on the role of guarantor for the integrity of the entire work. The requirement that all participants be named as contributors will eliminate the artificial distinction between authors and acknowledgees and will enhance the integrity of publication.

JAMA. 1997;278:579-585

### THE ETHICAL BASIS OF PUBLICATION LIES IN TRUST AND ACCOUNTABILITY

Published articles are the means whereby new work is communicated between scientists and scholars. However, they also establish priority, reputation, and standing. Publications are necessary for the correct attribution of credit,

which we are defining here to mean public recognition of scientific discovery, and they constitute a major coin of the realm by which academics proceed along the toll road of promotion.<sup>1</sup> It is for these reasons that scientists view authorship with so much anxiety and passion.

A foundation of trust underlies the entire publication enterprise. Science requires skepticism on the part of readers, but they should be able to start with the assumption that the investigators' report is an honest representation of what they observed. Readers are forced to accord authors trust because readers cannot be in the authors' institutions checking their work. This need to trust the authors' honesty is the basis of Lederberg's assertion that "Above all, the act of publication is an inscription under oath, a testimony. . . ."<sup>2</sup>

Trust in science is made possible by accountability. This became clear in the special case of anonymous publication, popular 200 years ago.<sup>3</sup> Anonymous opinion was considered to be more objective, and thus more authoritative, because the writer was thought to be shielded from prejudice. However, as anonymity freed the writer from ac-

countability for the work, its advantages were found to be spurious and the system was abandoned.

In accepting accountability, authors must ensure that the manuscript is a faithful and accurate representation of the work they did, and commit to resolving any questions that arise after publication. The standards they follow are those of telling the truth and nothing but the truth. It is central to our thesis that the collaborators, who are the witnesses of the work, hold each other to these standards of proof. The fulfillment of these duties requires meticulous research, as well as the investigators' faithful representation of the work in manuscripts. The standards must equally apply to attributions in multiauthored manuscripts (the byline and acknowledgments) to make the account of who deserves credit, and takes responsibility, as honest and complete as the report itself.

### HISTORICAL CHANGES: FROM ONE AUTHOR TO MANY

The concept of an author developed, like that of a composer, when there was but one accountable for the whole work. Sole, named authorship remained the predominant tradition in science until about 1955. But in science, as elsewhere, there has been a proliferation and specialization of jobs. The total number of scientists has multiplied, as have their total number of publications,<sup>4</sup> and the number of authors per publication.<sup>5,6</sup> As the proportion of 1- and 2-author publications has fallen, the proportion with 3 and 4 or more has risen.<sup>7,8</sup> Multiple authorship of articles is now the norm.<sup>5,6</sup> These changes have had an impact on the circumstances and concept of authorship.

### THE PRESENT AUTHORSHIP SYSTEM REEXAMINED

#### Collaboration Prompts New Questions About Accountability

The extreme example of the trend toward "big science" is that of the large, multicenter clinical trial, a phenomenon of the 1990s, which may involve hun-

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Dr Rennie conceived and codeveloped the idea for the paper; codeveloped and corefined the intellectual content; contributed articles and cases collected since 1978; wrote numerous drafts; discussed the ideas at scientific meetings worldwide; and contributed editorial expertise. Ms Yank codeveloped and corefined the intellectual content; contributed to earlier drafts; produced the final draft; coordinated the project; and contributed historical expertise. Dr Emanuel conceived and codeveloped the idea for the article; codeveloped and corefined the intellectual content; wrote the first draft; commented on subsequent drafts; and contributed expertise on ethics. All 3 contributors are guarantors for the integrity of the article as a whole.

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dreds of investigators and institutions.<sup>9</sup> But even in smaller projects, collaborators have different areas of expertise that allow them to make separate contributions to the project and that delineate and limit their accountability for their respective contributions.

The collaborators also have titles that are not tightly linked to their jobs in the project. A scientist with the title of "principal investigator," for example, may do little more than fund the project and provide distant oversight, or may originate the study, design it, and work daily toward its completion. While any system of authorship should recognize credit and accountability based on jobs rather than titles, it seems clear that this is often not the case. Twenty researchers worldwide, more than half being heads of biomedical laboratories, published at least once every 11.3 days throughout the 1980s.<sup>10</sup> It is certainly conceivable that sometimes their contributions were minimal.

It is difficult to give a clear account of who did which part of the research, thereby identifying who is responsible for it, when there is no clear and accepted method of delineating the overlapping, cooperative activities of multiple collaborators. Though the reader must assume that the collaborators have fulfilled their duty to hold each other to standards, ambiguity in the meaning of the byline undermines their practice of this duty. It is for these reasons that we believe that the current system of authorship is inadequate, prone to misunderstanding, and abused.

### Authorship Disputes

Authorship disputes now arise frequently, partly because scientists have not addressed the root of the problem: lack of clarity and openness about authorship. Indeed, vagueness in the byline opens the door to unfair attribution. This may explain why disputes about authorship are increasingly common (Linda Wilcox, MA, CAS, written communication, January 1997), so wasteful of time, and so poorly resolved.<sup>11</sup> Vagueness results in egregious behavior being left unexamined because roles and expectations are undefined and undisclosed. It is for this reason that, at present, the Office of Research Integrity does not even consider cases of alleged plagiarism if they seem to involve a dispute among coauthors.<sup>12</sup>

### Multiple Authorship Diminishes Accountability More Than Credit

The coin of publication has 2 sides: credit and accountability. On the credit side, no one has the least idea what the coin is worth, or who should be awarded

coins, or how the coins should be lined up for inspection,<sup>1</sup> so everyone takes credit. On the flip side of accountability, the greater the number of coauthors, the less responsibility any will take for the whole. So the expansion in numbers of authors per article has tended to dilute accountability, while scarcely seeming to diminish credit. Promotion systems that place more value on numbers of publications than on actual contributions exacerbate the problem. This tendency may explain why many authors perceive it to be in their self-interest to preserve the status quo. It may also explain, in part, why coauthors of fraudulent scientists so readily defend themselves by denying knowledge of the fabrications.<sup>13</sup>

### Misuse of the Current System of Attribution

Given that one of the foundations of the scientific enterprise is trust, it is disconcerting to observe such a disconnect between credit and responsibility, where the author's duty to be accountable is shirked. Some coauthors have been unwilling to take the necessary steps to ensure the integrity of their manuscripts, including their colleagues' work.<sup>14-16</sup> Others have failed to provide journals with highly relevant facts, though these would change the conclusions of the manuscript.<sup>17-19</sup> Or they have submitted to journals manuscripts containing data known, after audit, to be fraudulent without telling the editors.<sup>15</sup>

Guest authorship is the practice of inviting those whose contribution has been scientifically trivial to be coauthors, as payment for a service (eg, referral of a patient) or as tribute (eg, homage to a department head). The practice of guest authorship is deceptive because the "authors" so named gather credit without being able to account for the work. It is frequent,<sup>1,20</sup> deceptive, and dangerous to the guests, who are expected to vouch for the work. The cases of Darsee,<sup>21,22</sup> Slutsky,<sup>23</sup> and Pearce<sup>24</sup> are all examples of fraudulent scientists seeking out coauthors simply to lend legitimacy to their fraudulent publications.

Ghost authorship occurs when those who wrote the article, or contributed in important ways to its production, are not named as coauthors. Known instances are becoming common, as is the practice of paying big names to appear on the byline in place of the ghosts, though they contributed nothing except their prestige.<sup>1,25-30</sup>

A variant of the practice is for companies to give grants to academics to write up, and to journals to publish, the results of studies carried out by firms acting for drug manufacturers. None of those who carried out the study appeared as au-

thors so there was no link between authorship and accountability.<sup>31,32</sup> In another case, the manufacturer who paid for the study blocked the researchers from publishing it, and then published the researchers' results, but with opposite results and with none of the researchers named as authors.<sup>33</sup>

Repeated publication of the same work, with or without minor additions, inflates bibliographies and is common. When similar parts of the same trial are published repeatedly under different authors' names, without cross-referencing, the record is distorted in the name of promotion, and meta-analysis is confounded to the detriment of care.<sup>34</sup>

### Disagreement About Who Is Responsible

The scientific community is divided about how to apply current authorship standards where the contributions of collaborators have overlapped. Because Regalado<sup>9</sup> has shown that there has been an increase in articles with very large authorships since 1990, it is unlikely that the debate will diminish.

The chief area of disagreement about responsibility concerns that of a coauthor's responsibility for work done largely by others. Neglect of responsibility was fairly clear in one case when the authors advocating a test did not have the expertise to know that their published figure, prepared by someone else, was factitious.<sup>35</sup> However, other cases have proved more ambiguous. In 1989, 2 researchers at Stanford University were found by a National Institutes of Health (NIH) panel to be guilty of scientific misconduct in relation to several multi-authored articles.<sup>16</sup> Stanford University insisted that all the authors shared responsibility for the whole article. In contrast, the NIH panel felt that the requisite "detailed and in-depth level of knowledge by all collaborators is not feasible in contemporary multidisciplinary research."<sup>16(p56)</sup>

The problem was summarized starkly by a recent exchange of letters in *Science* concerning an article on a case of fraud.<sup>36</sup> Wooley<sup>37</sup> wrote, "If you haven't done the work, don't put your name on the paper. If you put your name on the paper, then you are stuck with it," while de Sa and Sagar<sup>38</sup> agreed that "[c]o-authors should bear collective responsibility for their publications, sharing blame as well as credit. It is a contradiction to be a co-author but then plead ignorance (and assume victim status) if there is controversy regarding data in the paper."

In contrast, 4 letters asserted that holding all authors fully responsible for all aspects of a publication would increase the risks of collaboration, espe-

cially between different specialties, to suicidal levels<sup>39,40</sup>; was ridiculous in massive projects<sup>41</sup>; and implied omniscience.<sup>42</sup>

The answer to such controversies seems obvious: those who did the work should explain who did what. It is encouraging to note, therefore, that some researchers on collaborative projects already explain to editors what work each person performed. While this may satisfy the editor, by itself it cannot help those readers or authors who want to see public distinctions in recognition.

Editors have to take the position that since only the investigators know who contributed what, only the investigators can decide on authorship. At the same time, they, as well as indexing services such as those of the National Library of Medicine (NLM), have founded policies on the reasonable assumption that to limit the allowable number of authors for each article will not only save space, but will concentrate the minds of collaborators on deciding who merits authorship.

Huth<sup>5</sup> has argued that only a few persons can truly serve the functions of responsible authors: adding authors beyond the number that can really be responsible for an article's content "debases the currency of authorship." While sympathizing with Huth, we also note that journals vary widely in the number of authors they customarily allow.<sup>1</sup> Moreover, editors are constantly required to make exceptions to their own rules, which weakens the claim that setting a limit on the number of authors can solve the problem of responsibility.

Large, multi-institutional clinical trials highlight the different goals of editors and authors most clearly.<sup>1</sup> On the one hand, the Uniform Requirements of the International Committee of Medical Journal Editors (ICMJE or "the Vancouver Group") have served notice that all members of groups carrying out multicenter trials who wish to be named as authors "should fully meet the requirements" (see below). Kassirer<sup>43</sup> has recently emphasized "that in every paper, each listed author must be able to take public responsibility for its content," a position already taken for the *New England Journal of Medicine* by Relman<sup>44</sup> and by Glass for *JAMA*.<sup>45</sup>

On the other hand, those who carry out large clinical trials (trialists) face an extreme version of the problem of being unable, in the current authorship system, to assign credit fairly and publicly recognize their many colleagues for their work. Trialists in the field believe they work hard but get no respect, because some outsiders characterize them as being ill-trained in the scientific method or lacking a research role beyond that of

being technicians or enrollers of patients. Yet the whole depends on their meticulous exertions. Whatever the reason, trialists resent it when editors set up rules that award senior authors alone and exclude them from public acknowledgment. Carbone,<sup>46</sup> noting this indignation, has suggested that limiting authorship severely will have a paradoxical effect: it will reward those who get it wrong by reporting small, nonrandomized trials, and punish those who go to very great trouble to get it right.<sup>1</sup>

### RESPONSIBLE AUTHORSHIP: EFFORTS SO FAR AND WHAT IS STILL LACKING

It is clear from this catalog of problems, confusions, and incompatibilities that the scientific community finds the current system of attributing authorship inadequate for describing modern research activities, while scientists also lack consensus on how to apply the system. In response, many efforts have been made to try to resolve these dilemmas.

#### The Vancouver Definition of Authorship

To focus the attention of scientists on accountability, the Vancouver Group in the mid 1980s codified and began disseminating a definition of authorship that emphasizes the idea of responsibility. In the Uniform Requirements for Manuscripts Submitted to Biomedical Journals of 1993,<sup>47</sup> the definition states:

Each author should have participated sufficiently in the work to take public responsibility for the content. Authorship credit should be based only on substantial contributions to (a) conception and design, or analysis and interpretation of data; and to (b) drafting the article or revising it critically for important intellectual content; and on (c) final approval of the version to be published. Conditions (a), (b), and (c) must all be met. . . . Any part of an article critical to its main conclusions must be the responsibility of at least one author. Editors may require authors to justify the assignment of authorship.

#### Order of Authorship

Recognizing that authorship is "awarded" inconsistently, scientists and editors in all sorts of disciplines have attempted to bring coherence to the order of authors by publishing their view of what is denoted by each position in the list.

Some scientists contend that the names in the byline should be listed in order of seniority, others that an author's place does not matter because credit is equal, or, alternatively, it does indeed matter because the system works like the prizes at a golf tournament<sup>48</sup>: each successive finisher receives half

the credit of the one ahead, down to 5 (or 6, or perhaps 8). Research colleagues all seem to "know" that the second author is always the statistician, or the graduate student if the graduate student is not first, or the physician who entered the most patients, but it is never the senior author, who, because of noblesse oblige, usually appears last, unless his or her noblesse has somehow failed to oblige. Burman<sup>49</sup> has produced an especially elaborate outline for placing people on the authorship totem pole.

Similarly, in an American Association for the Advancement of Science survey, only 7 of 39 editors of clinical journals confirmed that they "knew" what the order of authors meant in their articles, because they had written policies on the subject, yet these varied so widely that the first author could be the student, the person who did most of the work, the senior author, or whoever had previously been determined by official protocol.<sup>50</sup> Other editors, taking another approach, have tried to remove any hidden meaning from the order of authors, by insisting that authors be listed alphabetically. They have found for their pains that authors late in the alphabet have avoided their journals.<sup>51</sup>

Everyone is equally sure about their own system; the point is that none of these schemes is actually disclosed, so the readers, to whom this should be addressed, are not let in on the secret: they have not been told which code book to use and how it works. Indeed, Davies et al<sup>52</sup> have recently shown that only 1 of 16 Canadian departments of pediatrics had "explicit written criteria for evaluating authorship" of scientific articles, and, not surprisingly, the departments demonstrated great variability in their methods of assessing authorship.

The article on order of authorship that makes the best sense is the one by Davis and Gregerman<sup>53</sup> in 1969, and this was written as a joke. These authors suggested allocation of credit on the basis of the fraction of the total work performed. What makes particular sense is that the system is open to the reader and easily understood.

#### Initiatives to Promote Good Authorship Practices

Other commendable initiatives to promote good authorship practices include efforts, often similar and synergistic, by universities,<sup>54,55</sup> professional societies,<sup>56-58</sup> and outstanding researchers,<sup>58,59,11</sup> as well as journals.

All journals should keep publishing their criteria for, and policies on, authorship, and they should require authors to sign forms attesting that they take responsibility. Statements and forms give

notice (authors cannot later plead ignorance), draw attention, and so educate. Conversely, it may be awkward for an editor to object to a deceptive practice when the journal has never printed the rules of the game. Such criteria may also have prevented the cases of a listed co-author, after publication, having to dissociate himself from an article he knew nothing about.<sup>60</sup> Journals, in addition, should continue to flush ghost authors into the open by insisting that all who contributed substantially are named, so that they can take credit as well as responsibility.<sup>1,61-64</sup> Finally, editors should draw their readers' attention to poor behavior that is discovered only after publication. Embarrassment is a powerful tool. The Rudolf Virchow principle, "In my journal anyone can make a fool of himself,"<sup>65</sup> should be used by the editor, for just that: to expose misleading or dishonest practices that have slipped into print.

Although we support these efforts, we believe they do not and cannot resolve existing problems, because specialization of jobs has made the original concept of authorship impractical, and the authorship system's vagueness about contribution makes it prone to abuse. Even when current standards for authorship are strictly applied, they fail to represent accurately who should receive what credit and responsibility for aspects of cooperative projects. It is as obvious to us as it is to Bruce Squires (a long-time member of the Vancouver Group) that the "ICMJE definition is not working,"<sup>66</sup> a conclusion backed up by Drenth.<sup>67</sup> With modern research by multiple investigators, the authorship model is outmoded, stretched: it no longer fits.

## OUR PROPOSALS

Any new system that will reinforce trust and accuracy in the publication enterprise must convince readers of accountability for articles at 2 levels—for each part, or contribution, and for the whole. The idea that accountability can be divided and overlapping reflects the reality that the many-person, 1-product research article of today is an aggregation of the work of many people, each of whom takes full responsibility for certain parts of the project. But for the system to be able to identify accountability, there must be disclosure to the reader of every participant's contributions to the work and to the manuscript. It is equally necessary that the reader receive assurances as to the quality and integrity of the work as a whole. In the end, the only people who can accept accountability for the entire article are one or more of the coinvestigators.

## The Job-Centered Approach: Credit (and Blame) Where It Is Due

Because the current system of authorship is idiosyncratic, ambiguous, and predisposed to misuse, we propose in its place a radical change: a new system that is accurate and discloses accountability. We propose the substitution of the word and concept contributor for the word and concept author. Like others before us,<sup>53,68</sup> we are concerned to acknowledge work performed. But the word *author* is too imprecise to delineate the work of those many people named in the bylines of articles today. The word *contributor*, on the other hand, describes someone who provides jointly with others or who writes an article. Contribution is the activity of science that is most relevant to publication because its disclosure can identify who is accountable for what part of the research and allows the reader to assign credit fairly.

Abandoning the concept of author in favor of contributor frees us from the historical and emotional connotations of authorship, and leads us to a concept that is far more in line with the actuality of modern scientific cooperative work. No contributors can shirk responsibility or have credit withheld by avoiding or not having their names and work specified. The critical feature of our model is the idea that contributors describe their actual research activities to the reader. Thus, the plan is a simple one: it discloses what each person has already done.

## Describing Contributions

Coworkers should meet, discuss, and decide on their respective contributions to the project, as well as the relative value of the contributions to the whole, and in what order to list them in publications. Joint or overlapping activities should be described as such. We recognize that researchers may find this activity challenging, but it is a duty that should grow easier with practice.

The contributions to be described are more complex, detailed, and accurate than the principal components of authorship activities noted in the Uniform Requirements. The coworkers might start with a general roster of contributions that can be expanded and made more specific. When necessary, these descriptions can be combined in series to clarify further the exact, perhaps multiple, contributions of each person. For example, contributors may agree on descriptions similar to those listed below, which accompanied a manuscript submitted to *JAMA* (Alejandro Jadad, MD, DPhil, written communication, December 18, 1996) (the 3 names have been removed):

1. Design of the review, literature search, data extraction, data analysis, production of first draft, revision of subsequent drafts; coordination of communication among all investigators.

2. Literature search, retrieval of articles, creation of data extraction forms, data extraction, data analysis, comments on first draft, creation of first draft of table, comments on subsequent drafts.

3. Generation of the idea for a review on this topic, design of the review, financial support, comments on drafts.

As the practice of using job descriptions to disclose contribution becomes common, it may be helpful to develop predefined job categories that are made clear to the reader. Then phrases can be consistent across many research groups. However, it is important to remember that job categories—such as those seen in film credits ("director," "best boy," "key grip")—are intrinsically more rigid and less useful than phrases that describe the actual duties performed. Before job categories replace job descriptions, therefore, researchers and journals will have to be careful to develop descriptors for contribution that are accurate, flexible, and intelligible.

After agreeing on what jobs each did and how to describe them, the colleagues should determine the relative contribution of each person, perhaps as a percent value, to the project as a whole. Though it may be difficult to assign a numeric value to these estimations and they need not be published, the exercise will be useful in determining the order of contributors (see below).

## Guarantors

All contributors are fully responsible for the portions of the work they performed and have some obligation to hold one another to standards of integrity. At the same time, special contributors must be designated and disclosed as guarantors of the whole work. Guarantors are those people who have contributed substantially, but who also have made added efforts to ensure the integrity of the entire project. They organize, oversee, double-check, and must be prepared to be accountable for all parts of the completed manuscript, before and after publication. In this way the role of guarantor is precisely defined and differs from that of "first author" or "corresponding author" or "senior author," there being many examples of these showing themselves unable to vouch for the whole work.

The role of the guarantor is best demonstrated in the contrasting responses of Felig (in 1979) and Collins (in 1996) to charges that their respective junior colleagues had falsified data in articles they coauthored with the senior scientists. A

Yale advisory committee found that Felig had exercised "poor judgment" in not aggressively investigating charges that his junior had doctored data.<sup>69</sup> In contrast, it seems that Collins, director of the National Center for Human Genome Research at the NIH, responded with dispatch.<sup>70</sup> Accepting responsibility for the aftercare of his work, Collins quickly corrected the published literature by exposing tainted data in 5 articles, thereby preventing other researchers from wasting further efforts in trying to replicate the faulty reports.<sup>70</sup> His last important act as the articles' guarantor thus was publicly and speedily to withdraw his "guarantee" that they were based on honest science.

Such examples illustrate how essential it is, for the integrity of science, that contributors identify those among them who are guarantors and publish the description "guarantor" in the list of contributors (see below).

### Order of Contributors

We have been highly skeptical of the order of authorship as a way to convey to the reader the investigators' respective levels of contribution. But we cannot ignore 2 facts: that printing the names requires some sort of listing, and that co-workers will tend to covet positions that lend their names prominence, near the top of the list or in the last place. The colleagues, to address these preferences, and having agreed already on their respective contributions, should list their names systematically—in the byline and in the contributors list—according to the relative importance of their duties: in descending order, starting with the collaborator who made the most substantial contributions.

### Disclosure to the Reader: The Contributors List and the Byline

All collaborators must disclose to the reader, and not merely the editor, the contributions and guarantors on which they have agreed. These descriptions should be displayed next to the appropriate names in the *contributors list*, which should appear as a footnote on the first page of the article. Our model thus demands job-driven identification of contribution, determined by the colleagues themselves and displayed by editors. (Note, for example, our contributors list with the affiliation footnote on the first page of this article.)

Each journal editor decides on the exact method used to disclose the contributors list, but should not limit the number of contributors who are named as long as each has added usefully to the work. If the editor notes that no one has accounted for key aspects of the project, he

or she can require that the contributors identify the responsible person.

The *byline*, just below the title of the article, should name only those who contributed most substantially to the work. Journals may set their own rules about how many contributors can be listed in the byline, as they do now. A journal might decide, for example, to name only those participants whose contributions total more than 5% or 10% of the work, or, to use another criterion, all those whose contributions could alter substantive parts of the article. Informed of the journal's policy, the collaborators, again by consensus, identify all those who meet the criteria for being listed in the byline. These contributors should be those then required to sign the contribution (old "authorship") statement, together with the copyright, financial disclosure, and other forms currently used by the journal.

### Policies of Indexing Services

Indexing databases such as those of the NLM are second only to journals in their ability to recognize and publicize researchers' names and contributions to science. Like journals, they may establish their own guidelines as to the number of contributors that can be cited. If this seems arbitrary, one should note that the present convention for deciding who gets cited developed in an arbitrary manner. For example, the Vancouver Group initially stated that indexing services should list the first 3 names on articles. But in 1994, endorsing a plan originating with the NLM, it ruled instead that reference lists should name the top 6. More recently, molecular biologists have persuaded the NLM to list the first 24 names, plus that of the last author. In general, journal policies on the number of researchers that are listed in the byline have coincided with the number the NLM indexes will cite. When naming contributors, journals and indexing services should continue to coordinate their respective policies.

In addition, indexing services may consider implementing a mechanism for having each publication record disclose the contributors list of the article, or at least the names and contributions of those people in the byline. Such descriptions, along with an option for searching, by key word, multiple contributors lists, would enable readers to identify colleagues in their specialty or the contributors to whom they should direct specific questions.

### Policies at Universities, Agencies, and Societies

Journals and indexing services may lead the way, but academic centers and

granting agencies can influence the culture substantially through their hiring, promotions, and grant review committees. These committees should require that the references to each publication on the applicant's curriculum vitae include the description of the applicant's work that appeared on the article's contributors list. Professional societies should also institute consistent policies of disclosure of contribution in their materials: as Hopfield<sup>71</sup> has noted, truth in labeling could be an effective force in science if promoted by leading professional societies.

To change how we recognize credit and responsibility for articles, therefore, a number of influential groups—journals, indexers, academic and funding institutions, and professional societies—must agree to implement this explicit and transparent system for recognizing contribution.

## WHY THE PLAN WILL WORK

### General Advantages of the Proposal

There are several reasons to think that this system would be an improvement on the current one:

1. It is descriptively precise. Precision encourages a high level of honesty, which has intrinsic merit. It is also likely to bear unanticipated practical advantages, since a foundation that requires exacting levels of honesty is more solid than a foundation that allows for deceptions. Readers will feel able to allocate credit and responsibility accurately.

2. It is fair. Contributors should feel assured that they will be recognized appropriately. It will discourage guest and ghost authorship by forcing putative "authors" to describe their contributions, or else withdraw. Distinctions in the credit given for differential work will remain (for example, for being a guarantor or the first listed contributor), but provided that there is honest attribution, at one blow all the problems of hierarchy, order, and undeclared meaning will vanish.

3. It may discourage fraud. The proposed system is likely to provide additional protection against fraud by specifying responsibilities so that individuals are more effectively and publicly linked to those tasks for which they are accountable. Cross-checking of roles may also inhibit fraud by making it harder for individuals or collaborators to maintain a lie.<sup>22</sup>

### Specific Benefits: Why the Proposal is Useful

1. Academic appointment and promotions committees now will be able to weigh coins that have visible, assessable

worth. Institutions frequently, but variably, ask candidates to specify the part they played in their research.<sup>52</sup> The advantage to institutions will be that instead of wondering if an individual has given, in retrospect, a biased view of his or her role, they will be able to look up explicit statements: and the guarantee is that the candidate's colleagues agreed on the identified contributions at the time of the article's publication.<sup>71</sup>

2. Collaborators should obtain better protection from abuse by colleagues. In particular, those who feel increasingly put upon by the current system,<sup>11</sup> junior researchers, may gain because the proposal will make it less easy to defend—to oneself, let alone to others—an inaccurate and inflated statement of contribution.

### Skepticisms Addressed

Recognizing that some readers may have doubts about the necessity of this proposal, we have tried to anticipate and answer their concerns here.

1. "This proposal is no different than the present system of authors and acknowledgments." The proposal differs substantively from the present system by eliminating the artificial distinction, mostly of a social nature, between authors and nonauthor contributors—that is, between "authors" and "acknowledgees." The contributions of all (not just those of acknowledgees) are described and disclosed.

2. "Researchers will be reluctant to be on the leading edge of change, especially when the response of promotions committees and funding agencies is still unknown." We acknowledge the possibility of such resistance. At the same time, however, if journals and indexers adopt the plan, this will greatly encourage researchers to comply. Accompanying changes within academic centers, granting agencies, and professional societies will also promote the transition.

3. "It will not stop 'contributors' from claiming, when problems arise, that they did not understand what another contributor was doing." Authors already deny responsibility. But with responsibility pinned upon them for those contributions they have explicitly identified as their own, contributors will find it harder to make this excuse.

4. "It will not stop those who made minimal contributions from getting their names on articles if they have influence and seniority." Maybe. But we think that in a system that requires people to be explicit, people are less apt to lie by claiming that they performed work done by others.

5. "It is cumbersome." The counterargument to this critique is simply that the time, space, and attention are worth

it. The extensive energy already expended on trying to resolve problems in the current system demonstrates that the research community wishes to have the most fair and honest system possible<sup>57,72</sup>: for what could be a more important precondition for honest reporting of data than honest attribution of credit and responsibility for that data? The space taken up by a footnote in fact would be small. Moreover, giving written accounts of their respective work will be a familiar process for many researchers, who already do so in correspondence with editors.

6. "It will lead to hair-splitting negotiations about the origin of ideas, so often joint, and the amount of work done." This danger should be acknowledged, but with practice researchers should become more used to openly discussing and resolving what their contributions have been. The benefits of a better system will outweigh the effort required for such discussions.

7. "It would have been adopted a long time ago were it a good plan." We are by no means the first to advocate listing the contributions of authors,<sup>53,48,73-77,1,78</sup> so the answer to this point is best addressed by looking at the research environment from both an individual and a historical perspective. First, colleagues may continue to perceive themselves to benefit from leaving the question of their contribution ambiguous: if we leave the meaning of the byline obscure, then each of us will be able to claim 95% of the credit, but accept only 5% of the blame, for all our multiauthored articles. As Zuckerman<sup>79</sup> described, when discussing order of authorship and the noblesse oblige of Nobel prize winners, ambiguity makes the evaluation of individual roles impossible, but it also "reduces the stress of collaboration" and so may oil the research wheels. We believe this is a poor excuse to avoid frankness, which may prevent future disputes—and thus future stress—among collaborators. The colleagues of fraudulent scientists must surely wish they had gone through a process of delineating contribution. Second, it is only recently that multiauthor articles have come to dominate biomedical publications; consequently, it has taken some time for scientists to begin to understand that the current system of authorship no longer fits their research reality and cannot meet their needs: with the steady increase in collaborators per article and the ambiguity of the definition of authorship, a new system is needed.

### It Has Worked Before: The Example of Large Trials

There is evidence that the proposal of listing contributions is practical, because there are good examples of the contribu-

tor, or job-description, approach already in the literature. In fact, it has been adopted before, but only in the case of large trials. For example, an article from the ISIS (International Study of Infarct Survival) Collaborative Group listed roughly 2000 "members," whom we would call contributors, usefully divided by committee (writing, steering, data monitoring, and the like) and by country and hospital, and with the tasks of the overseeing research unit described in detail.<sup>80</sup>

This is an entirely reasonable, job-based approach, treating all participants as contributors, their work being differentiated and displayed: it fits the reality and assigns accountability. We endorse it, with the addition that guarantors be named.

### Recent Developments

We presented these ideas at a meeting on June 6, 1996, at the University of Nottingham, sponsored by the *Lancet* and the *BMJ*.<sup>81</sup> They formed the main focus of discussion at that meeting, and part of the agenda at the meeting of the Vancouver Group, which followed immediately and which one of us (D.R.) attended.<sup>66</sup> As a result, the Uniform Requirements for authorship have been modified to include the statement: "Editors may ask authors to describe what each contributed; this information may be published."<sup>82,83</sup> Finally, on July 5, 1997, the *Lancet* adopted a major part of our proposals by requiring publication of the contributions of its various contributors.<sup>84</sup>

### CONCLUSION

In short, in the proposed system all contributors decide on their own contributions, which are disclosed to the reader, and on their relative importance to the article, which drives the order in which their names appear (according to descending degrees of contribution) in the contributors list and the byline. The editors decide how they wish to display both lists, and the indexing databases and journals set up the rules for how many contributors are cited. Research institutions and societies then use the descriptions of contribution in their assessments of candidates.

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