The Information Exchange Group -- an Experiment in Communication

by

Errett C. Albritton

Office of Research Accomplishments
Scientific Evaluation Section
Division of Research Grants
National Institutes of Health

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The Subject: For the past four years, my office has had intimate association with the development of a medium of scientist-to-scientist communication that is highly specialized in function and service. It is designed for speedy verbatim professional communication, on a worldwide basis, between a researcher in a sharply circumscribed research area and all[1/] other scientists who are engaged in creditable research in the same area. This medium is the Information Exchange Group, together with its accessory, the exchange "center." There are at present seven such IEG's as I shall hereafter call them. Our office is serving each of them as its exchange center.

Historical: I am indebted to Dr. William Dameshek, under whose chairmanship the fifth in the series of seven IEG's was organized and now operates, for the information that the Royal Academy of London could be said to have been the first IEG. It started in London England in the 1630's, when early scientists with a variety of interest met informally at one another's homes to hear reports from members of their group. The practice developed of writing communications to one member who served as secretary, and these communications were made available to all in the group.

1/ All is the intent and is approached to the extent that present members are alert to nominate others, and/or that scientists working in the research area identify themselves by applying for membership.

What the IEG Does: Other information exchange groups have been set up in more recent history, though so far as I know no complete list of them and what they do has ever been compiled. I think I am right, however, in the belief that the seven IEG's we are assisting -- and I may say studying -- are unique in the simplicity of what they attempt and do: A scientist working in a certain research area that happens to be served by an IEG has something he wants to say to all other scientists working in the IEG's research area -- 50 or 100 or 500. It may be a sentence, a paragraph, or even a complete research paper, ready to submit to a journal or, indeed, already submitted and perhaps accepted. He mails his communication to the IEG "center" -- my office; we then submit the communication to the NIH Office of Printing and Reproduction (OPR), which is cooperating in the assistance being given to the seven groups. The OPR duplicates the member's communication by photo-offset to the required number of copies and immediately mails it out to all the scientist members of that IEG. There is no "review," no editing or abstracting. The material that is sent on its way to each of the members is a photographic replica of the material received from the author. In this respect the IEG, in operation, is a group of scientists engaged in a research-area-wide, worldwide private professional correspondence -- and we are what you might call the "mail drop."

For convenience, we have appropriated the term "memo" as a generic term for any scientific communication transmitted through

the IEG center. I shall have more to say about them later.

What are the Seven? The seven IEG's now operating with our office as a center are shown in Figure 1.

Figure 1

The Seven Information Exchange Groups
as of March 1, 1965

	Scientific Area	Age	Chairman; Co-Chairman
IEG #1	Oxidative Phosphorylation & Terminal Electron Transport	4.0 yr	David E. Green
IEG #2	Hemostasis	1.0 yr	Theodore Spaet
IEG #3	Computer Simulation of Biological Systems	0.8 yr	Homer Warner
IEG #4	Molecular Basis of Muscle Contraction	0.4 yr	John Gergely
IEG #5	Immunopathology	0.4 yr	William Dameshek G.V.T. Nossal
IEG #6	Interferon	0.3 yr	Alick Isaacs Samuel Baron
IEG #7	Nucleic Acid & the Genetic Code	1 mo	James D. Watson Marshall Nirenberg

Sharply Focused: Note at this time that the research areas are quite sharply defined. In #2, for example, research interest and activity are focused on stoppage of bleeding or hemostasis, one aspect of blood coagulation. Blood coagulation itself would have been too broad a research area for this IEG. Research in #6 is focused on interferon, presumably a single chemical entity produced by cells that have been exposed to a virus. Research interest in IEG #1 is focused on two closely related phenomena: oxidative phosphorylation and terminal electron transport.

This sharpness of focus with the consequent identity or near identity of research interests of the scientists has been a controlling consideration in setting up the seven IEG's. The nearer the research interests of two or more scientists, the greater the gain to be expected from participation in a private professional correspondence and the more they are moved to initiate and carry on such a correspondence.

How Did it Start? The first IEG in the group of seven operating with our assistance was and is IEG #1 (cf. Figure 1). IEG #1 resulted from a couple of conversations in late January 1961 in which the idea was explored. Three persons were involved: Dr. Philip Handler, distinguished biochemist at Duke University, Dr. David Green, Director of the Enzyme Institute at the University of Wisconsin, and myself. The part played by each of these two distinguished scientists was crucial and indispensable. Either one could be called the father of the IEG, for without the fathering they gave it the idea would never have materialized.

Chairmen: The first step in the organization of an IEG has been the selection of a chairman and, with the last three, the selection of a co-chairman. These men are leading scientists, if not the leading scientists, in their respective research areas.

Co-chairmen have been included where special needs have seemed to exist. In No. 5 the co-chairman is a distinguished Australian scientist who has assumed responsibility for building up the foreign

membership. In IEG #6 the chairman, discoverer of interferon, is a distinguished British scientist. The co-chairman (who happens to have triggered the organization of this IEG) is in easier telephone reach of our office -- he is on the research staff of the National Institute of Allergy and Infectious Diseases -- and can quickly handle smaller routine matters that would otherwise be referred to the chairman. IEG #7 has a co-chairman as well as a chairman, in anticipation of an unusually heavy administrative load. Expectations are that this IEG will be larger than all the others combined.

The Chairman's Responsibilities: The first step of the chairman (and co-chairman) is the selection of a list of prospective members -- other scientists who are publishing research in the same research area. Invitations then go out, signed by the chairman and co-chairman, and accompanied by a short statement of the conditions of membership. After that the IEG grows by nominations from current members and by applications. The chairman passes on the eligibility of proposed new members.

The chairman is, in fact, the decision-maker on all matters having to do with his IEG. Need has not been felt, as yet, for such accessories to management as a "council" or "membership committee," nor for a "grievance committee." Nor has there been any demand that the membership be polled on any matter. So long as members get what they banded together to get, the speedy private professional correspondence, other things are minor in importance.

. Growth of IEG Membership and Activity: Figure 2 shows the initial number and present number of members of each IEG and for each the number of scientific communications (memos) transmitted so far.

Figure 2

Number of Members and Number of Memos
Seven IEG's, as of February 5, 1965

	Research Area	No. of Members Initial	No. of Members Present	No. of Memos
IEG #1	Ox Phosph & Term Elec Transp	32	386	297
IEG #2	Hemostasis	32	38	41
IEG #3	Computer Simula of Biolog Syst	62	88	7
IEG #4	Molec Basis of Musc Contrac	76	92	8
IEG #5	Immunopathology	50	65	11
IEG #6	Interferon	99	111	33
IEG #7	Nucl Ac & the Genetic Code			
	Totals	351	780	397

The first IEG started with 32 members, four years ago. It now has nearly 400 members and the 400 have sent nearly 300 memos through the center to date.

IEG #2 started not quite a year ago with 32 members. It is in a much narrower research area than IEG #1 and is not showing the same rapid growth. The number of memos (41) to date, however, happens to be three times the number transmitted through the center by the first IEG in its first year of life.

No's. 3, 4, 5 and 6 are successively more youthful, yet each has experienced some growth and each has shown some activity in

transmitting memos. No. 7 is in the organizing stage and no numerical data are available as yet.

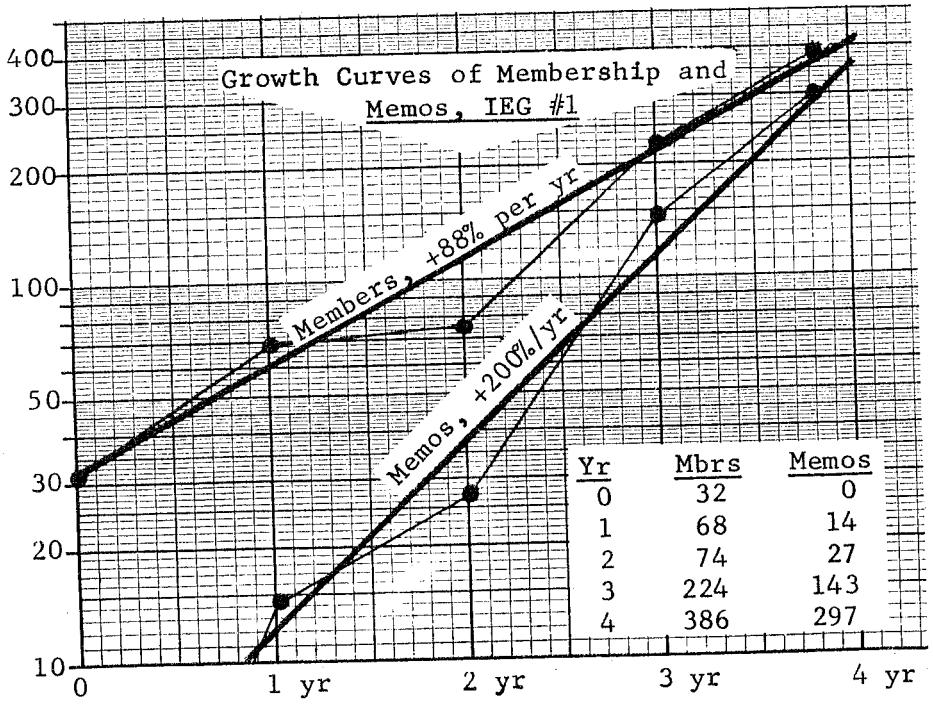
The first six IEG's now represent a membership approaching 800 and when IEG #7 gets under way, the combined membership will jump to well over 1,000.

Article in Science: An article in Science (Jan. 24, 1964) undoubtedly had much to do with the growth in number of IEG's in the past 12 months. After IEG #1 had been in operation for nearly three years, Dr. Green, its chairman, wrote the article, giving the first public account of this mechanism for speedy communication among scientists having the same research interests. The six additional IEG's were organized in rather rapid succession following its appearance.

Natural History Study: May I interject here a comment on our own role in studying these IEG's. We look on ourselves as playing the role of a naturalist, who is given the opportunity of studying seven individuals of a previously undescribed species. We want to observe the traits and behavior of each individual; generalize where we can, and learn. Particularly learn if we can, just what contributions to the advance of medical science this speedy private professional correspondence can make. Incidentally, let me add, we exercise no control, once we have made the decision to serve as the center for one of these groups.

Annual Growth Rates: The growth curve for IEG #1, plotted on semi-log paper, is seen in Figure 3. The rate of growth has been +88% a year, each year over the preceding year. The growth in number of communications, also shown, has been more than twice as fast as the growth in members. This difference probably means no more than a gradual acclimatization of new members to the continuous opportunity for ready communication offered by membership in the IEG.

Figure 3



For what they are worth, based on only a few months' observation, the computed annual growth rates of the next five IEG's are seen to be:

Figure 4

Growth Rates, IEG's #2 through #6

IEG #1 .... +88% per year

IEG #2....+19%/yr
IEG #3....+55%/yr
IEG #4....+61%/yr
IEG #5....+93%/yr
IEG #6....+46%/yr
IEG #7

IEG #7 is too new for any growth data to have accumulated; however predictions are that it will outstrip all the rest.

Conditions of Membership: I have referred to the conditions of membership, a copy of which is sent out with each invitation to the initial members and to all subsequent nominees and applicants approved as eligible for membership. The chairman of each IEG decides what these conditions shall be. As it happens, the conditions of membership set by the chairman of the first IEG, Dr. David Green, have been approved and adopted by the chairmen (and co-chairmen) of the succeeding IEG's.

The conditions are few. The one of outstanding importance I quote: "The member undertakes on his own behalf and on behalf of any other person with whom he shares the information that any research finding communicated via the Exchange will be treated as a 'personal communication' from a professional colleague and will be given due credit as such in any situation where question of priority might arise."

Protection of Priority: This matter of priority was understandably one of prime concern to prospective members when the first IEG was being organized; for in venturing to reveal to a hundred or two or three hundred other scientists in his research area the findings he had written up for publication, the scientist was aware he was stepping onto untested terrain. What was to prevent some other scientist from hurriedly gathering a few observations and publishing them in a journal that has a very short lag time between receiving a paper and publishing it? Scientists trust colleagues they know personally, and in private professional correspondence they keep one another informed of research findings as they come to light. But two or three hundred others let in on this private professional correspondence is another matter.

For the first scientists who agreed four years ago to run this risk, the venture is comparable to what was faced by the first pilot who broke through the sonic barrier. Fortunately, in neither case did any misfortune befall. The seven existing IEG's have been the medium for dispatch of several hundred scientific memos -- and I believe only one complaint of "failure to give credit" has occurred. The chairman was easily able to engineer a settlement to the complainant's satisfaction.

It may seem a paradox, but I believe I am safe in saying that this venture beyond the priority barrier has strengthened rather than weakened the security of priority. All the leading scientists in each research area, worldwide, are members of the IEG for that area.

Hardy indeed would be the individual who would attempt to claim credit for another man's discovery, with a jury of up to two or three hundred of his peers frowning down upon him.

Memos as They Come: Approximately 80% of the 300 memos that have passed through the center so far are full research papers destined for publication. The other 20% are discussions of research findings and/or interpretations in previously circulated papers, or discussions of theory. The center is receiving approximately 10 scientific memos a week and the number is expected to more than double within the year.

Perhaps one in thirty or forty memos comes in French. I think it is safe to predict that an occasional paper in German will also be coming along. After consultation with the chairman we have returned one paper received in Russian, with a letter explaining that possibly one in a hundred members might be able to read a document in their great language; that the waiting list of documents is such that translation at NIH would require up to three months and expressing the hope that the author might be able to supply an English translation. If IEG's ever get on their feet, beyond the present experimental stage, I hope it will be possible to accept a paper in any language and fairly promptly send out an English translation.

Foreign Members: The number of members in the first six IEG's is 780. Of these, 295, or 38%, are outside the USA. This same percentage also holds for the oldest and largest: IEG #1 has 147 members outside the USA, amounting to exactly 38% of its total membership.

Figure 5 lists the countries represented in descending order of the number of members from each. There are 27 foreign countries on the list and further additions are expected. The exact order in which countries are listed, depends, of course, on the accident that researchers in these countries are interested -- much or little -- in research in the six areas covered by the IEG's.

Figure 5

Foreign Membership of Six IEG's
as of February 4, 1965

Country	#1	#2	#3	#4	#5	#6	Total	%
England	34	5	5	13	6	8	71	24
Japan	21	-	-	6	-	4	31	10
Australia	12	1	1	1	7	-	22	7
Sweden	12	1	-	1	1	4	19	6
Canada	8	2	3	1	2	3	19	6
France	9	1	-	1	2	2	15	5
Germany	8	1	1	2	-	1	13	4
USSR	8	-	-	2	1	1	15	4
Belgium	1	3	-	2	-	6	12	4
Israel	2	-	-	1	2	5	10	3
Switzerland	3	2	-	1	2	1	9	3
Netherlands	6	-	2	-	1	-	9	3
Czechoslovakia	2	-	-	-	2	4	8	3
Italy	4	-	-	-	1	2	7	2
Poland	5	-	-	-	-	2	7	2
Norway	1	3	-	-	1	-	5	2
Denmark	1	-	1	2	-	-	4	1.4
Finland	-	-	1	-	1	3	4	1.4
India	3	-	-	-	-	-	3	1.0
Austria	1	-	-	-	-	2	3	1.0
Scotland	1	-	-	-	-	1	2	0.7
Mexico	1	-	-	-	-	1	2	0.7
Brazil	1	1	-	-	-	-	2	0.7
Spain	2	-	-	-	-	-	2	0.7
Hungary	-	-	-	1	-	1	2	0.7
Rumania	1	-	-	-	-	-	1	0.3
New Zealand	-	-	-	-	1	-	1	0.3

A Continuing International Congress -- by Mail: Up to this point, I have emphasized that IEG's carry on a research-area-wide private professional correspondence. This was all we saw in the IEG at first, and it is still an accurate description. But as the foreign membership grew to numbers that could no longer be viewed casually, now more than a third of the total, another aspect of the IEG forced itself upon the observer. The IEG is a "continuing international congress by mail." This characterization has stuck, and has found place on the front cover of all scientific memos. Present at the congress is the member who gets up and delivers a paper. Present also is the member (or more than one) who rises to discuss the paper and maybe wishes to "show a few slides." If not from the USA, either may have come from any one of 10 to 20 foreign countries. Missing are the coffee breaks with opportunity to corral a speaker for a few minutes and ask his advice on some matter; missing the social evening and the banquet speaker's witty address. But missing also is the rap of the gavel that says you have talked too long; missing too, the busy effort to take down adequate notes on the reports; and missing the cost of travel, even up to transatlantic or transpacific, that you are lucky if you can take out of your research grant.

I may have made the likeness a better likeness than the facts would support. All these "presents" and "missings" are surely true, but the "get up and discuss" detail of the picture is rather faint at present and could stand some strengthening. It has been growing more distinct in recent months.

Are IEG's Financially Viable? The answer is "No." Financial assistance is indispensable if IEG's are to survive.

The same question can be asked -- with the same answer -- about international or national conferences, about data storage and retrieval centers, or any other communication facility. The same is true even for journals. An increasing number have found that their income from subscriptions and the small amount of advertising they get is not enough to keep them afloat. "Page charges" are now a widespread practice among the leading biomedical journals.

Communication of research findings and of ideas -- the quicker the better -- is one of the essential factors in the advancement of science, on a par with research materials and equipment and laboratory space. In the early days of "little science," some scientist's children might be helping to fund his research by doing without shoes. In our present era an awakened society no longer tolerates any such avoidable sacrifice by the few for the good of the many.

What is the Cost? Then what is the order of magnitude of the cost per member? A firm answer to this is not available at this time. In any case it will be the cost per scientific memo, not per member. If one preprint or other document (memo) averages 20 pages, I think it safe to estimate its cost as about 10 cents -- half a cent a page. This, however, is under circumstances that may only be temporary -- reproduction of memos by NIH's own printing facility. Beyond the grounds of the NIH there lie the possibilities of reproduction

by a facility owned jointly by all IEG's, or by a privately-owned printing shop or possibly reproduction by the Clearing House for Federal Scientific and Technical Information -- the old Office of Technical Services.

Reproduction on microfilm is a possibility for consideration. A 4x6 inch "microfiche" card has up to 57 windows, each for one page of microfilm. Since memos of 57-page length have not occured in our experience so far, we can picture a complete file of 300 memos, the 4-year product of our most active IEG, on 300 4x6 cards in a box (with room for more) that could sit on a scientist-member's desk.

If IEG's federated and succeeded in obtaining a grant to set up and operate an information exchange center, microfiche reproduction would probably be not only the most economical but also the speediest. It seems not unlikely that the cards could be in the mail to all quarters of the globe within two or at most three days after receipt of the document at the center.

Unfortunately a microfiche reader, costing $150 to $200, must be available to the recipient. A reproduction center, could, if necessary, send out microfiche copies of a memo to those members who had readers and -- at more expense -- send out full size photo-offset copies of the same memo to those who did not have the readers.

Relation to Journals: As might be expected when a newcomer enters a small established community, the IEG, on a couple of

occasions, has innocently been responsible for some legitimate grief in the editorial office of one or two journals. Two instances have occurred in which an author's paper has included in its bibliography a reference such as this:

> Doe, John, personal communication: IEG #1, memo #195.

Since John Doe may be in any one of several countries, it behooves the author to go into more than ordinary detail in the text, if he doesn't want an occasional reader to be gnashing his teeth in frustration. The IEG, if it becomes an established institution, must not bring with it a cluttering up of the scientific literature with untraceable bibliographic references.

Another type of "cluttering up" has also occurred: An IEG member, call him "B", meticulously gave a proper bibliographic reference to a paper by member "A", but actually had never read it. He had only read A's IEG memo; but the matter B quoted had been omitted from the final published version of A's paper. This, I suspect, embarrassed B more than it troubled the journal editor.

In the broad context, two or three instances of error of judgment, or even carelessness, out of some hundreds of thousands of bibliographic references in a single year pose no serious threat to established and time-tested procedure. However, these few incidents and the possibility of others like them are matters of concern. The newcomer in the neighborhood surely wants nothing but good relations with the older residents.

Possible Competition: If the IEG becomes an established institution, will there be any competition for survival between IEG's and journals? Both are able to convey in convenient portable form, without any other required apparatus, full information about a completed research. Of the two the IEG is speedier, and besides, it permits back and forth discussion. So why continue journals? The answer can be generalized to cover all means of scientist-to-scientist communication: No one means supplies all the needs; each has its excellences and its shortcomings in comparison with each of the others. If there is a heierarchy or pecking-order of indispensableness, journals are at the top.

Admittedly, journals do not provide either the speed or the medium for back and forth discussion that IEG memos do, but journals have always had and still have the option of doing so. They recognize that speed is desirable and seek to increase it, but not at the expense of scientific standards. They recognize the desirability of discussion, but are willing to leave this to other communication mechanisms -- again to preserve scientific standards.

Standards of Excellence: The journal editor is in the forefront as guardian of the excellence of recorded scientific achievement. He feels a responsibility to science not just as it is but as it will be even a century hence. What he accepts goes into a trust-fund of knowledge for all scientists now and to come. If he accepts poor research he does injury to that trust. To meet the standards

of the best journals the investigator may have to rewrite his report; may have to perform further research and resubmit, or on some occasion he may have to go elsewhere to get his paper published. Meeting the standards of the best journals is a constant stimulus to excellence, felt by even the best scientists.

The members of some IEG may individually be of such high calibre as scientists that their memos through their IEG are all works of excellence, but the IEG was not designed to guard the pool of recorded scientific achievement against pollution. The journals of highest standards do perform this indispensable service. This is why IEG's and journals will never find themselves in the position of competitors for financial support.

Narrow Specialization: One more point is worth mentioning, however. The IEG's restriction of its communication to a highly limited research area, already discussed, is for its purpose a virtue. Its members are in a hurry to get word of all that is new in their sharply focused area, even though some of it may not have been subjected to the test of passing journal standards. However, this narrow specialization that is the IEG's virtue would be a charge against a scientific journal in a departmental or medical school library. In the field of biochemistry there could easily be 25 to 50 IEG's. But if 25 to 50 different stacks of memos were sitting there on the shelf, the professor of biochemistry would still reach for the JBC when he came in for half an hour of browsing at lunch time, or wanted something

to take home for an hour of reading that night. He knows he cannot afford to shut off all flow of information from research areas adjoining his own, or from the rest of his discipline, nor indeed from neighboring disciplines.

For the scientist who wants to "keep up" in other areas and fields, the broader coverage offered by journals is a convenience and their guardianship of excellence a continued necessity.

Journal Editors and Associate Editors as Members: In this connection it may be mentioned that the seven IEG's have among their members approximately forty who are either editors or associate editors of leading research journals (cf Figure 6).

Figure 6

Journal Editors and Associate Editors as IEG Members

American Journal of Epidemiology

Samuel Baron (#6 -- Co-Chmn.)

Archives of Biochemistry and Biophysics

Ronald W. Estabrook (#1)
Karl Folkers (#1)
David E. Green (#1 -- Chmn.)
Osamu Hayaishi (#1)
Howard S. Mason (#1)
Hugo Theorell (#1)
Birgit Vennesland (#1)

Australian Journal of Experimental Biology and Medical Sciences

G. B. Mackaness (#5)
Gus V. Nossal (#5 -- Co-Chmn.)

Biochemical Journal

W. N. Aldridge (#1)
J. B. Chappell (#1)
H. Gutfreund (#1)
June Lascelles (#1)

Biochimica et Biophysica Acta

Th. Buecher (#1)
Osamu Hayaishi (#1)
Martin Klingenberg (#1)
H. A. Krebs (#1)
E. R. Redfearn (#1)
E. C. Slater (#1)
C. Strittmatter (#1)

Biopolymers

Marshall W. Nirenberg (#7 -- Co-Chmn.)

Blood

William Dameshek (#5 -- Chmn.)

Theodore Spaet (#2 -- Chmn.)

Immunology

J. H. Humphrey (#5)

International Archives of Allergy and Applied Immunology

Howard Goodman (#5)

Journal of Biochemistry (Japan)

Bunji Hagihara (#1)
Kazuo Okunuki (#1)
R. Sato (#1)
Kunio Yagi (#1)

Journal of Biological Chemistry

John Edsal (#4)
Quentin Gibson (#1)
David E. Green (#1 -- Chmn.)
Frank Huennekens (#1)
Albert L. Lehninger (#1)
Efraim Racker (#1)
Anthony San Pietro (#1)

Journal of Clinical Immunology

Ian Mackay (#5)

Journal of Experimental Medicine

H. G. Kunkel (#5)

Journal of Molecular Biology

James D. Watson (#7 -- Chmn.)

The number of editors in the ranks of IEG members is unavoidably limited by the research areas covered by the seven IEG's and by whether a scientist who is editor or associate editor of a journal happens to be doing research in one of these seven areas. However, it would seem from the present showing that IEG's have competent counsel ready at hand toward building the best of relationships between IEG's and journals.

Conclusion: A further account is given of the Information Exchange Group, a device for quick scientist-to-scientist communication, described first by Dr. David E. Green in the Jan. 24, 1964 issue of Science. In operation the IEG is seen to have the characteristics of an area-wide private professional correspondence, and also to have characteristics that liken it to a "continuing international congress by mail." A close identity of interests of all members is believed to be essential for the successful operation of an IEG. Experience has shown that protection of priority is in no way jeopardized, but even furthered. The relationship between IEG's and journals is discussed and differences in their service to science are pointed out.