Rockefeller Foundation

February 25, 1959

Director, Division of Social Sciences
Rockefeller Foundation
49 West 49th Street
New York 20, N. Y.

Dear Sir:

Since Dr. Buchanan's death, I have been at a loss to know to whom my reports are to go. As you know, the Computation Center got a three-year grant, a year and a half ago, from the Rockefeller Foundation for work on the utilization of high-speed computors in the social sciences. The enclosed Semi-Annual Report (marked for your reference) indicates some of the work, under this grant, which is completed, in progress, and planned. I will continue to send these reports to you (incidentally, how many additional copies do you desire?) but I would appreciate hearing from you what other reports or notes on progress would be of help to you.

If you ever come up to the Institute, I would be glad to meet you and show you the installation.

Cordially,

Philip M. Morse
Director

PMM:gn
Enclosure

cc: FMV

THE ROCKEFELLER FOUNDATION
49 WEST 49th STREET, NEW YORK 20

November 20, 1957

Mr. Dean Rusk
Office of the President
The Rockefeller Foundation
49 West 49th Street
New York 20, New York

Dear Mr. Rusk:

Think nothing of it; we noticed it but weren't worried. As a matter of fact the basic trouble was that we got the picture to you at the last minute, as I remember.

If there is anything you might need for the next report, please let me know early, so I can get it to you well before deadline this time!

Yours,

Philip M. Morse
Director

PMM:LWH

THE ROCKEFELLER FOUNDATION
49 WEST 49th STREET, NEW YORK 20

OFFICE OF THE PRESIDENT

November 14, 1957

Dear Professor Morse:

Professor Dr. A. Walther has written us from Darmstadt, Germany, about the errors in the caption for the picture of the M.I.T. Computation Center as printed in the President's Review and the Annual Report.

Doubtless you had noticed these errors also and I am writing to tell you how sorry we are that we made them. There is no excuse for our errors; no captions were furnished with the prints, but the responsibility for accuracy remained ours.

We have written our sincere regrets to Professor Walther and have expressed to him the hope that the lay reader would nevertheless get the main point, namely, that your Center is exploring the possible application of computer techniques to problems in the social sciences.

We shall try not to let this happen again.

Sincerely yours,

Dean Rusk

Dean Rusk

Professor Philip M. Morse
Computation Center
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

THE ROCKEFELLER FOUNDATION
49 WEST 49th STREET, NEW YORK 20

THE SOCIAL SCIENCES
NORMAN S. BUCHANAN, DIRECTOR
LELAND C. DE VINNEY, ASSOCIATE DIRECTOR
KENNETH W. THOMPSON, ASSOCIATE DIRECTOR
ROGER F. EVANS, ASSISTANT DIRECTOR
ERSKINE W. McKINLEY, ASSISTANT DIRECTOR
MONTAGUE YUDELMAN, ASSISTANT DIRECTOR

CABLE ADDRESS:
ROCKFOUND, NEW YORK
TELEPHONE:
COLUMBUS 5-8100

June 21, 1957

Dear Professor Morse:

We have just heard from Mr. Svein Nordbotten of Oslo, who was awarded one of our fellowships and who planned to work at your Center at MIT, that he has contracted tuberculosis and will be hospitalized for some time. Perhaps he will have written you directly.

I enjoyed our brief conversation in Cambridge in May and shall look forward to hearing the report of the Center which you spoke of letting us have.

Yours very truly,

Erskine W. McKinley

Erskine W. McKinley

Professor Philip Mccord Morse
Department of Physics
Massachusetts Institute of
Technology
Cambridge, Massachusetts

EWM:amz

Dr. Norman S. Buchanan
Director, The Social Sciences
The Rockefeller Foundation
49 West 49th Street
New York 20, New York

Dear Dr. Buchanan:

I enclose the recent Progress Report of the Computation Center just off the press. It will give you some idea of our activities for the first six months of operation. A glance at pages 10 through 16 and at a number of the abstracts of problems put on the machine will indicate that we have begun to produce results in the social science field. The work of Cohen and Korbel is supported by the Rockefeller fund. We hope Dr. Korbel will continue with us next year. We have commenced discussions with several other people and hope that one or more of them will be with us next year.

We will send you four additional copies of this report at the time of our regular distribution. If you feel it would be useful for us to send you more than these four, please let me know.

Sincerely,

Philip M. Morse
Director

PMM:LWH
Enclosure

June 4, 1957

Mr. William C. Cobb
Office of Publications
The Rockefeller Foundation
49 West 49th Street
New York 20, New York

Dear Mr. Cobb:

I enclose two pictures of the Computation Center, which I hope will be of use to you in getting up your report. I also enclose rough draft of parts of our first Annual Report, which may provide you with useful material.

If you have further questions, please let me know.

Sincerely,

Philip M. Morse
Director

PMM:LWH

THE ROCKEFELLER FOUNDATION
49 WEST 49th STREET, NEW YORK 20

OFFICE OF PUBLICATIONS
WILLIAM C. COBB

TELEPHONE:
COLUMBUS 5-8100

May 23, 1957

Dear Professor Morse:

Thank you for your letter of May 14. Like the Center, our annual report has been delayed, and the picture section is still not quite complete. We should therefore be glad if you would keep us in mind when the photographs are taken. Even though they do arrive too late, they can always be held in reserve for next year's report.

Sincerely yours,

William C. Cobb

William C. Cobb
Office of Publications

Professor Philip M. Morse
Computation Center
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

WCC-aen

THE ROCKEFELLER FOUNDATION

Room 6-107

May 14, 1957

Mr. William C. Cobb
Office of Publications
The Rockefeller Foundation
49 West 49th Street
New York 20, New York

Dear Mr. Cobb:

Way back in February you wrote me asking when it would be possible for you to obtain photographs of our new Computation Center. I have been delaying answering you, hoping to give you a definite answer and perhaps some photographs, but there have been delays in building construction and the Center is not quite completed yet. It would be much more preferable, from our point of view, to wait until the installation is complete, when we will wish to take photographs for other reasons in addition to getting them for you.

I hope that we can make these photographs some time in June and that this will not be too late for your purposes.

Sincerely,

Philip M. Morse
Director

PMM:LWH

THE ROCKEFELLER FOUNDATION
49 WEST 49th STREET, NEW YORK 20

OFFICE OF PUBLICATIONS
WILLIAM C. COBB

TELEPHONE:
COLUMBUS 5-8100

February 15, 1957

Dear Professor Morse:

Each year we include in the Foundation's Annual Report a section of photographs showing some of the activities to which the Foundation is giving assistance. In the Report for 1956 we should like very much to have the Computation Center represented, and I am writing now to ask whether by the first of April you would have any pictures that you could send us of the new digital computer.

We like wherever possible to use pictures having some human interest, so that it would be helpful if the machine could be shown in operation. If this will necessitate the taking of special photographs, and you are willing to arrange for them, the Foundation will be glad to pay for three or four by a professional photographer.

I hope that this request will not present too much of a problem and that you will be able to provide us with illustrations for the Report.

Sincerely yours,

William C. Cobb
Office of Publications

Professor Philip M. Morse
Computation Center
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

WCC-aen

5-7-57
Verzuh says
- no photos now available
- probably by summer
- if we wanted to spend a chunk of their money & inconvenience ourselves we could rush around & get pix now
- send them a polite postponement

COPY

THE ROCKEFELLER FOUNDATION
49 West 49th Street
New York 20, N. Y.

December 6, 1956

Dear Chancellor Stratton:

I have the honor to inform you that at a meeting of the Board of Trustees of The Rockefeller Foundation on December 4 and 5, 1956, action was taken providing up to $98,400 to the Massachusetts Institute of Technology for use under the direction of Professor Philip M. Morse, toward the costs of exploring the potential uses of high-speed computing equipment in the solution of theoretical and applied problems in the social sciences. This sum is for use during the three-year period beginning July 1, 1957.

It is understood that if at any time Professor Morse ceases to be in active direction of this research, there shall be no commitment on the part of the Foundation for more than one year thereafter and the situation will be reviewed by the Institute and the Foundation.

If it meets with your convenience, we shall be glad to make payments on this grant on a semi-annual basis upon receipt at the beginning of each year of a budget for the program. We shall appreciate receiving also annual statements of receipts and expenditures. Any balance of the fund unexpended on June 30, 1960, will

revert to the Foundation.

A brief public announcement of this grant will be made in the next quarterly report of the Foundation. There is, however, no objection on our part to your announcement of the grant prior to the issuance of the Foundation's report if for any reason this appears to you desirable. In this connection I am enclosing, as a matter of routine, a printed statement of The Rockefeller Foundation policy regarding the announcement of grants.

It is a pleasure to report this action to you.

Sincerely yours,

FLORA M. RHIND

Secretary

Chancellor J. A. Stratton
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

Copy to: Professor Philip M. Morse

FMR:EJF

COPY

THE ROCKEFELLER FOUNDATION
49 West 49th Street, New York 20

October 31, 1956

Dear Professor Morse:

Many thanks for your letter of October 30 and the attached application which we had discussed here orally some weeks ago and, subsequently, rather briefly by telephone.

I expect to be in Cambridge on other matters on November 8 and until early afternoon on November 9. Would it be at all possible for me to see you during my visit? I find the statement of the project quite clear and straightforward. All the same, I would hope that perhaps a few minutes with one of your assistants might give a sense of concreteness to my understanding of this proposal which, so far, has been obtained entirely orally and from reading.

I should like also to raise with you the item of overhead at 20 per cent included in your budget. You are probably aware that this Foundation has a strong working rule against the inclusion of any flat percentage for overhead, except in the very rare case where the Foundation itself has in effect taken the initiative in a project. The word overhead, however, has a wide variety of connotations and I think it might be helpful if we could discuss it together.

I expect to check into the Commander in Cambridge on Wednesday night and, if you find it more convenient, you could leave word for me there.

Sincerely yours,

/s/ Norman S. Buchanan/ph

Norman S. Buchanan

Professor Philip M. Morse
Department of Physics
Massachusetts Institute of
Technology
Cambridge 39, Massachusetts

NSB:ph

Will call you Tuesday on this. PMM

November 29, 1956

Dr. Norman S. Buchanan, Director
The Social Sciences
The Rockefeller Foundation
49 West 49th Street
New York 20, New York

Dear Dr. Buchanan,

As you suggested in our talk of November 9, I have been keeping an ear open for examples of the social science problems in which our Computation Center is interested. As you know, the potential of such problems is largely unknown so that most examples must be of past computer applications. One example though of research activity which offers the promise of good team-work between a Computation Center staff member and social scientist is the following.

Professors Theodore Baer and Ithiel Pool of the M.I.T. Center for International Studies have approached us on the feasibility of "Computing Optimal Electoral Redistricting in Massachusetts". This is a problem of immediate interest in the local political situation but is also a type of problem of long-range national significance. Professors Baer and Pool have thought through the problem to the point of developing various criteria of "goodness" (e.g. closely or evenly distributed political strength in each electoral district, homogeneity of socio-economic factors, etc.). In my judgement, their ideas are now "ripe" for close liason with a computation specialist so that the difficult task of quantifying their concepts and solving their problem can begin. The method of solution will probably be by the techniques of "linear programming" which are very powerful on optimization problems of this kind.

I should say that the above problem was essentially brought to us, a procedure which in general puts the burden of computer knowledge on the social scientist. It is very likely that there are many problems of similar interest waiting to be discovered by computation experts consulting with social scientists. I need say no more since this was the gist of Professor Morse's proposal.

In addition, I have talked with Professor Orcutt of the Economics Department at Harvard. Professor Orcutt, who is also the Harvard Representative of our Computation Center, was kind enough to survey some of the major computational activities which have been or are being carried out in economics research. The activities divide roughly into two classes, those involving standard mathematical manipulations and those which utilize the computer for simulating or behavior studies of economic systems. A brief list of these activities is:

Professor Leontief (Harvard): inversion of large matrices (e.g. 100 x 100 matrices and larger); input-output analysis.

National Bureau of Economic Research: separating seasonal and trend movements from economic data and statistics so that more meaningful information is obtained.

University of Michigan: elaborate multiple regression schemes.

Professor Jay Forrester (M.I.T. School of Industrial Management): economic models of firm behavior and economic systems.

Cowles Foundation (Yale): interested in using complicated models of economic systems. Limited applications have been made on a small computer (IBM 650) but the machine speed is inadequate. Their approach is to formulate the problem by a large system of equations and then use "Monte Carlo" techniques to find the solutions.

Professor Orcutt (Harvard): interested in the simulation of economic systems, not as abstract models, but in such a fashion that contemporary economic problems can be considered.

The goal of our Center is not to compete as social scientists with activities such as those listed but rather to contribute from the computational expert side towards the inclusion of modern computing machines in social science research.

Professor Orcutt has said that he will be glad to amplify any of the above topics which I have attempted to summarize, (any distortions are mine). Due to the press of time before your December 3 meeting, his phone numbers are: (office) KIrkland 7-7600, extension 2550; (home) IVanhoe 4-2896.

If I can be of any further assistance, please do not hesitate to contact me.

Sincerely,

Fernando J. Corbato
Research Associate
M.I.T. Computation Center

FJC:jtn

copies to: Prof. P.M. Morse
Prof. G.H. Orcutt

THE ROCKEFELLER FOUNDATION

Policy with Respect to Announcement of Grants

The Rockefeller Foundation records its grants in an *Annual Report,* and in *Rockefeller Foundation Grants,* issued quarterly, in which brief reports of grants are published soon after they have been made.

The Foundation is always glad to have its reports supplemented through announcements issued locally by recipients at the time the award is made. Only if the announcement involves an interpretation of the Foundation's purpose in making the grant, do the officers of the Foundation request that they be given the opportunity of seeing the statement before it is released.

Acknowledgment of Foundation aid in the support of research may also be made when the research results are published.

The Foundation requests, however, that in making public references to grants, recipients avoid any implication that the Foundation has any control over the project or any responsibility for its results.

The name of the Foundation should not be used in advertising, especially of books, nor in designating projects, fellowships, laboratories, or buildings toward which it has contributed.

THE ROCKEFELLER FOUNDATION
49 WEST 49th STREET, NEW YORK 20

THE SOCIAL SCIENCES
NORMAN S. BUCHANAN, DIRECTOR
LELAND C. DE VINNEY, ASSOCIATE DIRECTOR
ROGER F. EVANS, ASSISTANT DIRECTOR
KENNETH W. THOMPSON, ASSISTANT DIRECTOR
MONTAGUE YUDELMAN, ASSISTANT DIRECTOR
ERSKINE W. McKINLEY, CONSULTANT

CABLE ADDRESS:
ROCKFOUND, NEW YORK
TELEPHONE:
COLUMBUS 5-8500

November 15, 1956

Dear Chancellor Stratton:

Thank you for your letter of November 8, in which you make formal application for a grant of $98,400 over a three-year period to be used by the MIT Computation Center toward the costs of exploring the potential uses of electronic computers in the social sciences.

We are planning to submit this proposal to our Trustees at their meeting early in December, and the outcome of their deliberations will be communicated to you promptly.

Sincerely yours,

Norman S. Buchanan

Norman S. Buchanan

Chancellor J. A. Stratton
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

NSB:ph

(Dictated by Mr. Buchanan;
signed in his absence)

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
OFFICE OF THE CHANCELLOR

Professor Morse

November 8, 1956

Dr. Norman S. Buchanan
The Rockefeller Foundation
49 West 49th Street
New York 20, N.Y.

Dear Dr. Buchanan:

Professor Philip M. Morse, Director of our Computation Center, has forwarded an application to you for a grant in support of a machine programming staff. This group will work on utilization of electronic computers in the social sciences.

The budget calls for an expenditure of $98,400 over a period of three years. I have reviewed the proposed program, and would like to express my whole-hearted endorsement of Professor Morse's request.

Sincerely yours,

J. A. Stratton
Chancellor

JAS/E

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

19

Memo to ? M M Room

Wed eve: Call Dr Buchanan
@ Rockefeller Foundation at
the Hotel Commander
KI7-4800

from Room

MURAN BOSTON

Message has been left at Commander for Dr Buchanan to phone P.M.M. at home this evening.

get Buchanan in touch with Floe

about overhead.

Call Corby about it

Capitol 7-9476

Floe will see Buchanan & Corby at 10 AM Thursday Room 3-240

November 2, 1956

Dr. Norman S. Buchanan, Director
The Social Sciences
The Rockefeller Foundation
49 West 49th Street
New York 20, New York

Dear Dr. Buchanan:

Thank you very much for your letter of October 31.

I am sorry to say that I will be out of town next Thursday and Friday when you are in Cambridge. However, I do plan to call you Wednesday evening at the Commander to talk briefly with you about our proposal and to make arrangements for you to see other people on the project here.

I hope that your visit here will be both informative and clarifying.

Sincerely yours,

Philip M. Morse

Philip M. Morse, Director
M.I.T. Computation Center

PMM:LWH

bcc: Dr. Corbato

THE ROCKEFELLER FOUNDATION
49 WEST 49th STREET, NEW YORK 20

THE SOCIAL SCIENCES
NORMAN S. BUCHANAN, DIRECTOR
LELAND C. DE VINNEY, ASSOCIATE DIRECTOR
ROGER F. EVANS, ASSISTANT DIRECTOR
KENNETH W. THOMPSON, ASSISTANT DIRECTOR
MONTAGUE YUDELMAN, ASSISTANT DIRECTOR
ERSKINE W. McKINLEY, CONSULTANT

CABLE ADDRESS:
ROCKFOUND, NEW YORK
TELEPHONE:
COLUMBUS 5-8100

October 31, 1956

Dear Professor Morse:

Many thanks for your letter of October 30 and the attached application which we had discussed here orally some weeks ago and, subsequently, rather briefly by telephone.

I expect to be in Cambridge on other matters on November 8 and until early afternoon on November 9. Would it be at all possible for me to see you during my visit? I find the statement of the project quite clear and straightforward. All the same, I would hope that perhaps a few minutes with one of your assistants might give a sense of concreteness to my understanding of this proposal which, so far, has been obtained entir ely orally and from reading.

I should like also to raise with you the item of overhead at 20 per cent included in your budget. You are probably aware that this Foundation has a strong working rule against the inclusion of any flat percentage for overhead, except in the very rare case where the Foundation itself has in effect taken the initiative in a project. The word overhead, however, has a wide variety of connotations and I think it might be helpful if we could discuss it together.

I expect to check into the Commander in Cambridge on Wednesday night and, if you find it more convenient, you could leave word for me there.

Sincerely yours,

Norman S. Buchanan ph.
Norman S. Buchanan

Professor Philip M. Morse
Department of Physics
Massachusetts Institute of
Technology
Cambridge 39, Massachusetts

NSB:ph

Nov. 2:

Copy to Floe marked "Will call you Tuesday on this."

Copy to Corbato.

LWH

ROUTING SHEET

Will recipients please check off their names, make appropriate comments, and send the material on to the next person on the list. Will the last on the list please return it to me.

P. M. Morse, Room 6-109, ext. 857

FYI, Please return soon
my only spare copy

To F. Verzuh, Comments Very Good!
Couple trivial points - we will have 12 Tape Units not 13.
2. IBM is providing 1 Key Punch Oper & 2 Mach Oper.
What is the 20% Overhead computed on? 20% of 28,800 = 5760; 25% = OK?

To Dean Arden, Comments Sounds good if we can get staff

To Carbato, Comments ok.

To _____, Comments _____

COPY

October 30, 1956

Mr. Norman S. Buchanan
The Rockefeller Foundation
49 West 49th Street
New York 20, New York

Dear Mr. Buchanan:

I enclose an application for a grant of $36,000 a year for three years to help support a research staff, so that the Computation Center at MIT can explore new ways whereby high-speed computing equipment can be utilized in social science. Directions for initial research are indicated, though details cannot be given before work is started. A tentative budget and description of the computing equipment are appended, together with an outline of the arrangements for other New England colleges to participate in use of the equipment.

I have talked this application over with Dr. Carl F. Floe, Assistant Chancellor of MIT, and it has his approval. Please let me know if you wish more information.

Sincerely yours,

Philip M. Morse, Director
M.I.T. Computation Center

PMM:JF
Enclosure

THE ROCKEFELLER FOUNDATION
49 WEST 49th STREET, NEW YORK 20

THE SOCIAL SCIENCES
NORMAN S. BUCHANAN, DIRECTOR
LELAND C. DE VINNEY, ASSOCIATE DIRECTOR
ROGER F. EVANS, ASSISTANT DIRECTOR
KENNETH W. THOMPSON, ASSISTANT DIRECTOR
MONTAGUE YUDELMAN, ASSISTANT DIRECTOR
ERSKINE W. McKINLEY, CONSULTANT

CABLE ADDRESS:
ROCKFOUND, NEW YORK
TELEPHONE:
COLUMBUS 5-8100

September 12, 1956

Dear Professor Morse:

Thank you for your letter of September 10.

Three o'clock on Friday, October 5, would be the most convenient time for me, and I look forward to seeing you at that time.

Sincerely yours,

Norman S. Buchanan

Norman S. Buchanan ph.

Professor Philip M. Morse
Department of Physics
Massachusetts Institute
of Technology
Cambridge 39
Massachusetts

NSB:ph

September 10, 1956

Dr. Norman S. Buchanan, Director
The Social Sciences
The Rockefeller Foundation
49 West 49th Street
New York 20, New York

Dear Dr. Buchanan:

I hope you had a pleasant vacation in August. As you no doubt deduced, I was not back from California until after you get away in August, so I had postponed writing you until you got back.

In line with suggestions made in your letter of July 13, I am trying to plan to see you some time when I come to New York anyway.

My first visit to New York will be on Friday, the fifth of October. I have to give a talk on operations research at a lunch meeting of the American Management Association , but I could see you either in the morning, say at 10 o'clock, or in the afternoon, say at 2.30 or 3.00. Would either of these times be convenient for you?

Sincerely,

Philip M. Morse
Professor of Physics

PMM:LWH

THE ROCKEFELLER FOUNDATION
49 WEST 49th STREET, NEW YORK 20

THE SOCIAL SCIENCES
NORMAN S. BUCHANAN, DIRECTOR
LELAND C. DE VINNEY, ASSOCIATE DIRECTOR
ROGER F. EVANS, ASSISTANT DIRECTOR
KENNETH W. THOMPSON, ASSISTANT DIRECTOR

CABLE ADDRESS:
ROCKFOUND, NEW YORK
TELEPHONE:
COLUMBUS 5-8100

July 13, 1956

Dear Professor Morse:

Many thanks for your letter of July 12. I will be here the week of August 6 but away from August 13 until after Labor Day.

I hope that you will not make a special trip to New York on my account. If, however, you should be coming here for some other purpose -- either during the week of August 6 or later in September -- I would be very pleased to see you. My secretary, Miss Harris, will be glad to fix an appointment if you will get in touch with her when your plans are settled.

Sincerely yours,

Norman S. Buchanan ph.

Norman S. Buchanan

Professor Philip M. Morse
Department of Physics
Massachsetts Institute of
Technology
Cambridge 39, Mass.

NSB:ph

July 12, 1956

Dr. Norman S. Buchanan, Director
The Social Sciences
The Rockefeller Foundation
49 West 49th Street
New York 20, New York

Dear Dr. Buchanan:

I have been delaying answering your kind letter of May 21 in order to see whether I could come down to New York to talk to you about our plans.

One thing and another has interfered, however, and now I have looming ahead of me the necessity of having to go off to California for three weeks. I will be back in Cambridge again the first part of August, however, and would welcome a chance to talk things over.

If it is satisfactory with you, I will try to call you the early part of the week of August 6 and at that time will try to make a date to visit you in New York. If you are going to be out of town that week, perhaps you can leave a message when I can get in touch with you later.

Sincerely,

Philip M. Morse
Professor of Physics

PMM:JF

ROCKEFELLER FOUNDATION
49 WEST 49th STREET, NEW YORK 20

...CTOR
...SOCIATE DIRECTOR
...TANT DIRECTOR
...SON, ASSISTANT DIRECTOR

CABLE ADDRESS:
ROCKFOUND, NEW YORK
TELEPHONE:
COLUMBUS 5-8100

May 21, 1956

Dear Professor Morse:

I have read with considerable interest your paper -- I hope it was not considered a secret document -- "The Application of Digital Computers to Social and Operational Problems: Opportunities and Needs."

I was quite interested in the emphasis you gave to the possibilities for work in the Social Sciences. I should like the opportunity to hear more about this from you and your social science colleagues at MIT. May I hear from you?

Sincerely yours,

Norman S. Buchanan

Professor Philip M. Morse, Director
Computation Center
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

NSB:ph

Application for a Grant for the Support of Machine Programming Staff for the Utilization of Electronic Computers in Social Science

The Facility and its Potentialities

The high-speed computing facility, to be installed by IBM at the new Computation Center at MIT will be the largest and most flexible facility in this country to be devoted exclusively to unclassified research and education. IBM will contribute more than a fifth of a million a year in its support for maintenance and operation. What is needed, in addition, to make this an outstanding center for the investigation of digital computer potentialities in all branches of scientific research, is about $100,000 a year for the support of a research staff, which can work with scientists in various fields to develop new and more effective techniques of machine utilization.

Arrangements have been made for all the colleges in New England to participate in the use of the machines, and IBM has set up funds for Assistantships to enable graduate students, at MIT and at the participating colleges to spend time at the Center, learning to use the equipment. The installation is expected to be completed by February 1957. Details of the installation and of arrangements with the participating colleges are given in Enclosures B and C to this proposal. This Center and these arrangements represent potentialities for new developments in social and physical science of great and unexplored importance.

There will be no charge, for machine time, made to students or faculty of the participating institutions. Maintenance and the

routine aspects of operation will be taken care of by IBM, so that those who know how to use such equipment can use it, without cost, up to the 14 hours a day during which the machine will be available at first. A number of problems in economics are going to be put on the machine by Professor Solow, of MIT, and by Professor Orcutt, at Harvard and, as other research workers in the social sciences learn how to use the equipment, other problems will be brought to the Center.

The Importance of Team Research

But an instrumentality, by itself, cannot produce new research. To make the important advances, which are possible with a computer of the speed and flexibility of this, one needs a team of research people, some of whom know the machine and some of whom know the research field. To get exciting new possibilities beyond the stage of a "gleam in the eye" we need, in addition to the machine, a staff of experts in machine use, ready to team up with those scientists who believe the machine can help them but are not sure how, so that, between them, they can translate the "gleam inthe eye" into new and important results.

In the long run, the various social scientists in New England will probably learn enough about machine operation to be able to make the machine useful to them. But it takes time to learn to program a machine of this size, and research workers in any field are reluctant to take much time off to learn new techniques. In addition, to get the most out of a computer, one should have more than a casual knowledge of the electronic details of its operation. This combination of knowledge, of a social science and of a computer, will probably be developed in our next

generation of research workers. But if we want to get started using computers in social science now, we will have to use a team; a man who knows the field plus a man who knows the machine.

Need for a Research Staff in Machine Utilization, an Ingredient in the Team

This last ingredient is the part which is left out of the contribution which IBM has made to the Computation Center. To put the Center at the forefront of research, we must have a full-time staff of enthusiastic machine specialists, to teach prospective users how to make the machine do its tricks and to join with research workers, who come with a "gleam in their eye," forming teams which can utilize to the fullest the computer's capabilities in research. This staff will be hard, but not impossible, to recruit. We have the beginnings of one formed now, at present slanted chiefly toward research in the physical sciences, and we have obtained an NSF grant of $35,000 a year for three years to support it. We have the graduate student bodies of the participating institutions to pick from and we have already begun to make contact with those students who are interested in machine utilization. There are about two dozen IBM research assistants appointed for this year. We should be able to pick from the best of these a few who would like to stay on for two or three years more, after they have obtained their advanced degrees in engineering, mathematics or science, to be a part of our research staff, potential members of research teams.

Budget for the Social Sciences

To make up a staff which could handle the social science problems as well as the physical science ones would need another

four or five good men, research men plus the technicians to back them up, plus a small budget for travel and incidental supplies and equipment, approximately $35,000 a year for three years. It would take about three years to get rolling and the developments should be reviewed at the end of three years, to see where to go next. Such a staff should be more important during the beginning stages of the utilization of electronic computers, when the problems are not too clearly formulated and when neither partner in the team knows the others plans and ideas. Later, when some of the more important potentialities have been demonstrated, the research can be split up into projects, each with a definite goal and with its own budget, which can include partial support for the continuing staff of the Center. So, eventually, the Center could be financed indirectly by contributions from each project which uses it, if this were considered to be the most desirable way of keeping it going. At present, however, support by contributions from established research projects can only support about a third of the $100,000 needed, which would leave unsupported the most fruitful research of all, the unknown results which are sure to come when a machine expert of the Center staff works together with the economist, psychologist or sociologist, on the faculty of one of our participating colleges who comes to the Center with only a "gleam in his eye."

Possible Initial Directions for Investigation

As indicated, we cannot write down in any detail the directions which this research effort will take, as the various teams are formed and begin to interact. There are several general

areas which we feel should be investigated, which are certain to produce results of immediate interest and which, in addition, should provide hints as to still more important applications.

A. One of these is the deeper investigation of machine logic itself. A computer of the complexity of the 704 is too big to be able to see immediately how it can "think." Most machines are now programmed to do ordinary arithmetic, a few programs have been devised to make the machine obey the rules of Boolean logic and some thought has been spent on working out programs to make the machine play chess or checkers, in other words to obey the logic of a game. Different sciences and branches of learning have their own kinds of thought processes. For example, economics and genetics each have patterns of thought which do not exactly duplicate those of physics. Fundamental research is needed to work out programs, rules of thought for the machine, which correspond more closely to these other patterns. With a machine of the flexibility and storage capacity of the 704, such research is worth while. It will have to be tackled, at the beginning, by teams of experts in the field of interest, together with mathematical logicians who know machine operation.

B. Another general line of attack is in the field of the storage and rapid access to information, such as is needed in the problems of language translation and historical research, for example. Several schemes of coding of information, so that it can be found quickly and easily, have been devised on paper, but the "bugs" in such schemes will only become apparent when masses of information, of the order of several hundred thousand items, are to be ordered and sorted out. The new installation at the

Computation Center will have a storage capacity of this size. Some of the proposed schemes should be tried out, and others developed, by members of the Center staff working with persons familiar with the information and its uses. For example, a project in machine translation has already been set up, under the direction of Professor Locke of the Language Department. As it develops, it will need the help of machine programming specialists and will need the use of a machine to test its ideas. The translation project is already supported by the Rockefeller Foundation, but parallel work by the Computation Center on techniques for rapid access to large-quantity data would help this work as well as others. Another promising direction of investigation is in the application of machine techniques to library inventorying, cataloguing, and record-keeping. Although special-purpose machines will probably be required in the end, many ideas and procedures can be developed and checked out on the general-purpose machine at the Center with the addition, perhaps, of some specially built input and output equipment. The staff of the MIT Library is interested in this work and will contribute its knowledge to its progress.

C. Perhaps the most promising line of advance, in part because the least investigated up till now, is in the field of social science experiments, where the computer can be used as recorder, scorer and referee. Tactical situations in warfare are already being studied by "gaming techniques" at Rand and in other military operations research groups. Similar problems in various fields of the social sciences can also be studied by simplifying

the situation down to some sort of "game," with more or less complicated rules, which can be played by groups of investigators, to see what are the consequences of various strategies. If the "games" are to correspond, even distantly, to some actual social situation, the rules must be quite complicated and the scoring will require a great deal of statistical computation. It has been found that only by the use of computing machines can the scoring be speeded up sufficiently so that enough games can be run through to provide an overall grasp of the situation under study. Such "gaming techniques" are closely related to the experiments of Bavelas on the behavior of task-oriented groups. The use of a properly programmed computer would provide such experiments with a powerful and flexible means of changing, controlling, and analyzing these experiments in social psychology. In this field we could work in close collaboration with the Center for International Studies at MIT and with the psychology departments in several other colleges.

Suggested Guidance for the Research

The research activities of the Computation Center are guided and coordinated by an Advisory Committee consisting of representatives from each of the participating colleges each chosen by the president of their college. This Committee provides overall policy guidance in all activities. But to guide the work in social science outlined above, we will need another, more specialized group. If financial support for this activity is forthcoming, about six top-flight social scientists from the participating institutions will be invited to join a special advisory

committee, to talk over possible lines of research with the Center staff, to help find those social scientists with "gleams in their eye" regarding machine utilization in their field, to help arrange the formation of teams for the pursuit of the suggested research and to advise on relative priorities, if and when there is more work to be done than there is machine time available.

Equipment, Personnel and Budget

The attached enclosures give details of the equipment to be installed in the Computation Center by February or March 1957, and the arrangements with other colleges in New England. The suggested budget, for three years, is tentative and is more dependent on our ability to hire one or two more experts in computer programming than on the amount of work to be done. If we can find more men of the right sort, more work can be done. During the calendar year 1957 we may not be able to find more than one senior man, one or two post-doctoral fellows and a couple of technical assistants. By the fall of 1957 we may be able to persuade one or two faculty members of the cooperating institutions to spend appreciable fractions of their time at the Center, working on some of the problems mentioned earlier. A suitable fraction of their salaries should be carried by the research funds of the Center and, if the work is in the social sciences, would be chargeable to the proposed grant. Some of the experiments in "gaming" will require special input or output equipment. Therefore, it may turn out that less than $35,000 will be spent the first year; more than $35,000 the second. The important point, however, is that because of the presence of the equipment of the Center, supported by

IBM, the majority of the budget of this grant can be spent on salaries for people directly carrying out the research outlined in this proposal.

The staff can begin to be assembled this spring, but expenditures would probably not reach full rate until the summer of 1957. Consequently, the grant could officially start March or April 1957, or could start as late as June, if some earlier expenditures could be charged against the grant at that time.

APPENDIX A

Estimated Budget per Year.

Salary, senior scientist (1 full-time man, or two faculty members, half time)	9,000
Salary, junior scientist (one full time research associate)	7,000
Salaries, two technicians (coders or electronics technicians as needed)	10,800
Equipment	1,000
Travel	500
Miscellaneous, Publication of reports, etc.	500
Overhead, 20 per cent	7,200
Total, per year	$36,000
For three years	$108,000

APPENDIX B

Organization of Computation Center; Its Cooperative Use by New England Colleges.

The M.I.T. Computation Center has been recently established for the purpose of promoting academic research in the New England area with modern electronic digital computing machines. As such the Center will make available to New England Colleges research facilities which have been heretofore denied because of the large financial and staff obligations required for modern computer operation. To implement the operation of the Center, the IBM Corporation is installing a high-speed model 704 computer along with an extensive set of peripheral machines required for proper usage. These machines will be operated by the Center and will be at its disposal (with the exception of one-third of the 704 computing time which has been temporarily retained by the IBM Corporation because of the current shortage of computing facilities.) The remaining two-thirds of the 704 computing time will be evenly divided between research at M.I.T. and research at the remaining New England Colleges.

In addition to the cost-free use of the 704 computer, the IBM Corporation will provide machine maintenance personel and will contribute financially towards the support of about a dozen technicians required for the effective operation of the computer. The latter will include two

and two card punch operators
computer operators, one pair for each shift of operation.

Besides the technicians, the Center will have a research staff of from six to twelve persons who will be partially supported by a National Science Foundation grant. This staff will work in part on the problems of making modern computers more powerful and easy to use, (e.g. utility programs, special function generation, compiler programs), and will also explore the undefined region of new computer applications.

In order that all the New England Colleges can take an active role in the Center, the IBM Corporation is also supporting an assistantship program. There are at present 35 research assistants and associates in this program; graduate students and faculty members of the participating New England Colleges. The major purpose of the program is to promote broad academic familiarity with modern computer techniques and applications. The individual assistants and associates will do research in their respective specialties, with the general criterion that the work should lead to results of publishable significance. This aspect of the program will be supervised at the Center by a full-time research Associate.

The M.I.T. Computation Center is under the direction of Professor P.M. Morse. To advise on general policies and to help coordinate the program there have been set up a committee of M.I.T. departmental faculty representatives and a committee of Institutional Representatives from the faculties of the other New England Colleges. The members of these two groups also act as supervisors over the activities

of the research assistants and associates at the respective departments or schools.

The facilities of the Center will be available to any person from M.I.T. or the New England Colleges. Requests for computing time will be submitted to the M.I.T. departmental representive or the Institutional Representative at the respective schools. Final approval of computing time requests will be made by the Computation Center staff. All computation preparation (e.g. programming, analysis, card punching) will be on a serve-yourself basis, with the research staff at the Center available for extra help only by special arrangement.

All computational work involving the use of the Center will be periodically summarized in a report to be published semi-annually. The Center also conducts a weekly seminar on topics related to computers. In addition, computer time for student problems will be made available to those departments and colleges with courses which teach the use of modern computing machines.

APPENDIX C.

Location and Equipment of Computation Center.

The M.I.T. Computation Center will have its permanent quarters on the M.I.T. Campus in the new Carl T. Compton Laboratory, which is scheduled for completion about March 1957. In this building the Center will occupy integrated parts of the basement, first floor and second floor. This area will have office space for the research staff, technicians, research assistants and associates, besides room for the computational equipment used by the Center.

The computing equipment of the Center, which will be furnished by the I.B.M. Corporation, will primarily consist of a 704 computer and the related peripheral equipment. This machine is an up-to-date, fast, general-purpose electronic digital computer. The basic machine code includes over 80 instructions, including those for arithmetic operations with floating-point numbers. The basic operating time is 24 microseconds for most instructions, with a normal maximum of 240 microseconds. The 704 to be installed will have a magnetic core memory with a storage capacity of 8192 words, each word containing 36 binary digits. (The storage capacity will be increased to 32,768 registers in 1958.) The computer will also have, as an additional storage device, a magnetic drum with a 8192 word capacity. As with most modern computers, magnetic tape is used both

for additional storage and for input-output requirements. The installation will have 13 tape units, (at most 10 under computer control), each unit storing up to a maximum of 900,000 words.

In addition to the magnetic tape units, the input-output equipment which will be under direct computer control will be a punched card reader, a line-by-line printer, a card punch, and a photographic oscilloscope unit. In addition there will be units, not attached to the computer directly, for recording card information on magnetic tape and for reading information from magnetic tape and printing or punching cards. Finally, for card preparation purposes, there will be the usual assortment of standard IBM accounting machines, including key punches, printer, reproducer, sorter, etc.

As a further feature the installation will also include a punched card tranceiver which is a device for transmitting or receiving punched card information via telephone lines to remote punched card centers similarly equiped with a tranceiver unit.

An additional computer output device planned for the near future, will be a Photon machine to be provided by the Photon Incorporated. This machine, designed as a high-quality photographic replacement for periodical and book type-setting, will offer the opportunity of transcribing computer results directly into better-than-average publication form without any human intervention. Because of the possibility of built-in self-checking, the process can be made completely error-free. The Photon machine

therefore should play a vital role in the publication of numerical tables or similar problems where perfect publication accuracy is required. Other specialized input and output devices are to be added as they are developed and as the need arises.

December 7, 1956

Memo to: Institutional Representatives

From: Professor Philip M. Morse, Director
M.I.T. Computation Center

Dear Colleague:

Our next meeting will be on Monday, December 17, at 12:15 in Dining Room 2 at the M.I.T. Faculty Club, Sixth Floor of the Sloan Building, 100 Memorial Drive, Cambridge. Part of the agenda will have to do with our plans for development of the NSF and Rockefeller Grants. The enclosed item will perhaps indicate some of the things we plan to do under these grants. As you can see, some of the activity would be of interest to some of you, and we hope some of the faculty of the participating universities could take part in the research. We will talk about these matters at our meeting, and I'll be glad to answer questions.

Other items on the agenda were mentioned in the previous notice.

Sincerely,

Philip M. Morse

PMM:LWH

Enclosure

THE SUPPORT OF MACHINE PROGRAMMING STAFF FOR THE UTILIZATION OF ELECTRONIC COMPUTERS IN SOCIAL SCIENCE

The Facility and Its Potentialities

The high-speed computing facility, to be installed by IBM at the new Computation Center at MIT will be the largest and most flexible facility in this country to be devoted exclusively to unclassified research and education. IBM will contribute more than a fifth of a million a year in its support for maintenance and operation. What is needed, in addition, to make this an outstanding center for the investigation of digital computer potentialities in all branches of scientific research, is about $100,000 a year for the support of a research staff, which can work with scientists in various fields to develop new and more effective techniques of machine utilization.

Arrangements have been made for all the colleges in New England to participate in the use of the machines, and IBM has set up funds for Assistantships to enable graduate students, at MIT and at the participating colleges, to spend time at the Center learning to use the equipment. This Center and these arrangements represent potentialities for new developments in social and physical science of great and unexplored importance.

There will be no charge for machine time made to students or faculty of the participating institutions. Maintenance and the routine aspects of operation will be taken care of by IBM, so that those who know how to use such equipment can use it, without cost, up to the fourteen hours a day during which the machine will be available at first. A number of problems in economics are going to be put on the machine by Professor Solow of MIT and by Professor Orcutt of Harvard and, as other research workers in the social sciences learn how to use the equipment, other problems will be brought to the Center.

The Importance of Team Research

But an instrumentality, by itself, cannot produce new research. To make the important advances which are possible with a computer of the speed and flexibility of this, one needs a team of research people, some of whom know the machine and some of whom know the research field. To get exciting new possibilities beyond the stage of a "gleam in the eye" we need, in addition to the machine, a staff of experts in machine use, ready to team up with those scientists who believe the machine can help them but are not sure how, so that, between them, they can translate the "gleam in the eye" into new and important results.

In the long run, the various social scientists in New England will probably learn enough about machine operation to be able to make the machine useful to them. But it takes time to learn to program a machine of this size, and research workers in any field are reluctant to take much time off to learn new techniques. In addition, to get the most out of a computer one should have more than a casual knowledge of the electronic details of its operation. This combination of knowledge, of a social science and of a computer, will probably be developed in our next generation of research workers. But if we want to get started using computers in social science now, we will have to use a team: a man who knows the field plus a man who knows the machine.

Need for a Research Staff in Machine Utilization, an Ingredient in the Team

This last ingredient is the part which is left out of the contribution which IBM has made to the Computation Center. To put the Center at the forefront of research, we must have a full-time staff of enthusiastic machine specialists, to teach prospective users how to make the machine do its tricks and to join with research workers who come with a "gleam in their eye", forming teams which can utilize to the fullest the computer's capabilities in research. This staff will be hard, but not impossible, to recruit. We have the beginnings of one formed now, at present slanted chiefly toward research in the physical sciences, and we have obtained an NSF grant of $35,000 a year for three years to support it. We have the graduate student bodies of the participating institutions to pick from and we have already begun to make contact with those students who are interested in machine utilization. There are about two dozen IBM research assistants appointed for this year. We should be able to pick from the best of these a few who would like to stay on for two or three years more, after they have obtained their advanced degrees in engineering, mathematics or science, to be a part of our research staff, potential members of research teams.

Budget for the Social Sciences

To make up a staff which could handle the social science problems as well as the physical science ones would need another four or five good men, research men plus the technicians to back them up, plus a small budget for travel and incidental supplies and equipment, approximately $35,000 a year for three years. It would take about three years to get rolling and the developments should be reviewed at the end of three years, to see where to go next. Such a staff should be more important during the beginning stages of the utilization of electronic computers, when the problems are not too clearly formulated and when neither partner in the team knows the other's plans and ideas. Later, when some of the more important potentialities have been demonstrated, the research can be split up into projects, each with a definite goal and with its own budget, which can include partial support for the continuing staff of the Center. So, eventually, the Center could

be financed indirectly by contributions from each project which uses it, if this were considered to be the most desirable way of keeping it going. At present, however, support by contributions from established research projects can support only about a third of the $100,000 needed, which would leave unsupported the most fruitful research of all, the unknown results which are sure to come when a machine expert of the Center staff works together with the economist, psychologist or sociologist on the faculty of one of our participating colleges who comes to the Center with only a "gleam in his eye".

Possible Initial Directions for Investigation

As indicated, we cannot write down in any detail the directions which this research effort will take, as the various teams are formed and begin to interact. There are several general areas which we feel should be investigated, which are certain to produce results of immediate interest and which, in addition, should provide hints as to still more important applications.

A. One of these is the deeper investigation of machine logic itself. A computer of the complexity of the 704 is too big to be able to see immediately how it can "think". Most machines are now programmed to do ordinary arithmetic, a few programs have been devised to make the machine obey the rules of Boolean logic and some thought has been spent on working out programs to make the machine play chess or checkers, in other words to obey the logic of a game. Different sciences and branches of learning have their own kinds of thought processes. For example, economics and genetics each have patterns of thought which do not exactly duplicate those of physics. Fundamental research is needed to work out programs, rules of thought for the machine, which correspond more closely to these other patterns. With a machine of the flexibility and storage capacity of the 704, such research is worth while. It will have to be tackled, at the beginning, by teams of experts in the field of interest, together with mathematical logicians who know machine operation.

B. Another general line of attack is in the field of the storage and rapid access to information, such as is needed in the problems of language translation and historical research, for example. Several schemes of coding of information, so that it can be found quickly and easily, have been devised on paper, but the "bugs" in such schemes will become apparent only when masses of information, of the order of several hundred thousand items, are to be ordered and sorted out. The new installation at the Computation Center will have a storage capacity of this size. Some of the proposed schemes should be tried out, and others developed, by members of the Center staff working with persons familiar with the information and tis uses. For example, a project in machine translation has already been set up under the direction of Professor Locke of the Language Department. As it develops, it will need the help of machine programming specialists and will need the use of a machine to test its ideas. The translation project is already supported by the Rockefeller Foundation, but parallel work by the Computation Center on techniques for rapid access to large-quantity

data would help this work as well as others. Another promising direction of investigation is in the application of machine techniques to library inventorying, cataloging and record-keeping. Although special-purpose machines will probably be required in the end, many ideas and procedures can be developed and checked out on the general-purpose machine at the Center with the addition, perhaps, of some specially built input and output equipment. The staff of the MIT Library is interested in this work and will contribute its knowledge to its progress.

C. Perhaps the most promising line of advance, in part because the least investigated up till now, is in the field of social science experiments, where the computer can be used as recorder, scorer and referee. Tactical situations in warfare are already being studied by "gaming techniques" at Rand and in other military operations research groups. Similar problems in various fields of the social sciences can also be studied by simplifying the situation down to some sort of "game", with more or less complicated rules, which can be played by groups of investigators, to see what the consequences are of various strategies. If the "games" are to correspond, even distantly, to some actual social situation, the rules must be quite complicated and the scoring will require a great deal of statistical computation. It has been found that only by the use of computing machines can the scoring be speeded up sufficiently so that enough games can be run through to provide an over-all grasp of the situation under study. Such "gaming techniques" are closely related to the experiments of Bavelas on the behavior of task-oriented groups. The use of a properly programmed computer would provide such experiments with a powerful and flexible means of changing, controlling, and analyzing these experiments in social psychology. In this field we could work in close collaboration with the Center for International Studies at MIT and with the psychology departments in several other colleges.

Suggested Guidance for the Research

The research activities of the Computation Center are guided and coordinated by an Advisory Committee consisting of representatives from each of the participating colleges, each chosen by the president of his college. This Committee provides over-all policy guidance in all activities. But to guide the work in social science outlined above, we will need another, more specialized group. If financial support for this activity is forthcoming, about six top-flight social scientists from the participating institutions will be invited to join a special advisory committee, to talk over possible lines of research with the Center staff, to help find those social scientists with "gleams in their eyes" regarding machine utilization in their field, to help arrange the formation of teams for the pursuit of the suggested research and to advise on relative priorities, if and when there is more work to be done than there is machine time available.

Equipment, Personnel and Budget

The suggested budget for three years is tentative and is more dependent on our ability to hire one or two more experts in computer programming than on the amount of work to be done. If we can find more men of the right sort, more work can be done. During the calendar year 1957 we may not be able to find more than one senior man, one or two post-doctoral fellows and a couple of technical assistants. By the fall of 1957 we may be able to persuade one or two faculty members of the cooperating institutions to spend appreciable fractions of their time at the Center, working on some of the problems mentioned earlier. A suitable fraction of their salaries should be carried by the research funds of the Center and, if the work is in the social sciences, would be chargeable to the proposed grant. Some of the experiments in "gaming" will require special input or output equipment. Therefore it may turn out that less than $35,000 will be spent the first year, more than $35,000 the second. The important point, however, is that because of the presence of the equipment of the Center, supported by IBM, the majority of the budget of this grant can be spent on salaries for people directly carrying out the research outlined in this proposal.

The staff can begin to be assembled this spring, but expenditures would probably not reach full rate until the summer of 1957. Consequently, the grant could officially start March or April 1957, or could start as late as June, if some earlier expenditures could be charged against the grant at that time.

THE SUPPORT OF MACHINE PROGRAMMING STAFF FOR THE UTILIZATION OF ELECTRONIC COMPUTERS IN SOCIAL SCIENCE

The Facility and Its Potentialities

The high-speed computing facility, to be installed by IBM at the new Computation Center at MIT will be the largest and most flexible facility in this country to be devoted exclusively to unclassified research and education. IBM will contribute more than a fifth of a million a year in its support for maintenance and operation. What is needed, in addition, to make this an outstanding center for the investigation of digital computer potentialities in all branches of scientific research, is about $100,000 a year for the support of a research staff, which can work with scientists in various fields to develop new and more effective techniques of machine utilization.

Arrangements have been made for all the colleges in New England to participate in the use of the machines, and IBM has set up funds for Assistantships to enable graduate students, at MIT and at the participating colleges, to spend time at the Center learning to use the equipment. This Center and these arrangements represent potentialities for new developments in social and physical science of great and unexplored importance.

There will be no charge for machine time made to students or faculty of the participating institutions. Maintenance and the routine aspects of operation will be taken care of by IBM, so that those who know how to use such equipment can use it, without cost, up to the fourteen hours a day during which the machine will be available at first. A number of problems in economics are going to be put on the machine by Professor Solow of MIT and by Professor Orcutt of Harvard and, as other research workers in the social sciences learn how to use the equipment, other problems will be brought to the Center.

The Importance of Team Research

But an instrumentality, by itself, cannot produce new research. To make the important advances which are possible with a computer of the speed and flexibility of this, one needs a team of research people, some of whom know the machine and some of whom know the research field. To get exciting new possibilities beyond the stage of a "gleam in the eye" we need, in addition to the machine, a staff of experts in machine use, ready to team up with those scientists who believe the machine can help them but are not sure how, so that, between them, they can translate the "gleam in the eye" into new and important results.

In the long run, the various social scientists in New England will probably learn enough about machine operation to be able to make the machine useful to them. But it takes time to learn to program a machine of this size, and research workers in any field are reluctant to take much time off to learn new techniques. In addition, to get the most out of a computer one should have more than a casual knowledge of the electronic details of its operation. This combination of knowledge, of a social science and of a computer, will probably be developed in our next generation of research workers. But if we want to get started using computers in social science now, we will have to use a team: a man who knows the field plus a man who knows the machine.

Need for a Research Staff in Machine Utilization, an Ingredient in the Team

This last ingredient is the part which is left out of the contribution which IBM has made to the Computation Center. To put the Center at the forefront of research, we must have a full-time staff of enthusiastic machine specialists, to teach prospective users how to make the machine do its tricks and to join with research workers who come with a "gleam in their eye", forming teams which can utilize to the fullest the computer's capabilities in research. This staff will be hard, but not impossible, to recruit. We have the beginnings of one formed now, at present slanted chiefly toward research in the physical sciences, and we have obtained an NSF grant of $35,000 a year for three years to support it. We have the graduate student bodies of the participating institutions to pick from and we have already begun to make contact with those students who are interested in machine utilization. There are about two dozen IBM research assistants appointed for this year. We should be able to pick from the best of these a few who would like to stay on for two or three years more, after they have obtained their advanced degrees in engineering, mathematics or science, to be a part of our research staff, potential members of research teams.

Budget for the Social Sciences

To make up a staff which could handle the social science problems as well as the physical science ones would need another four or five good men, research men plus the technicians to back them up, plus a small budget for travel and incidental supplies and equipment, approximately $35,000 a year for three years. It would take about three years to get rolling and the developments should be reviewed at the end of three years, to see where to go next. Such a staff should be more important during the beginning stages of the utilization of electronic computers, when the problems are not too clearly formulated and when neither partner in the team knows the other's plans and ideas. Later, when some of the more important potentialities have been demonstrated, the research can be split up into projects, each with a definite goal and with its own budget, which can include partial support for the continuing staff of the Center. So, eventually, the Center could

be financed indirectly by contributions from each project which uses it, if this were considered to be the most desirable way of keeping it going. At present, however, support by contributions from established research projects can support only about a third of the $100,000 needed, which would leave unsupported the most fruitful research of all, the unknown results which are sure to come when a machine expert of the Center staff works together with the economist, psychologist or sociologist on the faculty of one of our participating colleges who comes to the Center with only a "gleam in his eye".

Possible Initial Directions for Investigation

As indicated, we cannot write down in any detail the directions which this research effort will take, as the various teams are formed and begin to interact. There are several general areas which we feel should be investigated, which are certain to produce results of immediate interest and which, in addition, should provide hints as to still more important applications.

A. One of these is the deeper investigation of machine logic itself. A computer of the complexity of the 704 is too big to be able to see immediately how it can "think". Most machines are now programmed to do ordinary arithmetic, a few programs have been devised to make the machine obey the rules of Boolean logic and some thought has been spent on working out programs to make the machine play chess or checkers, in other words to obey the logic of a game. Different sciences and branches of learning have their own kinds of thought processes. For example, economics and genetics each have patterns of thought which do not exactly duplicate those of physics. Fundamental research is needed to work out programs, rules of thought for the machine, which correspond more closely to these other patterns. With a machine of the flexibility and storage capacity of the 704, such research is worth while. It will have to be tackled, at the beginning, by teams of experts in the field of interest, together with mathematical logicians who know machine operation.

B. Another general line of attack is in the field of the storage and rapid access to information, such as is needed in the problems of language translation and historical research, for example. Several schemes of coding of information, so that it can be found quickly and easily, have been devised on paper, but the "bugs" in such schemes will become apparent only when masses of information, of the order of several hundred thousand items, are to be ordered and sorted out. The new installation at the Computation Center will have a storage capacity of this size. Some of the proposed schemes should be tried out, and others developed, by members of the Center staff working with persons familiar with the information and its uses. For example, a project in machine translation has already been set up under the direction of Professor Locke of the Language Department. As it develops, it will need the help of machine programming specialists and will need the use of a machine to test its ideas. The translation project is already supported by the Rockefeller Foundation, but parallel work by the Computation Center on techniques for rapid access to large-quantity

data would help this work as well as others. Another promising direction of investigation is in the application of machine techniques to library inventorying, cataloging and record-keeping. Although special-purpose machines will probably be required in the end, many ideas and procedures can be developed and checked out on the general-purpose machine at the Center with the addition, perhaps, of some specially built input and output equipment. The staff of the MIT Library is interested in this work and will contribute its knowledge to its progress.

C. Perhaps the most promising line of advance, in part because the least investigated up till now, is in the field of social science experiments, where the computer can be used as recorder, scorer and referee. Tactical situations in warfare are already being studied by "gaming techniques" at Rand and in other military operations research groups. Similar problems in various fields of the social sciences can also be studied by simplifying the situation down to some sort of "game", with more or less complicated rules, which can be played by groups of investigators, to see what the consequences are of various strategies. If the "games" are to correspond, even distantly, to some actual social situation, the rules must be quite complicated and the scoring will require a great deal of statistical computation. It has been found that only by the use of computing machines can the scoring be speeded up sufficiently so that enough games can be run through to provide an over-all grasp of the situation under study. Such "gaming techniques" are closely related to the experiments of Bavelas on the behavior of task-oriented groups. The use of a properly programmed computer would provide such experiments with a powerful and flexible means of changing, controlling, and analyzing these experiments in social psychology. In this field we could work in close collaboration with the Center for International Studies at MIT and with the psychology departments in several other colleges.

Suggested Guidance for the Research

The research activities of the Computation Center are guided and coordinated by an Advisory Committee consisting of representatives from each of the participating colleges, each chosen by the president of his college. This Committee provides over-all policy guidance in all activities. But to guide the work in social science outlined above, we will need another, more specialized group. If financial support for this activity is forthcoming, about six top-flight social scientists from the participating institutions will be invited to join a special advisory committee, to talk over possible lines of research with the Center staff, to help find those social scientists with "gleams in their eyes" regarding machine utilization in their field, to help arrange the formation of teams for the pursuit of the suggested research and to advise on relative priorities, if and when there is more work to be done than there is machine time available.

Equipment, Personnel and Budget

The suggested budget for three years is tentative and is more dependent on our ability to hire one or two more experts in computer programming than on the amount of work to be done. If we can find more men of the right sort, more work can be done. During the calendar year 1957 we may not be able to find more than one senior man, one or two post-doctoral fellows and a couple of technical assistants. By the fall of 1957 we may be able to persuade one or two faculty members of the cooperating institutions to spend appreciable fractions of their time at the Center, working on some of the problems mentioned earlier. A suitable fraction of their salaries should be carried by the research funds of the Center and, if the work is in the social sciences, would be chargeable to the proposed grant. Some of the experiments in "gaming" will require special input or output equipment. Therefore it may turn out that less than $35,000 will be spent the first year, more than $35,000 the second. The important point, however, is that because of the presence of the equipment of the Center, supported by IBM, the majority of the budget of this grant can be spent on salaries for people directly carrying out the research outlined in this proposal.

The staff can begin to be assembled this spring, but expenditures would probably not reach full rate until the summer of 1957. Consequently, the grant could officially start March or April 1957, or could start as late as June, if some earlier expenditures could be charged against the grant at that time.