A Report on the Feasibility of GEODATA
by Chandler Harrison Stevens
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GEODATA

A Man-Machine System for Political Districting

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Contents

Acknowledgements

Part I The Philosophy and the Experiment

Part II Feasibility and Future Development

Appendix A Congressional Reapportionment In Massachusetts

A Computer Approach

Appendix B Written Communications From Representative Stevens to Congressional Districting Officials

Appendix C News Media Reports on the Computer and Massachusetts Congressional Districting
Acknowledgements

It would be very difficult to mention, to even recall all of the many persons who have given freely of their time and knowledge either in carrying out this GEODATA experiment or in preparing this report.

First, I appreciate the close cooperation which I received from persons formally involved—Jim Weaver, Sidney Hess, Harry Siegfeld and others at CROND; Jim Dorsey, Kathy Gallery, and Sally Lewis at MIT's Center for International Studies; and Roy Salzman and others at the Arthur D. Little Corporation. This work was financially supported by a fellowship from CROND and was administered by the MIT Center for International Studies. The Arthur D. Little Corporation was used as a consultant in the preparation of part of the report.

The computer experiment could never have been performed in so short a time if it were not for the generous assistance and long hours which were voluntarily provided by Ron Zeilinger and his expert staff at the MIT Computation Center and by Elmer Bartels, Cynthia Benson and Helen Forweiler all of Bedford, Massachusetts. Their talents and enthusiasm were indispensible.

Professor Ithiel de Sola Pool launched this research project when he became its faculty sponsor, and he kept the project afloat by having his Political Science Department provide additional computer time when the original budget was found to be insufficient. The modest feasibility study which we originally set out to do became secondary to the full-scale programming and operation of an experimental version of GEODATA, which we were able to apply to the actual problem of congressional districting.
in Massachusetts. This opportunity could never have been seized if it were not for the combined energies of a large number of persons. Also the experiment would have ended prematurely if the MIT Computation Center had not itself donated a great deal of computer time.

Finally, I want to thank Robert La Porte of Chelmsford for his interest in what we tried to do and for allowing me to include his college term paper on this subject as an appendix to this report.
There is an art as well as a science to drawing election districts. Since I come from Massachusetts, you might guess that the "art" I speak of is the variety practiced by the famed artist Gilbert Stuart back in 1812 in a Boston newspaper office. There he sketched the wings, teeth and claws onto a newly drawn state senatorial district, which was then dubbed as the original Gerrymander, named after then Governor Gerry and the salamander, a beast of similar shape. The not so fine art of Gerrymandering to serve individual and partisan ambitions is still practiced in Massachusetts as a recently-drawn, buzzard-shaped congressional district clearly demonstrates.

I'm not talking about the districting art technique which was developed in Massachusetts a century and a half ago. I'm referring to a technique which just a few months ago was developed in a computer laboratory at MIT. In MIT's computer labs, and particularly in a research program known as Project MAC, persons involved have been developing a healthy respect for the art of decision making, for the qualitative immediacy of a decision as opposed to the quantitative application of a formula, for human judgment—particularly when it is placed in tandem with the computational speed of computers.

A little more than a year ago I began investigating the possibility
of doing computer districting on, what they call in the computer field, a real-time basis.* I wanted to use a time-shared computer to display maps and calculations on a cathode-ray tube or TV screen and to receive intermittent commands through a manual keyboard. This would allow for the instantaneous man-machine interaction, the immediate coupling of human judgment with the computer, which I felt the districting problem required.

To let human judgment creep into the field of computer districting may at first seem like an unnecessary risking of computer-aided gerrymandering, especially if you view gerrymandering, as I do, to be an unnecessary political evil--an underlying cause of voter alienation. But that risk is definitely worth taking for four reasons:

- There are certain districting criteria which may well or may not be constitutional and which cannot be readily quantified for purely computerized, non-human evaluation by an advance formula--such as how well do election districts correspond to various regional development and planning patterns?
- Human judgment, such as contained in the subjective weights applied to conflicting criteria, can never be completely eliminated.
- A computer districting system which does not allow for the rapid interplay of human judgment, will in my opinion, go largely unused.

*This research was done under sponsorship of CROND, Inc. and the MIT Center for International Studies.
Finally, and most importantly, such a man-machine system will for the first time allow the anti-gerrymanderers to rapidly challenge and expose the faults of districts drawn by the gerrymanders. In other words, the computer-aided anti-gerrymanderers will have the relative advantage, for they were previously barred from the smoke-filled room, because the districting issue was too complex for the political outsider of the pre-computer era.

I should mention that others disagree with my assessment of relative strengths. A recent thesis (Slingsby) is dedicated to the proposition that the political parties will subvert the computer process to their own purposes and create computer-based districts to favor individual parties, in secret, to the detriment of the voter and of non-partisan districting.

Further general remarks concerning the philosophy behind this man-machine system, which I have labeled GEODATA, should be saved until after I first give a specific description of how the GEODATA system works. I'll do this with the aid of three pictures.

Please understand that what you're seeing is a hastily developed version of GEODATA, which we had no intention of applying to a real districting problem so soon. But, last February 15, a federal court in Massachusetts declared Massachusetts Congressional districts to be invalid. Just four months later, this first picture was taken of an operational version of GEODATA. The man shown standing in the picture is William Finnegan, who was the chief staff man on our state's Legislative
Committee on Congressional Redistricting. Not shown in the picture are the amazing number of volunteers who helped prepare the data and the programs to make this demonstration possible in so short a time.

I had previously appeared before the districting committee with results of a preliminary run of CROND's redistricting program. With these results, I tried to explain to the committee two points:

- Population equality of as little as 1% deviation could be easily achieved, and
- More importantly, even within such limits, great variations in compactness were possible.

The committee seemed to understand the first point, for subsequently, every districting plan they considered had population deviations of 1% or less. But they ignored the second point, for their final plan was clearly the least compact of all the plans they considered. GEODATA analysis of the Legislature's districting made transparent that within the limits of the court-imposed criteria of population equality, within 1% deviation from average, the second criterion, traditional Gerrymandering had plenty of room in which to operate.
In this first picture, Mr. Finnegan is looking over my shoulder at a districting plan which his committee had prepared. This plan had been prepared without the aid of GEODATA, which had just become operational on the very day this picture was taken. Let me point out a few pieces of computer hardware visible in this picture. In the background are various units of the IBM 360 computer to which this display scope is connected. Specifically, you can see the card-reader, through which the basic population, geographic and political data had been entered into the computer, along with CROND's redistricting program, modified to contain GEODATA scope output and keyboard input routines. In the standard CROND program, computer input is through the same sort of card reader, and computer output is through a high-speed printer, a corner of which is also visible in this picture. The GEODATA system hardly modifies this basic input and output system. Instead GEODATA supplements this system in two ways. First, on the input side, the districting analyst may type in instructions through the typewriter-like keyboard, visible in the picture. For example, the instruction, "MOVE LEXINGTON FROM DISTRICT 5 TO DISTRICT 3" might be typed in, displayed on the screen, and then executed. Upon execution of a further instruction, CROND's REDIST program will produce approximately ten pages of description and evaluation of a modified districting plan. GEODATA then supplements this permanent printed record with its output display of the same information in map and tabular form, as shown in the second picture, a closeup of the map and data table.
Let me briefly review what is shown in this display, easy to see when you're in the computer room, but unfortunately blurred in this picture. First, the state of Massachusetts and an enlarged section of the metropolitan Boston area are outlined by the scope's beam of light, repetitively scanning the screen as directed by positioning commands of the GEODATA program.

The boundaries of each city and town and each Boston ward—the basic building blocks for this districting problem—are also shown in black on a transparent plastic overlay taped to the face of the scope. This was a short-cut procedure, but even in the long run it might be relatively inefficient to have the computer store community boundary descriptions and repetitively draw these unchanging community boundaries. The computer-controlled beam of light should be reserved primarily for
display of dynamic information, that is, mapping and data characteristics which change with the districting plan. Ideally, static mapping information such as community boundaries could best be displayed by slides or microfilm projected upon the scope's screen, rather than plastic overlays as in this experimental version of GEODATA. The slide projection system I have just suggested would be needed in order to realize the full potential of the GEODATA system. Imagine how useful it would be to the districting analyst if he could call forth slides of regional planning districts, of newspaper-reading patterns, of commuting patterns, of transportation networks, and of other already available mappings which would help him judge how closely various communities are tied together in comparison to the districts shown on the computer-beam map.

Boundaries of cities and towns are constant, but the boundaries of Congressional districts are, of course, the primary variable. The computer identifies these districts by displaying that district's identifying number (Congr. Dist. #1, 2, etc.) in the center of each border community. Thus, a rectangular district #2, in south central Massachusetts, is outlined on three sides by a string of 2's in the center of the district's perimeter communities.

The computer knows when to put the numbers in the detailed map of Boston and vicinity, shown at the right, rather than the statewide map.

Each of twelve congressional districts outlined on the map are further described in the table on the lower half of the screen, which changes instantaneously with the changes in the map's districts. Columns one and two show, respectively, the districts' identifying numbers and
populations. Columns three, four, and five evaluate the districts according to the three previously discussed criteria—population equality, contiguity and compactness.

- In column three, population deviation from average is shown;
- in column four, the letter C is displayed if the district is contiguous, the letters NC if noncontiguous; and,
- in column five, the district's moment of inertia, which I call the "Gerry Index," is given.

The three remaining columns can be used to display any district characteristics which the districting analyst considers relevant and for which there is sufficient data in corresponding area units. We might have here shown average income, total property valuation, average age or other social or economic data. There might be considerable justification for the display of such information if we were using the GEODATA technique for drawing service or planning districts rather than legislative districts. I personally feel we need much better correspondence between legislative districts and other districts used for regional planning, mass transportation, mental health, pollution control, welfare and employment services and a myriad of other programs. It's almost impossible nowadays for a citizen to keep track of his political address because of criss-crossing districts. No wonder the alienated voter feels he is losing control of his government.

The constitutionality of consideration of such elements of demographic data has not yet been determined. The courts have dealt in one or two cases with the handling of racial data in districting, but none
of the other items of information mentioned above such as average income or total property evaluation have been considered at all. We will have to know more about the intent of the total districting process before we know whether the court will eventually consider it proper or improper to consider these variables in the drawing of election districts. Nevertheless, it is certain that some of those doing the present districting do consider them, and my intent here is to make available the necessary data for districting to clarify the variables really involved. The next variable which we discuss may also be unconstitutional.

The voting population in each district seems most important to those legislators now doing districting. Gerrymandering presently overrides most other rational districting criteria, so we have shown in these last three columns of our display table the numbers of Democrats, Republicans, and Independents in each district. During recent debate on Massachusetts Congressional districts, GEODATA results demonstrated to legislators and newsmen that the districting committee was guilty of gerrymandering to favor incumbent congressmen and at least one potential challenger who sat on the districting committee. Proof was on our screen, by comparing committee plans against alternative plans suggested by others.

Any plan displayed can be modified according to suggestions made by on-the-scene observers. In the third picture, you see several on-the-scene observers making suggestions, one of which caused GEODATA to produce a noncontiguous district in this particular picture. (NC in the 4th column)
GEODATA has an additional feature designed to give the observer a quick feeling for the direction of changes in the tabular figures. It displays a plus or minus sign to the right of each figure in columns 2, 3, 5, 6, 7, and 8, to show whether the number currently displayed has gone up or down relative to the number previously displayed.

At the last minute before one of our GEODATA demonstrations, we got word that the House Rules Committee was planning to switch certain towns among districts along the border of a district where an incumbent reportedly felt he was in trouble. During our demonstrations, we showed how interchanging these towns clearly made districts less compact while making one district safer for that particular incumbent. The proportion of district voters in his party went up considerably.

Needless to say, gerrymandering won out over compactness in
Massachusetts this year. But this type of public exposure should help hasten the day when state constitutions will be revised and/or courts will be armed to force fairer districting.

GEODATA can be used to compare districting plans visually and modify them on the spot, by moving border communities from one district to another, as described above. But also a function key permits the districting analyst to improve any districting plan on the screen to make it more compact. This is done by calling upon CROND's very powerful iterative process, which redraws the districts on the scope, right before the GEODATA viewers' eyes.

Since GEODATA is meant to be an open-ended system, I hope in the future to use CROND's basic routine in additional ways, other than minimizing the weighted sum of squared geographical distances from district population centers. For instance, I might initially consider transportation patterns qualitatively, by flashing highway maps on the screen. Then in a more sophisticated system, I might want to replace geographical distances with time required to travel between communities. For instance, in my own legislative district, one town next to my hometown takes me quite a while to visit because I have to go around an Air Force Base, parts of which are located in each of the two towns. CROND's routine could be used to minimize not only such "time distance" but also various economic and social "distances" in the study of various patterns of homogeneity.

I realize that this opens up many controversial questions, but in the interest of basic science--basic social science--these questions demand exploration.

As before, I should mention that some of the data I mentioned may
not be constitutional, but no criteria are yet available to determine which are and which are not constitutional. I should also mention that the speed with which this interaction takes place requires one more step which has not yet been incorporated in our GEODATA program. From experience I know that observation can suggest immediate reasons for changing border populations into different districts, but after that moment has gone by the reasons for such changes are hard to reconstruct. Therefore, we plan to insert into this program the opportunity, or perhaps the requirement, that each change of a population unit from one district to another be accompanied by some statement or reason which can explain why the change is being made. This would be available as a part of the print-out of the sequence, which now takes place, so that in reviewing the sequence of plans prepared, the originator, or the legislature, or even the courts, will have some indication of the process of reasoning that was going on. Of course, it would be impossible to prove that such reasons were real or rationalized, if gerrymandering were the real purpose, but since the courts seem to be now requiring rational districting, such provisions should be compiled right into the GEODATA programs.

One other shortcoming now concerns us. Our printouts show the tabulations as they appear on the screen, for every plan prepared, but we do not have a means as yet for making permanent the maps which show on our TV screen. Remember that this whole thing was a research experiment. Two or three courses of action are available to permit a permanent record of the image on the TV screen, which is available to the viewer but not to the historian looking at the printout. One proposal is to use microfilm
or a hand camera to take a picture of each image.

Another proposal is to incorporate a plotting program which could reproduce the basic parts of the map on the printout itself. The thesis by Slingsby, already referred to, provides one rather slow alternative for creating such a map directly on an available piece of plotting computer equipment, where a census tract map can be placed to pick up the images.

Other alternatives would really provide more detailed maps, requiring input of detailed border data on each of the towns. Then our shortcut mapping techniques could perhaps be substituted completely for present tedious procedures.

Now to summarize the GEODATA philosophy, if it can be called that. Since a brewery in Massachusetts advertises its "beer philosophy," I guess it's okay if I speak about the "GEODATA philosophy." This philosophy advocates:

1) an OPEN-ENDED SYSTEM to allow for the progressive development of the districting science and the districting art;

2) use of COMPUTER GRAPHICS to directly facilitate communication within the districting discipline and with the outside world;

3) MAN-MACHINE INTERACTION to allow the computer to do that part of districting which is well-defined and to allow man to handle the ever changing but always remaining ill-defined portion; and finally
4) UNIVERSAL ACCESSIBILITY of the system so that the full weight of the democratic process might be applied to bring about districts which are more meaningful to citizens.
PART II

FEASIBILITY AND FUTURE DEVELOPMENT

Part I of this report gave a general description of GEODATA and a 1967 experiment with this system, the second part of this report will discuss the technical and economic feasibility of the GEODATA technique and the prospects for its future development. For purposes of this discussion, three versions of GEODATA should be distinguished: Experimental GEODATA, Intermediate GEODATA, and General GEODATA. "Experimental GEODATA" is the system which was developed in 1967 in less than four months time. It was tailor-made for the particular problem of dividing the state of Massachusetts into 12 congressional districts. No attempt was made to generalize the GEODATA system during this experiment for time was short and this project was meant only to demonstrate many of the important GEODATA features as applied to this specific problem. By way of contrast a highly versatile and flexible "General GEODATA" system will be proposed in the latter section of this report, but first a detailed description of the hardware and software employed in the experimental GEODATA system will be given. Then "Intermediate GEODATA" will be described as a system which could be used for election districting across the country after a minimum amount of additional programming.

Experimental GEODATA

Experimental GEODATA was run on an IBM computer model 65 with 512,000 bytes of computer memory. Employed with this was an IBM 2250 display scope model 1 with 8,000 bytes of buffered memory. For a general
description of the hardware requirements for the GEODATA program see CROND's manual on the REDIST program from which GEODATA was derived. While the GEODATA modifications do use a significant amount of memory, this amount of memory is dwarfed by the data requirements which vary with the size of the districting problem being handled by the basic REDIST program.

Experimental GEODATA was designed to handle a districting problem calling for the division of 357 population units among 12 congressional districts. An IBM 7094 was originally considered for this problem, but its 32,000 words of memory were found to be insufficient for a districting problem of this size. Since four bytes of memory on the IBM 360 computer are approximately equivalent to one word of memory on the IBM 7094 computer, it can therefore be concluded that a 360 with only 128,000 bytes of memory would likewise be insufficient for handling a problem of this particular size. From a memory capacity standpoint, this particular problem could have been run on a 360 model 40 with 256,000 bytes of memory. A smaller districting problem could have been run on a 360 model 30. However, in both of these cases the computational speed might have made the man-machine interaction with the computer driven display scope impractical because of excessive delays. As a rule of thumb the model 65 computes approximately 10 times faster than the model 40. None of the delays encountered in using the model 65 were problematical but the delay which might be expected during a large matrix inversion on a model 40 could be expected to be intolerable. Therefore, a model 65 is preferable to a model 40 for running GEODATA.

The IBM 360 system at MIT was chosen over MIT's 7094 not only because
of memory consideration but also because of the particular scopes that were available for the two machines. The special purpose display scope that was associated with MIT's 7094 had the disadvantage of not being generally available in other parts of the country. Also this particular display scope did not have any memory of its own. The IBM 2250 display scope attached to the 360 computer had 8,000 bytes of buffered memory. A 4,000 byte memory buffer might have been sufficient for our purposes. In any event some memory buffering was needed in that it allowed the GEODATA system to operate without tying up the main computer in regenerating the display of the map of Massachusetts and its related table of statistics. Once a particular version of the map and table of statistics were generated by the computer, the 2250 could independently through use of its own memory system cause the continuous regeneration of the necessary image on the display scope.

Such display scope buffering can leave the main computer and its memory free for operation on other computer problems while the GEODATA analyst might want to pause and ponder what changes he would like to make in the districting pattern currently being displayed on the scope.

The IBM 360 model 65 used in this experiment is perfectly capable of running GEODATA problems along with other problems on a time-sharing basis. Nevertheless, for the major portion of this experiment the 360 was not time-shared principally because of administrative difficulties which would have arisen in equitably allocating the costs of computer operation between the GEODATA problem and whatever other problems would then have been running on the computer. MIT's computer operations were
then divided between the 7094 computer, which was being used strictly for time-shared problems, and the 360 computer, which was being used almost exclusively for so-called batch processing. Unfortunately the 360, which was needed for its larger memory and buffered display scope, was not equipped to administratively make an equitable allocation of costs among time-shared programs, and time-sharing was needed for the GEODATA program to run efficiently.

Consequently time-sharing could not be employed in this experiment but is recommended for General GEODATA and even for any further application of Experimental GEODATA. Otherwise the computer will sit idle 80 to 90 per cent of the time, which is, of course, inefficient. In other words, the 1967 experiment with GEODATA used computer time at a rate which was five to ten times more expensive than it would have been under time-sharing. MIT's rates varied from $100 to $200 per hour during this experiment. At current commercial rates this type of computer time might cost $400 to $500 per hour. However, a relatively active application of GEODATA would still only absorb only a portion of that time under time-sharing and therefore might be estimated to cost only 10 to 20 per cent of that amount or in other words $40 to $100 per hour. Of course, if the map and statistics in a GEODATA problem were being displayed on the screen and if the analyst wanted to pause and ponder that map and table of statistics for an excessively long time, say an hour, then there would be no charge during that hour for the main computer but perhaps only a much smaller charge for the use of the 2250.

Another reason why the 360 computer along with the 2250 scope were
chosen for this experiment was the fact that these two systems in combination are expected to be generally more widely available than any other similar computer system during the next few years.

For the ultimate purpose to which GEODATA might be put, it is also important that time-sharing on such systems as these be generally possible, across the United States. To evaluate that possibility one must first examine the general state of software development for such systems. There are two major software packages which IBM makes available for use with the 360 computer. One is known as Operating System/360 or briefly OS/360. Under this system time-sharing is possible as long as the programs are small enough to fit in the computer memory simultaneously.

A more flexible and more efficient time-sharing system is currently under development by IBM. It is known as TSS, which in fact stands for Time-Sharing System. TSS will be employed on the 360 model 67 which differs from the model 65 by simply having what is known as a dynamic addressing system built into the hardware. Time-sharing under TSS on the model 67 is much different from either time-sharing on the 7094 or time-sharing on the 360 model 65. On MIT's 7094, time-sharing is achieved by swapping programs into and out of the computer memory one at a time. There may be several computer users sitting at remote terminals attached to the 7094, but at any particular instant only one of these computer users has his program currently in the main computer memory. On the 360 model 65 it is possible to have more than one program in the computer memory at any particular time provided the programs are not so large as to prohibit that type of sharing of the computer memory. Finally on the
360 model 67 under TSS, the size of the programs being time-shared will make little difference for it will be possible to share the computer memory among parts of various computer programs in an effort to make optimum use of such memory as well as optimum use of other computer circuitry used in the input-output and computing processes.

Promising as TSS might be, it presently does not have the capability of time-sharing 2250 display scopes at one or more of its terminals. Also it appears that the development of such graphic capabilities does not have a high priority among the tasks that still remain before the developers of the TSS software package. It would be unwise to count on such graphic support being available prior to say 1970.

Meanwhile under the more limited capabilities of OS, the necessary display scope subroutines are available in two forms. First there is GPS (Graphics Programming System) which IBM recently released and which it will continue to update and improve. Then there is also GPAC (Graphics Package) which was written by IBM but is not fully supported by it.

Experimental GEODATA was written using GPAC, but conversion to GPS would be trivial. On the other hand, conversion from OS to TSS would not be trivial but could possibly require the same approximate six man months which went into preparing Experimental GEODATA in the first place. However, experimental GEODATA would be of very little further value unless it was generalized considerably.

Intermediate GEODATA

The Experimental GEODATA system just described is usable only on a very specific problem, having been developed as a feasibility demonstration
and with only a small amount of programming effort applied. This system proved that the concept of man-machine interaction to arrive at an optimal districting plan is not only technically feasible but also highly desirable, combining the algorithmic problem solving capability of the computer using a program involving large amounts of computation such as REDIST with the judgement factors that only a human being can provide.

Now it is desired to consider the applications of such a system using fundamentally the same components, i.e., the IBM 360 with a 2250 graphics console, the REDIST program to calculate and minimize population deviations and moments of inertia, and the GEODATA technique of displaying the resultant districting plan on a scale compatible with the plastic overlay used on the face of the 2250. Various directions of change from Experimental GEODATA might be considered. First, a central processor other than the IBM 360 might be used. Since the REDIST program and much of the GEODATA additions to it are in FORTRAN, it is conceivable that with only minor modifications, most of the program can be translated for execution on another machine. In practice, however, such modifications tend to become much more complicated than one might expect. Moreover, because of the heavy orientation of GEODATA toward a rather unique input/output device such as the 2250, major modifications would have to be made to the graphics interface and the actual display routines since few, if any, other computer manufacturers have a software package similar to GPAC which was used in Experimental GEODATA.

Another direction of change might be the use of a different model of the 360 other than the model 65 which was used in the initial version. As
was stated in the preceding section, while it is certainly possible to run GEODATA on a smaller model such as the model 40, the slower speed of such a machine might jeopardize the interactive nature of the application, particularly when larger problems are attempted.

A third deviation from Experimental GEODATA would be the use of a system for other districting problems within the Commonwealth of Massachusetts, such as, the Senatorial districting problem which is a current issue, or even the state representative district problem. Other forms of districts might also be worked on, such as counties, water pollution districts, mental health districts, etc.

A fourth direction of change would be the use of GEODATA for determining congressional districts for any state. A fifth direction of change might be an alteration of the kinds of data that are displayed for the districting criteria used for optimization of the districting plan. This would involve changes which may be either major or minor depending upon the extent of changes desired to the internal structure of REDIST or GEODATA. The final form of change which might be possible is a change in the specific configuration of the computing system used to run GEODATA, such as using a 2250-IV (a 2250 type display console using an IBM 1130 as a local buffer memory and display processor) connected remotely to a different time sharing configuration of the 360.

Some change in all of these directions is seen necessary to achieve the goals described in general GEODATA as shown below. Intermediate GEODATA, described in this section, is a system which could be developed with a minimum amount of additional effort building on the basic design.
and programming already accomplished. It is possible that such a system would be of no real value for anything, since it would contain more than the necessary power to demonstrate feasibility as a concept and would not contain enough generality to allow the concept to be widely applied, as it must be to justify the considerable investment to bring it beyond the prototype stage. It is, however, worthwhile to consider the type and scope of changes that are possible without requiring a thorough revision of the system design as would be expected with general GEODATA.

From a basic central processor point of view, there seems to be little gain in trying to adapt GEODATA to some other manufacturer's equipment. Since IBM, with its comprehensive 360 product line, controls over 70% of the U.S. computer market, it is quite safe to assume that access to a 360 of some model large enough to permit effective execution of GEODATA will be available. Many state governments have 360's as do many large university computing centers. While a version of a program could be written in a small enough sub-set of FORTRAN that virtually any manufacturer's computer would be able to process it, there is still a significant problem of compatibility between FORTRAN programs compiled and executed on different machines, and any program which attempted to use a rudimentary enough sub-set of the language to avoid this problem would probably be hopelessly inefficient and unsatisfactory from a response time point of view. As another consideration, IBM is one of the few computer manufacturers (Control Data being another with UNIVAC a poor third and General Electric, Burroughs, RCA, and the others barely giving a nod in this direction) to offer an interactive graphics capability as an integral part of their
product line. In other words, except for a few rare cases of CDC 6400's or 3300's with 274 display consoles connected through either a special purpose controller or a CDC 1700, the only machine on which interactive graphics capabilities exist on a more or less wide-spread basis is the IBM 360. While there are many vendors of computer graphics equipment itself (Information Displays Incorporated, Systems Engineering Laboratories, Digital Equipment Corporation, Tasker, Sanders Associates, Stromberg-Carlson, and others) few if any have been willing to invest the considerable sum required to provide adequate software for their devices to become generally usable. Recent moves by IBM indicate that this disparity will become even more pronounced and unless Control Data or one of the other computer manufacturers makes a strong bid to counteract IBM's advances in this area, it seems likely that the 360/2250 combination will almost completely dominate the computer graphics scene. Hence, selection of any other computer or display console would certainly restrict the applicability of GEODATA and there appears to be no evidence to suggest that there would be any corresponding advantages gained.

The specific configuration of the 360/2250 combination that is to be used for operation of a more generalized GEODATA is not a firm decision and does not need to be absolutely established beyond some minimal practical thresholds. The considerations behind the rationale for selection of the model 65 as described in the previous section, apply here: namely, the more powerful the processor, the better the response time; and the more memory available, the larger the size of districting problem that may be done on it. For the most part, the configuration chosen to run
a specific problem will be more a function of availability of any size processor with a 2250 connected rather than a choice of the best possible configurations, since 2250's are relatively rare and will remain so for the next two or three years. A minimum graphics-oriented configuration is given below with approximate monthly rental prices. Any new version of GEODATA developed might well be designed to operate on this configuration under the assumption that any greater capacity would only improve the operation of the program.

MODEL 40
GRAPHICS ONLY

2040-H

256K bytes
Dec. Arith
Flt. Pt. Arith
(1) Sel. Ch.

1052 Console

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$16,337

$19,312
While a dedicated computer with a graphics scope may be obtainable in some research or highly engineering-oriented organizations, as the use of graphics progresses, it will be more common to see remote graphics consoles such as the 2250-IV connected to a time shared 360 Model 50, 65, 75 or even 85. The 2250-IV, a relatively recent offering by IBM, is expected to increase the use of remote graphics on a time shared basis because of the additional usefulness of the 1130 itself as a stand-alone engineering computer or as a remote job entry terminal as well as functioning as a display processor when the 2250 is in use. Time-sharing, although undeniably threatened by the proliferation of small inexpensive computers, is a technique which is definitely here to stay. In reviewing the trend, it has been noticed that new computer installations are building up in number at both the very low and very high end of the computer-size spectrum with a corresponding decrease in volume of medium scale computers. Most large organizations either have or are in the process of installing at least one large computer (model 65 or above) with foreground/background facilities to allow some terminal applications, such as the use of graphics, to be carried in the foreground mode while conventional batch jobs are being run in the background mode on a lower priority basis. Such simplified time sharing systems are now running under versions of IBM's Operating System 360 containing MFT or MVT (Multi-programming Fixed number of Tasks and Multi-Programming Variable number of Tasks) scheduling systems. More exotic time sharing systems such as TSS/67 have somewhat fallen from favor in spite of their very attractive characteristics as originally envisioned, due to enormous problems of
implementation and disappointing performance under actual operation conditions. Thus, a more advanced version of GEODATA should be developed on IBM software which is capable of being run under MFT or MVT versions of OS/360 on a time shared basis or, alternatively, run on a dedicated machine which would also use OS/360. Any new, more comprehensive software developed by IBM is expected to use GSP and/or GJP which would be capable of operation under either of these environments. Hence, conversion of GEODATA to these graphics utility packages would be advisable since it would then be usable under many more available systems and the effort required would not be great.

A major area of change seen for Intermediate GEODATA would be the provision of a facility for accepting the boundary coordinates of any arbitrary political entity (e.g., a state), rather than having only the Commonwealth of Massachusetts information programmed permanently into the system. In addition, the facility should exist for accepting the geographical and political descriptions of each of the units within that entity which must be combined to make up an arbitrary but fixed number of districts. Several techniques for getting such information into a computer exist. The most common, but perhaps the most cumbersome, involves using punched cards for describing each straight line segment of a boundary, giving, perhaps, its end-point coordinates or incremental vector information, along with the designations of the political units on each side of the boundary. Another technique involves the use of automatic position digitizing equipment such as is produced by Concord Controls, Inc. for various cartography applications. This equipment, which costs upwards of $60,000,
allows an operator to trace boundaries on a map using a stylus whose position is monitored and either point-by-point or vector information is recorded for later computer input. A third technique would be the use of the CRT light pen and a separate computer program for tracing boundaries through a photographically produced transparent overlay placed on the face of the tube. Still another approach would be the use of a less expensive graphic input device such as the Rand tablet (now commercially available from Sylvania or Grafacon) for tracing boundaries with somewhat less precision than the Concord Control equipment allows.

Either the first or the last of these techniques is probably most desirable from the point of view of expense (including both software and hardware considerations) and also allowing greater control over the volume of boundary data fed to the system. The boundaries, after all, can be quite imprecise and the primary concern would be with minimizing the amount of data which must be stored and processed. While the boundary of the overall political entity would be continuously displayed, the data for each unit in the entity would be used for calculating the common boundaries between units within a given district and displaying only the portions of the boundaries which interface between two separate districts. It would probably be necessary to retain the individual boundaries of each political unit on an auxiliary storage medium such as disc packs until REDIST has calculated a new district plan, at which point the boundary information would be brought in and those boundaries between units in different districts displayed.

Along with the boundary information, it is necessary to have some
means for inputting the coordinates and the numerical values for the center of population for each political unit. It should also be possible (as was done in Experimental GEODATA) to indicate the initial suggested district into which this political unit falls, such as the district in which it was previously included prior to this redistricting exercise. This information could be entered by a combination of the graphical means described above and digital means such as paper tape or punched cards. Since it is this information which is actually used for the computation in the REDIST program, and the boundary information really is only a means for more convenient visualization of the districting plan, it is really more important to design the system such that this data is conveniently arrived at and able to be entered.

The major question here and one to which an answer is not possible until the detailed system design for intermediate or general GEODATA has been accomplished, is the determination of the scope of the problem which can be handled by any given computer configuration. A fairly simple algorithm similar to the one used for REDIST could no doubt be established for determining this by means of an arithmetic combination of number of districts desired and the number of political units encompassed in the state or other political entity in which these districts are to be determined. If this number is unreasonably small for even a fairly large configuration system, it might be necessary to develop a means for augmenting computer main memory by means of the 2311 Discpack which would normally accompany most time shared or graphics-oriented versions of the 360. Taking such a step, however, would substantially increase the amount
of time required to solve a given problem and one might wish to make other compromises, such as bypassing the printing out of the complete information picture for each districting plan. Thus, some examination should be given to the memory allocation problem, the initial data reading phase of the program and the overall GEODATA executive routine which calls for various functions to be performed. At this point, it is not possible to describe precisely all of the options that might be possible or the specific limitations that must be placed on the program. The design approach would be, however, to remove as much as possible limitations on the ties or complexity of the districting problem itself to permit the widest possible use across the country even at the expense of some impatience on the part of the user with a less than ideal response time. Where response times are expected to be poor, a message would be generated informing the user that computation is in process and he will get an answer shortly.

General GEODATA

If one reflects on the nature of a general purpose GEODATA type system, two major attributes become evident:

1. It is basically a technique for pattern generation, and
2. It is also a somewhat specialized technique for pattern comparison.

Any district, regardless of its type, is in effect a pattern imposed on a defined and bounded entity. The entity might be a county, a state, a region or even the country. District "patterns" might be for elective representation, water pollution, air pollution, sewerage or other typical
forms of political districts. However, if the concept of pattern can be extended to include such things as newspaper readership, age distribution, housing starts, and other such groupings of people and/or their traits, the ability to consider relationships between patterns takes on new meaning. Let us examine now General GEODATA under these circumstances.

The ability to generate patterns (districts) based on data fed into a computer, requires that the rules for pattern generation be very specific. (We will assume the other requirement for data accuracy is being met.) Thus, the number of election districts that must be drawn within a state is an example of such a specific rule. Additional rules can also be accommodated provided that still more rules exist in the event that occasional conflicts are incurred when the rules are followed. What we need here, of course, is a priority rule to identify which of several rules have primacy if they should be in conflict in their results. Unfortunately, the bulk of patterns we establish in our lives frequently depend more on unstated or even unrealized rules than they do on those that are clear and explicit. Thus, in trying to obtain "the best" districting pattern in many areas, it is often quite useful, having obtained a pattern somehow, to step back and ask "Now, what have I done?" In effect, this question says "What is the impact of the district pattern I have just generated on other patterns that are also of interest to me? What, for instance, has the creation of this election district done to patterns of voter registration, income distribution, or patterns of race and sex. Also, what has this pattern done to historical associations between towns
that are very important?"

The requirements of general purpose GEODATA clearly go far beyond those which were met by experimental GEODATA. To be truly general purpose, it must first be possible to describe virtually any set of bounds within which patterns will be drawn. This frees one from specific geographic restraints. In addition, it may even prove useful to permit bounds that are not geographically oriented at all. This is somewhat akin to modeling in the operations research sense, where the limits of a system as it were, are defined without the restriction that the "system" be a geographic entity. Once the boundaries within which patterns are to be cut are established, general purpose GEODATA needs to be very flexible in its ability to accept rules for developing patterns. Obviously, the types of rules needed to define a valid arrangement of air pollution districts are quite different from those needed to develop an arrangement of electoral districts.

Another feature of General GEODATA is that it be able to accept and remember district patterns already in existence. This means the model can be given a basic districting pattern to be used as a base so that, in effect, other districts serving other purposes can be overlaid for comparison. This could include variations in district arrangements to serve the same purpose in order to see how they stack up side-by-side.

The critical problem is to achieve a method for making comparisons between different patterns. It will be recognized that what is being compared, however, is not necessarily simply two different overlays of geography. Rather, a comparison must be made between similar types of
of things that characterize a district as these things happen to be
distributed within the different geographic districts involved. Also,
the things being compared will influence the manner in which the com-
parison is presented to the GEODATA user. Overlapping geography between
water pollution districts and sewerage districts, for example, can readily
be displayed as just that—overlapping geography. On the other hand,
overlapping responsibilities of different representatives in different
districting arrangements might well be better presented in tabular form.
The medium of the CRT of course can handle both quite readily.

From a practical, implementation point of view, General GEODATA will
differ from Experimental or Intermediate GEODATA primarily in scope rather
than in its basic nature. An IBM 360 is still an appropriate machine,
although a somewhat larger one (Model 75 or 85) will probably be required
to give the response times necessary and to control the rather large
amounts of mass storage required to contain all of the districting data
used to allow the various overlays. The 2250-IV scope may be adequate,
although the quantity of data which may be desirable to display might
dictate the use of a CRT with greater line displaying capacity. Alter-
natively, a different approach might be used for displaying overlays of
various district patterns such as a "back-ported" scope (which would
allow simultaneous projection of photographic slides showing district
patterns with computer-generated information showing more dynamic district
plans) or CRT's which allow mixed video information as stored on video
disks with computer-generated information. Such devices are now available,
but not common, and one would have to judge between the general availability
of 2250's which would require more software effort, more digital storage and, perhaps, less desirable features; and the more elegant but less available devices.

Input-output devices for General GEODATA would be of much more concern than with the more limited versions due to the greatly increased problems of generating a large, universal data base of district information which is implied. Ideally, one would like to have available all of the district information pertaining to a unit along with its geographic boundaries, population, party registration, demographic statistics, newspaper reading habits, economic information, educational alliances, etc. Accumulating this information alone is a formidable task, getting it into the computer is another, and storing it in such a way that it is conveniently updated as well as being usable for normal operation of the system is probably the most awesome of all. Since much of the information will be digital in nature, normal forms of data entry such as punched cards, punched tape or on-line data entry through keyboards would be suitable. Much of the information will probably be available from other sources on magnetic tape (e.g., Census Bureau data) and a number of preliminary programs might be required to extract the appropriate information, reformat it and merge it with other data pertaining to a given political unit. The graphic data (boundaries of discrete political units and important natural geographic information such as rivers, major highways, etc.) can be entered by any of the techniques described in Intermediate GEODATA with emphasis on the more highly sophisticated techniques allowing higher volumes of data to be input at greater speed.
As suggested above, the storage requirements for this data and the techniques for structuring the data base might easily become the dominant problems for General GEODATA. Since only a relatively small number of units will be of interest for any discrete re-districting problem (on the order of several hundred to a thousand), immediate random-access mass-storage may not need to be too enormous. The bulk of the data base would probably be kept on a cheap "off-line" medium such as magnetic tape or removable disc packs and only the relevant data extracted from this medium and put "on-line" by a special program preparatory to a run of GEODATA on a specific problem. Techniques and programs for maintaining this file will have to be developed in addition to methods of generating it and adding new categories of information to it as they become available.

The software for General GEODATA will, of course, have to be completely re-defined and re-programmed although some of the algorithms in REDIST may be incorporated, at least in concept. An executive system will have to be designed which allows for incorporation of various types of districting criteria, various sizes and degrees of prevision of districting problems, flexible overlaying and comparison of several types of districts being simultaneously re-defined and the handling of a comprehensive data structure which might change in content with time. Such a software package could easily cost several hundred thousand dollars and a thorough systems analysis would be required which would build on the knowledge gained from Intermediate GEODATA, prior to initiating any detailed design or implementation.

To summarize the outline then of General GEODATA, it will clearly
be seen that its general purpose nature is both its greatest strength and its most difficult development challenge. Like any computer-based system, it demands either that we know what we want to do with our data (i.e., how we wish to establish districts) or alternatively, that we know what we like or don't like about what we've done with our data (i.e., the districts we have established). Gerrymandering rules are as important as all other rules to the computer. If they are stated, they could probably be accommodated. If they are not stated, they would have to be ignored. If they are not stated, and districts are carved out according to other rules, then it is necessary to understand what consequences of the new districting arrangement we are interested in observing. General GEODATA offers the potential for either refining or eliminating gerrymandering. A general purpose tool is available to be used. How it is used and what use is made of it is still up to us.
APPENDIX A

CONGRESSIONAL REAPPORTIONMENT IN MASSACHUSETTS:

A COMPUTER APPROACH

by Robert La Porte

(A college term paper reprinted by permission of the author with a few minor corrections of fact made by Chandler Stevens)

The logical starting point for Massachusetts' infamous election districting history was the year 1812, when the famed artist Gilbert Stuart,\(^1\) in a Boston newspaper office, sketched the Gerrymander. It turned out to be the newly-drawn state senatorial district to which was added wings, teeth and claws. This sketch became dubbed the original Gerrymander, being named after the then Governor Gerry and the salamander.

From this starting point the term "gerrymandering" has been used by almost every state to mean unfair apportionment of a state's election districts. In today's modern world this practice is still taking place.

In Massachusetts the case for reapportionment was brought about by Attorney Edmund Dinis, et als, and his complaint registered in the United States District Court for the district of Massachusetts. The suit was brought by seven registered voters (one in each of seven of the twelve Congressional Districts in Massachusetts) against the Governor, the Secretary of State and the Attorney General of Massachusetts. The plaintiffs asked that the then current Massachusetts Apportionment Act

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\(^1\) Other artists have been mentioned for this honor. However the author feels that Gilbert Stuart is the more correct.
be declared unconstitutional and that the defendants be restrained by court injunction from assuming any responsibility or taking any action with respect to the nomination or election of Representatives to the Congress of the United States from the Congressional Districts as they were then constituted.

The Court found that, under the plan adopted by the legislature in 1962, the difference in population between the largest and smallest districts, viz., the 1st and 9th, was 102,626, or approximately 1/4 the size of an ideal district. Under plans which the legislature had rejected in 1962 the differences between the largest and smallest districts were slightly less than 50,000 or approximately 1/10 the size of an ideal district.

Based on these and other findings the Court declared on February 15, 1967 that the Massachusetts Reapportionment Act "violates Article I, section 2 of the Constitution of the United States and is invalid." The Court then said in conclusion:

We shall not now grant any injunctive relief. Instead, since the Massachusetts Legislature is now in session and the next congressional election is almost two years distant, and since "legislative reapportionment is primarily a matter for legislative consideration and determination, and... judicial relief becomes appropriate only when a legislature fails to reapportion according to federal constitutional requisites in a timely fashion after having had an adequate opportunity to do so," Reynolds v. Sims, supra, 586, quoted with approval in Burns v. Richardson, 384 U.S. 73, 85 (1966), we shall, in accordance with the general practice in these cases, retain...
our jurisdiction pending appropriate action by the Massachusetts Legislature.²

Thus the United States District Court threw the task of congressional reapportionment back to the Massachusetts General Court (the state legislature). The legislature then formed a Joint Legislative Committee, and assigned it the task of formulating a new plan.

The author of this paper will show the attempt of Representative Chandler Stevens, an Independent from Bedford, to urge reapportionment of Congressional districts with the aid of a computer. A history of his attempt, along with a brief outline of the technical aspects, will be shown. Though these aspects at first might seem irrelevant to the reader, it is through these aspects that the value of his theory becomes apparent.

The first suggestion of a computer programmed redistricting plan appeared in an article authored by Gloria Boykin of the Boston Record American, April 1, 1967. She referred to Mr. Stevens as a computer expert who recently earned his Ph.D. in Economics at the Massachusetts Institute of Technology. In a recent interview with Representative Stevens (March 6, 1968) the technical aspects of his plan were discussed.

About eighteen months ago Rep. Stevens began investigating the feasibility of doing computer districting on a "real-time" basis. By using a time-shared computer located at M.I.T., he would be able to display maps and calculations on a cathode-ray tube or TV screen and to receive intermittent commands through a manual keyboard. The keyboard

² Dinis v. Volpe, Civil Action No. 66-767-G United States District Court of Massachusetts.
would allow for instantaneous man-machine interaction, the immediate coupling of human judgment with the computer. It might appear that this would defeat the entire idea of the computer. However, as Rep. Stevens states, this becomes a necessity, and the risk is worth taking for four reasons:

"First, there are certain legitimate districting criteria which may well be constitutional and which cannot be readily quantified for purely computerized, non-human evaluation."³ By this Rep. Stevens is making reference to those election districts that might be affected by various forms of regional development and planning patterns.

Secondly, "human judgment, such as contained in the subjective weights applied to conflicting criteria, can never be completely eliminated."⁴ This in essence means that no matter how man is going to redistrict he will, through no fault of his own, be subjective.

Thirdly, "a computer districting system which does not allow for the rapid interplay of human judgment, will go largely unused."⁵ Here Rep. Stevens makes use of the flexibility of his system—if changes are to be made, they can be changed instantaneously on the screen and the computer will adjust itself to these changes.

Finally, and what he considers most important, "such a

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⁴ Ibid.
⁵ Ibid.
man-machine system will for the first time allow the anti-gerrymanderers to rapidly challenge and expose the faults of districts drawn by the gerrymanderers." To this last reason Stevens adds that the computer-aided anti-gerrymanderers will have the relative advantage of being an integral part of the districting process. Mr. Stevens has named his computer system GEODATA.

Representative Stevens' theory is based on "A Procedure for Nonpartisan Districting: Development of Computer Techniques" by James B. Weaver and Sidney W. Hess.

It should now be emphasized that from the outset Stevens' plan was not to be considered a proposal. His plan was done by machines to demonstrate that it was possible to come up with districts that have some compactness and nearly equal populations. Stevens wanted to evaluate maps of new redistricting plans by computers, rather than being formulated by them. He states in the Record American, "It is a powerful tool for evaluating any districting plan and seeing how it can be improved. . . specifically to satisfy court requirements of population equality and compactness of districts." 

The population equality and compactness of districts which Stevens just referred to, plays an important part in his theory. It is generally understood that a district having a compact shape, such as a square or a circle, is more desirable than one with an elongated or snaky shape.

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6 Ibid.
7 Ibid.
For Stevens this compactness is not just a matter of geometric shape but also depends upon population distribution. The main objective of a district is to be relatively more compact, and to have a greater proportion of the population living near the center of the district. It is also more desirable not to split existing concentrations of population.

According to Stevens (and in the first instance, Weaver and Hess) if we know the population of each town and the coordinates (latitude and longitude) of its population center of an election district. With this the distance of each town from its district center can be determined, this squared and multiplied by the town's population. Taking the sum of all such products for all towns in the district, gives us what is called the district's "moment of inertia" or "Gerry Index".

With such information the computer would then be given the task of reassigning towns to districts so as to minimize the total moment or maximize compactness for a districting plan.

While the boundaries of cities and towns go unchanged, the boundaries of Congressional districts for Stevens are the primary variables. In his GEODATA system each of the twelve congressional districts outlined on the scope which is attached to the computer, is further described on a table directly underneath the map on the screen.

Columns one and two show the district's identification numbers and populations. Columns three, four and five evaluate the districts according to three criteria: population equality, contiguity, and compactness. Column three shows the deviation from the average district population.
The contiguity is shown by the letter C and NC if it is not contiguous. In column five the Gerry index, or the more technical term "moment of inertia," is given.

If it were desired, more columns could be added which the districting analyst considered to be justified and for which there was sufficient data available. For Stevens these might include average income, total property valuation, average age or other social or economic data useful in drawing planning districts. In the election districting effort, Stevens included columns showing the numbers of registered Democrats, Republicans and Independents (registered but not enrolled in either party).

An important factor which Mr. Stevens would like added in the future would be the use of transportation patterns qualitatively inserted into the computer. In explaining this to the writer he used the example of his own legislative district. It takes considerable time to reach one town in his district because of geographical and other physical obstacles. By replacing geographical distance with the time required to travel between communities, a better weighted index could be reached. Also to be added to the list of columns would be the number of Democrats, Republicans and Independents in each district.

It should be mentioned at this time that while Mr. Stevens used much of his basic procedures from "A Procedure For Nonpartisan Districting: Development of Computer Techniques," he also used the help of CROND, Inc. This is a non-profit Delaware corporation financed by a $96,000 grant from the Ford Foundation—administered through the National Municipal
League. The name is an acronym for "Computer Research on Nonpartisan Districting". Two of the five scientists with this group, James B. Weaver and Sidney W. Hess have been previously mentioned. CROND's technique considers four criteria: population equality, compactness and contiguity, and the maintenance of the integrity of certain political subdivisions.

In summarizing the GEODATA philosophy, Mr. Stevens states:

"1. An OPEN-ENDED SYSTEM to allow for the progressive development of the districting and the districting art;

2. use of COMPUTER GRAPHICS to directly facilitate communication within the districting discipline and with the outside world;

3. MAN-MACHINE INTERACTION to allow the computer to do that part of districting which is well-defined and to allow man to handle the ever-changing but always remaining ill-defined portion; and, finally

4. UNIVERSAL ACCESSIBILITY of the system so that the full weight of the democratic process might be applied to bring about districts which are more meaningful to citizens." 8

With Rep. Stevens' philosophy and with an outline of the general characteristics, we will now look into his attempt to introduce the computer and anti-gerrymandering into Massachusetts politics. It should also be noted here that Stevens is the only Independent in the House of Representatives, owing allegiance to no party and yet getting no support from any one party.

Mr. Stevens' attempt to introduce computers was put to a test on April 24, 1967, before the Congressional Redistricting Committee. The

8 Stevens, p. 6.
hearing, to say the least, was a "flop", according to The Boston Traveler, April 24, 1967, in an article written by David Hern. As he saw it that day "no incumbent congressman appeared, but some had friends in the room to listen to what was going on..." Stevens at this meeting introduced his "non-plan". It was his purpose at this meeting to show what could be done by machines in coming up with districts that have some compactness and nearly equal population. The norm which the state was using at the time, based on the 1960 census, was 429,000 persons. The non-plan that Stevens presented to the committee had a variation of only 1.08 per cent. From this meeting the only reaction was that of a cool reception from Sen. William G. Saltonstall (R-Manchester) who wanted economic, ethnic and other factors to be included. Stevens, in reply, said that careful programming for the computer can permit the use of such variables as these.

In other articles which appeared in The Quincy Patriot, The Springfield Union, The Boston Record-American and The Boston Globe, the apathy of the incumbent congressman was voiced. The apathy discussed here can probably be attributed to a similar reapportionment case six years ago. Then the possibility of an at-large election arose. This caused the congressional delegation to "push the panic button" and "jam" through the plan now under fire. ⁹

On June 21, 1967, Stevens invited the members of the Special Committee on Congressional Districting, Special Committee on Legislative Districting,

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the Joint Committee on Election Laws, the Massachusetts Congressional Delegation and members of the press to a computer demonstration of a technique for developing, evaluating and improving the election districting plans. It was to be held at the Computer Center on the campus of Massachusetts Institute of Technology.

The main demonstration was to focus attention on the current Congressional Districting Plan which, at the time, was before the Legislature. The computer displaying the plan as a map on a TV tube would evaluate it. Also at this time any modification suggested by persons attending the demonstration would be entered through a keyboard attached to the computer. Each plan or modification given would be evaluated, not only for equality of population among districts, but also for compactness. Competitiveness within the districts would also be evidenced by display of the number of enrolled Democrats, enrolled Republicans and unenrolled voters in each district.

In an article appearing in The Boston Record American on June 24, 1967, the news of the demonstration was released to the public. It disclosed that the three other proposed Massachusetts Congressional redistricting plans were more compact in population than the plan recommended by the Special Joint Committee on Redistricting. At the time, Stevens noted that the other three proposals were as good in "population equity" as the plan recommended by the legislative committee. These three plans

10 Gloria Boykin, "Robots Upset Redistricting," The Boston Record American, (June 24, 1967).
lumped together Fall River and New Bedford in a single district.\textsuperscript{11}

The plan recommended by the Special Joint Legislative Committee did not group together Fall River and New Bedford. Stevens maintained that the committee's plan could be made more compact and so demonstrated it by using his computer. One bright spot out of the committee's plan was the fact that they lowered the population deviation in the proposed districts down to one percent. The deviation before the redistricting was in some cases 12 percent.\textsuperscript{12}

In an article appearing in The Springfield Union on June 24, 1967, U.S. Rep. Silvio O. Cente's (R-Pittsfield) and U.S. Rep. Edward P. Boland's districts were compared against the proposed plan. It was shown that the old districts had a lower "Gerry Index" score figure than those proposed. The old districts were more compact than the new districts.

Two days before the demonstration a Boston radio station, WEEI came out with an editorial calling the redistricting plan "...the most objective, statesmanlike function of government this year." They continued by stating that the plan permits every incumbent a chance to retain his seat and every district retain its political make-up. In the editorial they left out one important fact—that while population equality was an easy task to accomplish, what the new plan failed to accomplish was compactness.

In answer to WEEI's editorial, Stevens criticized their fallacious praise for the new districts. In WEEI's editorial they stated that the practice of gerrymandering for the first time since Governor Gerry would finally disappear with the acceptance of the new plan now before the General Court. Mr. Stevens in his broadcast response to the editorial pointed out that the committee easily developed a set of equal districts, but, however, failed to develop a set of compact districts. The courts stated that the districts in addition to being equal in population should be compact. In Gerrymandering, the districts are non-compact, and he further states that districts which not only have noncompact shapes, will also split the natural concentrations of the population. As to giving incumbent Congressmen a fair chance to retain their seats, Stevens stated that this is possible under other plans which at the same time achieve more compact districts of equal population.

Stevens' time was slowly running out. The Congressional Districting Committee's plan to this point was referred to the Joint Rules Committee, John F. X. Davoren being House chairman on the committee.

In a letter to Mr. Davoren dated June 30, 1967, Mr. Stevens once again emphasized that while the committee had met the one percent deviation objective, no real attempt had been made to draw compact districts. In fact, the committee did not even seek the aid of the computer in meeting the objective of compactness. Mr. Stevens on many occasions offered the use of the computer to the committee.

While emphasizing the fact that the alternative plans and even the present set of districts, have been found to be more compact than the
Committee's plan, Mr. Stevens invited Davoren and the members of the committee to attend a computer demonstration at M.I.T. on the following Tuesday, July 6, 1967. At the meeting a mapping and statistical comparison of alternative plans on a TV tube connected to a computer were to be shown. Also at this meeting anyone who wished to make a modification of any plan would be able to do so.

On July 11, 1967, Stevens sent an "urgent" letter to the Rules Committee wherein he re-scheduled the demonstration for the following Thursday. It appears to the writer that a general lack of interest and apathy existed throughout the committee.

One of the reasons for this can be explained by an article appearing in The Boston Herald on July 4, 1967, which states, "The plan before the Legislature has met with the general approval of all of the state's Congressmen, none of whom appear to be worried about re-election under the proposed redistricting." Without the pressure from Congressmen the committee found no urgent need to change their present plan. If the Congressmen were satisfied, there was no reason to cause friction with them and go against their wishes. All Mr. Stevens seemed to be doing was irritating a healed wound; the committee had no real interest in the demonstration of his GEODATA system or any other alternative plan. As far as they were concerned there was no sense in stopping gerrymandering now.

In his letter to the Rules Committee Rep. Stevens explained the tremendous amount of volunteer effort which had been expended in recent months developing a visual computer technique for evaluation and improvement of districts. He offered the committee the use of the computer for several
hours to modify their own plan.

He also asked the committee to conduct public hearings on whatever districting plans came before them. Even though the hearing held earlier had light attendance, nothing concrete was available to discuss. Stevens stated in part: Now that there was a specific plan, he hoped that this would develop into a larger attendance.

On July 13, 1967, H. 4990 was on its way to being accepted. Stevens' campaign against the plan took on added haste. Time was quickly running out on him. Stevens printed an article entitled "One Gerrymander After Another" and circulated it throughout the State House. In his article Stevens warned them not to act too hastily and accept H. 4990 without proper judgment. He explained that no serious attempt had been made to draw compact districts of equal population. He urged H. 4990 to be referred to the Election Laws Committee for "rightful" public hearing.

Atty. Edmund Dinis stepped into the spotlight briefly in attempting to obtain a temporary injunction to bar the Legislature from proceeding with congressional reapportionment. His bid was refused by a three-judge panel.

For Rep. Stevens, fear was mounting, stemming from a rumor that Gov. John A. Volpe would agree to sign the leadership-backed congressional redistricting plan quickly once it reached his desk.13

In a letter dated July 20, 1967, and released to the press on July 25, Rep. Stevens urged Governor Volpe to consider certain facts

13 For a clear definition of compactness check pp. 5-6 of this paper.
before signing the bill. In the letter Stevens stated that all of the amendments to the plan were defeated. Even substitute plans, which were more compact than the one which Volpe was to examine, were defeated either by the Legislature or the committee. By use of his Gerry Index Stevens showed the difference of compactness between the committee's plan (Gerry score of 2421) and that of one done by CROND methods (Gerry score 1876). The lower the score, the more compact the district.

To show what could be done by use of a computer, Mr. Stevens drew up a map using the procedures from CROND. This plan was not a proposal of Mr. Stevens' but a demonstration of how an equally populated and compact district could be drawn.

By way of contrast, the districting plan adopted has several noncompact features. District 3 has an elongated shape. But as Rep. Stevens pointed out to the writer, it is not only the shape of District 3 that makes it noncompact. According to the 1960 Federal census, 43 percent of the people in this district live in Newton, Waltham and Watertown, which is more than twenty-seven miles from the 21 percent of the people who live in Fitchburg, Leominster and Gardner.

Rep. Stevens cited three more areas in his letter to the governor which were also a noncompact feature in the new plan. Congressmen Boland and Conte called for an exchange of towns among their districts to achieve a greater continuity of interests for each district. The new plan also split New Bedford and Fall River while the other plan rejected by the committee combined these two. A third area, the Merrimac Valley, lost its attempt to create a greater unity among the communities.
These towns are embarking on many joint economic development projects. In the letter Stevens appealed to the Governor to ask the Legislative to modify its plan to achieve greater compactness.

To Rep. Stevens' dismay, H. 2990 was passed, after first being amended in such a way as to produce even less compactness. However, as Rep. Stevens readily admits, the venture was not without benefits. Gerrymandering has long been established in most of our states. To expect that this will change overnight is being overly optimistic. In time systems like GEODATA and others will be more widely used. If one is to be optimistic, he can say that gerrymandering will someday be eliminated by the use of a computer. In an article appearing in *The Morning News*, January 16, 1968, the state of Delaware was presented as the nation's first state to be reapportioned by the use of mainly a computer. The job was done by CROND. The final product was 90 percent of a set up done by CROND, the other 10 percent consisted of changes in lines made by the legislators to accommodate the new districts to political considerations.

An ironic part of the situation is the fact that Rep. Stevens now plans to run for Congress in the 3rd Congressional District. His home in Bedford was close to the population center of gravity of the 3rd District, but the gerrymander narrowed down to a single town width when it reached Concord which borders Bedford. One of the members of the districting committee told Representative Stevens that he could have asked them to include Bedford in the 3rd District. But that would have been against his principles. Now he has moved to Concord, hopes
to win election and thus prove that "gerrymandering no longer pays and should be abandoned."
June 30, 1967

Honorable John F. X. Davoren
Speaker of the House
House of Representatives
State House
Boston, Massachusetts

Dear Mr. Speaker:

Prior to your appointing members of the Special Committee on Congressional Districting, you suggested that I sit in with the committee so that they might use my computer program to evaluate various districting plans. The only opportunity I had to meet with the committee was at their public hearing where I demonstrated that one per cent population deviation among compact districts was certainly possible. The committee is to be commended for meeting the one per cent deviation objective, but no serious attempt was made to draw compact districts. Nor did the committee seek the aid of the computer in meeting the objective of compactness.

Now that the Committee has proposed a plan to the Legislature, I have had the opportunity to use the computer to compare this plan to alternative plans—one of which the committee itself had devised earlier in its deliberations and two others which have been put forth by Representatives Koplow and Shinberg, respectively. All of the alternative plans and even the present set of districts have been found to be more compact than the Congressional Districting Committee’s plan.

Now that the Congressional Districting Committee’s plan has been referred to the Joint Rules Committee on which you serve as House Chairman, I would like to invite you and your committee to attend a computer demonstration at MIT at 10:00 A.M., next Thursday, July 6, 1967. At that time, you can see a mapping and statistical comparison of alternative plans on a TV tube which is connected to the computer.

Furthermore, you can make on-the-spot modifications of any plan and immediately see the effect on population equality, compactness, contiguity and competitiveness—the latter being indicated by the member of enrolled Democrats, enrolled Republicans and enrolled voters in each district shown. The computer can also be used to generate additional modifications which improve compactness.
After seeing the demonstration, you - or someone you designate - will be welcome to return to work at the computer for several hours. At this working session, I am sure you could come up with a modified plan which meets whatever criteria you and your committee set. Undoubtedly, such a plan could be more compact than the one presently before your committee. The courts have stated that districts should be compact as well as equal in population. Since the courts will later be offered the use of the computer in order to see that the objective of compactness has been reasonably approached, I hope that we in the Legislature will adopt a plan which is acceptable in terms of compactness as well as population equality.

Please let me know if you can attend the Thursday computer demonstration. If you cannot, please feel free to suggest another time more convenient to you.

Sincerely,
Chandler Harrison Stevens

CHS:sal
APPENDIX B

WRITTEN COMMUNICATIONS
FROM REPRESENTATIVE STEVENS
TO CONGRESSIONAL DISTRICTING OFFICIALS
TO MEMBERS OF

1) SPECIAL COMMITTEE ON CONGRESSIONAL DISTRICTING
2) SPECIAL COMMITTEE ON LEGISLATIVE DISTRICTING
3) JOINT COMMITTEE ON ELECTION LAWS
4) MASSACHUSETTS CONGRESSIONAL DELEGATION

Please pardon the haste with which I invite you to come to a computer demonstration of a technique for developing, evaluating and improving election districting plans. The first demonstration of this technique will be given Wednesday, June 21, at 10 AM at the 360 Computer Center in Building 32, Room 100 at MIT.

At that time the current Congressional Districting Plan which is now before the Legislature will be evaluated by having the computer first display the plan as a map on a TV tube. Then this plan will be compared to others which have been considered. Also, any modifications suggested by persons attending the demonstration may be entered through a keyboard attached to the computer.

Each plan or modification thereof will be evaluated not only for equality of population among districts but also for compactness. Also, competitiveness within the districts will be evidenced by display of the number of enrolled Democrats, enrolled Republicans and unenrolled voters in each district.

The computer calculates a measure of district spread (the opposite of compactness) which indicates whether the population is close to or far away from the population center of each district. Gerrymandered districts receive a high score on this spread scale which is also called the "Gerry score." Upon instruction from the computer console, I will also have the computer improve the compactness (that is, lower the Gerry score) of whatever districting plan is then being shown on the screen.

Please see me at the State House or call 275-6643 in Bedford (at any time of the day or night; I have an answering service) and leave word as to whether or not you would like to attend the Wednesday demonstration or one at another time, more convenient to you. If very many choose to join me Wednesday, I may want to arrange for more than one time to keep the groupings small, since the computer TV screen is not much bigger than the home variety. Therefore, I'd appreciate it if you would also leave your phone number when you call.

CHANDLER HARRISON STEVENS
STATE REPRESENTATIVE, 35th MIDDLESEX VISITING SOCIAL SCIENTIST, M.I.T.
Massachusetts gave birth to the Gerrymander. We should and can bury it here.

The first "Gerrymander" was a district shaped like a salamander. It is generally understood that a district having a compact shape, such as a square or a circle, is more desirable than one with an elongated or snaky shape. However, compactness (which the courts call for along with population equality and contiguity) is not just a matter of geometric shapes but also depends upon population distribution. Intuitively, a district is relatively more compact if a greater proportion of the population lives near the population center of the district. A districting plan is more compact if it tends not to split existing concentrations of population.

To see how population distribution as well as district shape affects compactness, consider the diagrams on the right.

Suppose that each district below had the same population within it, but distributed differently. Each dot represents, say ten thousand people.

1. This district is less compact than this one.

2. This district is less compact than this one.

3. This district is less compact than this one.

4. Also district 4 is more compact than district 2 (and 1), but to judge the relative compactness of districts 2 and 3, some numerical calculation such as the one described below is needed.

If we know the population of each town and the coordinates (say, latitude and longitude) of its population center, we can determine the coordinates of the population center of an election district. Then the distance of each town from its district center can be determined, then squared, and weighted (i.e., multiplied) by the town's population. The sum of all such products for all towns in the district gives us what is called the district's "moment of inertia" or "Gerry index".

Then the computer can be used to reassign towns to districts so as to minimize the total moment or maximize compactness for a districting plan.
COMPUTER DEMONSTRATION - CONGRESSIONAL DISTRICTING

Tomorrow, Thursday, 13 July 1967, a computer districting evaluation technique will be demonstrated at 10 AM at M.I.T. This demonstration will take place at the 360 Computer Center in Building 32, Room 100. See attached directions for parking.

The current Congressional Districting Plan which is now before the Legislature will be evaluated by having the computer first display the plan as a map on a TV tube. Then this plan will be compared to others which have been considered or recently put forth. Also, any modifications suggested by persons attending the demonstration may be entered through a keyboard attached to the computer.

Each plan or modification thereof will be evaluated not only for equality of population among districts but also for compactness. Also, competitiveness within the districts will be evidenced by display of the number of enrolled Democrats, enrolled Republicans and unenrolled voters in each district.

The computer calculates a measure of district spread (the opposite of compactness) which indicates whether the population is close to or far away from the population center of each district. Gerrymandered districts receive a high score on this spread scale which is also called the "Gerry index". Upon instruction from the computer console, I will also have the computer improve the compactness (that is, lower the Gerry index) of whatever districting plan is then being shown on the screen. (See attached explanation of compactness).

For further information contact:

Chandler Harrison Stevens
State Representative, 35th Middlesex
Visiting Social Scientist, M.I.T.
Phone 275-6643
Massachusetts gave birth to the Gerrymander in 1812, and in true tradition the Joint Rules Committee would have us perpetuate the breed this afternoon by adopting their amendment (creating the district pictured on the left above).

But times have changed and the courts have said that districts should be compact as well as equal in population. In the past compactness hasn't been as easy to measure as population equality. But the above district obviously doesn't even meet the eyeballing test for compactness. Furthermore now we do have a numerical measure of compactness which this morning was used in a computer evaluation of alternative districting plans.

Even without the Joint Rules Committee's gerrymandering amendment, the set of Congressional Districts in H. 4990 was shown to be less compact than any alternative plan ever put forth—and even less compact than the present Congressional districts.

To correct this situation and still treat incumbents as fairly as possible, we should not act hastily. There has been no public hearing on H. 4990. There has been no serious attempt to draw compact districts of equal population. No committee has taken advantage of the offer to use MIT's Computer for this purpose.

We should refer H. 4990 to the Election Laws Committee for its rightful public hearing.

Let's give the Gerrymander a proper burial before the courts take the matter out of our hands.

Chandler Harrison Stevens
Representative, Bedford
URGENT
Please consider at today's meeting.

Dear Rules Committee Member:

As I stated in a letter to Speaker Davoren on June 30, 1967 no attempt has yet been made to draw compact Congressional districts. If this is not done by the Legislature, then it could very well be done by the courts. For the courts have expressed interest not only in the equal population criteria (one man, one vote) but also in the compactness criteria (burying the Gerrymander).

A tremendous amount of volunteer effort has been expended in recent months in developing a visual computer technique for evaluation and improvement of districting plans. Unfortunately, your committee has not as yet had the opportunity to take advantage of this technique during the time that you have had the Congressional Districting Bill before you. For all practical purposes, the Legislature has been in recess during this period of time.

Now you have an opportunity to avoid hasty action by at least viewing a demonstration of this computer technique. The demonstration originally scheduled for last Thursday has been rescheduled for this Thursday. (See enclosed announcement of time, place and demonstration objectives.) I will be glad to reschedule this demonstration again for any time which you designate as being more convenient to your committee.

Also, I again repeat the offer previously made in the letter to Speaker Davoren that, after seeing the demonstration, your committee—or your designee(s)—will be welcome to return to work at the computer for several hours. At this working session, it is quite likely that you could come up with a modified plan which meets whatever criteria your committee sets. Undoubtedly, such a plan could be more compact than the one presently before your committee. The three alternative plans which have been brought to my attention and even the present set of districts have all been found to be more compact than the plan which is presently before your committee.
A second demonstration is scheduled for next Tuesday at 10 AM, at which time I hope to present some results of an extensive study being made of Massachusetts Congressional Districts. This study is being conducted by a group in Delaware known as CROND (Computer Research On Nonpartisan Districting), which is supported by the National Municipal League. CROND could very well develop a highly compact districting plan, but I would like to emphasize the desirability of your Rules Committee taking on this task yourselves. One of the principal advantages of my visual computer technique is that it can readily be used by the people who have the responsibility, knowledge and judgment needed to develop a plan which accounts for all relevant considerations.

Finally, I want to express my hope that your committee will conduct public hearings on whatever districting plans come before you. A great deal of concern was expressed over the light attendance shown at an earlier hearing held by the Special Committee on Congressional Districting. But there was nothing concrete to discuss at that time. Now a specific plan has been put forth which should be freely discussed since ultimately election districting is practically as fundamental as our constitution in providing the foundation of our democratic government.

Sincerely,

Harry Stevens
Dear Senator:

Before you vote on the Congressional Districting Plan which has been approved by the House, you might be interested in the following computer-aided evaluation of this and other plans.

The House-approved plan meets the criteria of (1) contiguity within each district and (2) population equality among the districts (all districts are less than 2% in population deviation from the average district population). However, the computer confirms what a quick glance at the plan suggests--this plan does not satisfy the criteria of (3) compactness.

A measure of district spread (the opposite of compactness) has been developed by a Delaware group called CROND (Computer Research On Nonpartisan Districting). This measure is discussed by James B. Weaver and Sidney W. Hess in their article "A Procedure for Nonpartisan Districting: Development of Computer Techniques", in The Yale Law Journal (Vol. 73, page 288), December 1963. Their measure of district spread, which I call the Gerry index, has been incorporated into a computer program which has been used to evaluate a number of alternative districting plans. One such plan was just prepared by the CROND group itself, at my request, when it became apparent that neither the Special Committee on Congressional Districting nor the Joint Rules Committee would accept the offer to use the MIT computer to develop a relatively compact plan.

Various congressional districting plans are listed below in order of compactness (most compact to least compact) as measured by the Gerry Index.

**MOST COMPACT PLAN**

1. CROND Plan - not officially recommended
   (will be shown for the first time at tomorrow's demonstration--see below)  
   
   **Gerry Index**  
   1855
2. Congressional Districting Committee's Intermediate Plan
   (developed by the committee, but set aside at the last minute, even though this plan kept incumbents in separate districts) 2198

3. Representative Koplow's Regional-Planning-Oriented Plan
   (Presented to the districting committee, midway in their deliberations) 2207

4. Representative Shinberg's "Improved Plan"
   (based on committee's plan in 6 below, but recombinining splits in major metropolitan centers such as New Bedford-Fall River) Rejected by House. 2209

5. Present Congressional Districts 2373

6. Congressional Districting Committee's Final Plan 2413

7. House Approved Plan (including Rules Committee amendment) 2421

LEAST COMPACT PLAN

If you would like to see a statistical and mapping comparison of these plans on a computer-driven display screen, you are welcome to attend a demonstration at 10 AM, tomorrow, Tuesday, July 18 at MIT in Room 100 of Building 32. See the enclosed map for traveling and parking directions.

Only the Senate or the Governor could now divert the Legislature from adopting a plan that is so obviously gerrymandered that it could be rejected by the courts.

Sincerely,

Harry Stevens
The Governor of Massachusetts
House of Representatives
State House, Boston

July 20, 1967

Dear Governor Volpe:

Before you decide whether or not to sign the Congressional Districting Bill passed by the Legislature, you might want to consider certain facts which were uncovered in the course of computer evaluation of this and other plans.

It was found that every one of the several amendments defeated during the course of legislative debate would have produced more compact districts than in the plan which is now before you. Also, every one of the substitute plans which were turned down either during legislative debate or by the districting committee were considerably more compact than the plan now on your desk.

This has been publicly demonstrated several times on an MIT computer which measures compactness in a manner which is outlined on the enclosed sheet. Poor compactness was registered by a high score on what was called the "Gerry index." The least compact plan (the one now before you) received a Gerry score of 2421; the most compact plan (prepared by a Delaware group known as Computer Research On Nonpartisan Districting) received a Gerry score of 1876. The Gerry score of the plan now on your desk deviated from that of the most compact plan (CROND) by an amount that was 64% greater than the deviation of three relatively compact plans—one proposed by Representative Shinberg, one by former Representative Koplov, and one developed by the districting committee itself before it turned to the present gerrymandered plan.

To quote Edgar Mills of the Christian Science Monitor: "There is little dispute that the present plan is basically designed to preserve the status of the incumbent seven Democratic and five Republican congressmen...." The gerrymandering became even more obvious when the Joint Rules Committee offered a successful amendment that produced the odd shape for District 3 (pictured on the enclosed sheet). One of the least compact features of the pending plan is shown there where the top half of Congressman Philbin's old C-shaped district is largely preserved, but then is extended in gerrymander fashion through a neck of Concord and Lincoln to the gerrymander's head, which consists of Waltham, Watertown, Newton, and Weston.
It is not just the shape of District 3 that makes it noncompact. According to the 1960 federal census, forty-three percent of the people in this district live in Newton, Waltham, and Watertown, which is more than twenty-seven miles from the twenty-one percent of the people who live in Fitchburg, Leominster, and Gardner.

District 3 is not the only gerrymander or noncompact feature of the pending plan. The Legislature ignored arguments advanced by Congressmen Boland and Conte calling for an exchange of towns among their districts to achieve a greater community of interests for each district. While all of the rejected plans combine New Bedford and Fall River which have many interests in common, the plan pending splits those twin cities apart. Also, that plan makes no attempt to create greater unity among the communities of the Merrimac Valley, which are embarking on many joint economic development projects.

I am not advocating any particular plan or any particular modification. All I am suggesting is that some modest amount of attention should be given to compactness. All of the alternative districting plans mentioned above achieved the same one percent maximum population deviation and therefore meet the equal population criteria set down by the courts. However, the plan presently on your desk is the only plan which has been shown to be less compact than the present Congressional districts (which receive a Gerry score of 2373).

Now that the Legislature has acted, only you as Governor, or the courts, can ask the Legislature to modify its plan to achieve greater compactness. Up until now, it has been quite discouraging that legislative leaders of both parties have been working towards maintaining a "division of the spoils," rather than towards compact districts, with which an alienated citizenry can better identify.

As you know, Massachusetts must during 1967 redistrict the General Court and the Governor's Council as well as these Congressional seats. You have before you an unusual opportunity to halt this politically corrupt practice of gerrymandering begun under your predecessor, Governor Corry.

Sincerely,
APPENDIX C

NEWS MEDIA REPORTS ON
THE COMPUTER AND
MASSACHUSETTS CONGRESSIONAL DISTRICTING
GERRYMANDERING ON WAY OUT

State May Be Redistricted by Brainy Computer

By Gloria Boykin

Don't be surprised if computers are used in Massachusetts congressional redistricting and in the next State legislative reapportionment as well. They can insure population equality and compactness in the state's 12 congressional districts.

And they can be used to bury, for good, the political gerrymandering born 153 years ago in this state.

An order for a special commission to redistrict the Legislature is in time for the 1968 election is due to be submitted to the House and Senate Tuesday. This group would be completely separate from the 21-member commission named earlier this week to re-draw the lines of congressional districts.

The Legislature, uniquely, has a computer expert in its own ranks. Rep. Chandler (Harry) Stevens of Bedford, will make available, for redistricting purposes, his knowledge as a computer analyst.

Stevens, 32, recently earned a Ph.D. in economics at the Massachusetts Institute of Technology. MIT has the facilities to make an evaluation of a redistricting plan.

“We have a computer program at MIT that will evaluate any plan in terms of compactness and population equality,” he said. If given the data, the computer also can evaluate other characteristics - social, economic and political.

Stevens was interested in computerized apportionment long before a three-judge federal panel ruled in February that Massachusetts' present congressional districts do not conform to the one-man, one-vote edict of the U.S. Supreme Court, and must be redrawn.

Although he was not named to the 21-member Joint Legislative Committee assigned on Thursday to formulate a new plan, Stevens told the Record American that House Speaker John F. X. Davoren is interested in the possibility of using a computer to aid in redistricting.

“The speaker told me he thinks it would be a good idea if these computer techniques are available to the Committee on Redistricting,” Stevens said. “He wants me to sit in with the committee so they will have easier access to the techniques.”

Stevens, who prides himself on the fact that as an independent he owes allegiance to no party, said, “Ultimately, I want to see fair districts drawn, I'd like to see 1967 go down as the year Massachusetts laid aside the practice of gerrymandering in drawing congressional and legislative districts.”

He said he hoped the redistricting

Turn to Page 19, Col. 1

Continued from Page 5

redistricting committee would be receptive to his ideas and added, “I hope this concept of fairness will dominate partisan motives.”

An associate of the National Municipal League, William Boyd, predicted that 50 years from now computers will do all redistricting. He said the League believes a majority of states will eventually take redistricting out of the hands of legislatures and turn it over to special commissions.

Already several states have experimented with the use of computers and have included part of the results in redistricting plans. Some states have even gone so far as to have computers actually prepare a whole redistricting map, although it was not completely accepted.

Stevens hopes to see the map here evaluated by a computer, rather than formulated by the machine.

“You can build up false expectations,” he said, “Too often one sees a computer as some mystical thing sitting in a corner, but it is not.

“It is a powerful tool for evaluating any districting plan and seeing how it can be improved,” he said, "specifically to satisfy court requirements of population equality and compactness of districts.

He said New York was an example where false expectations developed. "There was a lot of talk, but not too much evidence of results.

"More recently, in Iowa, a Legislative committee has received from an Iowa professor a presentation of computer districting evaluations," he said.

In Connecticut, he said a federal court is considering the advisability of using computers to evaluate district plans.
Redistricting Hearing Flops

BY DAVID HERN

Dr. Chandler Stevens, the independent representative from Bedford, today gave the Congressional Redistricting committee a lecture on computers and a "non-plan" prepared by the MIT computer last night.

The sole objective was to show how modern computers can come up quickly with answers and how the committee might utilize them. In doing this, Stevens saved the day for the committee, which despite its political weight, hadn't been able to keep the public hearing alive.

No incumbent congressman appeared, but some had friends in the room to listen to what was going on. None of these spoke publicly. Three times Sen. George V. Kenneally (D-Dorchester), chairman, had to declare a recess because there were no witnesses. It was obviously embarrassing because there were seven television cameras, with sound attachments, were ready to roll and needed the action.

Another embarrassment was that a substantial proportion of the 21-member committee showed up for this public session. There weren't enough seats for the members.

The issue is quite simple. The federal court has declared the present congressional district plan as improper and has ordered the Legislature to draw a new plan forthwith. If it isn't done by proproration this year, the federal court will assume the task. The state is directed to establish 12 districts as nearly equal in population (based on the 1960 census) as possible.

Rep. Stevens explained how this could be done. A second termer in the General Court, Stevens received a doctor's degree in economics from M.I.T. in January and lectures at Brandeis University. His specialty in computers although he was in the field before entering Legislature and follows them closely.

Stevens emphasized that the "plan" he brought to the hearing was "intermediate" in nature and wasn't to be considered a redistricting proposal. It was done by the machines to demonstrate that it was possible to come up with districts that have some compactness and nearly equal populations.

The "norm" at present is 420,000 persons to a district and the "non-plan" of Stevens offers a variation in the extremes of only 1.08 percent.

Sen. William G. Saltonstall (R-Manchester) reacted somewhat cooly to the computer discussion. "There were numbers out of all the people," he said. Stevens replied that he didn't do this anymore than a committee would be doing in promulgating a plan.

Saltonstall mentioned economic, ethnic and other interests he feels should be weighted in devising political districts. Stevens said careful programming for the computer can fed into the machine this data which is available to the committee and solutions can be suggested.

He said the political science department at MIT has offered limited time for this work if the redistricting committee wants to use it. Sen. Kenneally said other computer centers also have volunteered assistance.

Bristol County Dist. Atty. Edmund Dinis of

Computer Map

Record American

May Aid State Redistrict Plan

(BY GLORIA BOYKIN) — A computer-produced map designed to redistrict Massachusetts' 12 Congressional areas with a maximum population deviation of only 1.08 percent compared with the present 12.4 percent was introduced yesterday during a hearing at the State House.

Rep. Chandler Stevens of Bedford, a computer analyst and the only independent in the Legislature, told the Special Committee on Congressional Redistricting that computers can play a major role in solving the problem.

The computer expert emphasized that his map was not a redistricting proposal but it was compiled to give the committee members an idea of what computers can do in helping solve the controversial reapportionment problem.


could also be seen.

Dist. Atty. Edmund Dinis of Bristol County, who filed the original petition which resulted in the federal court declaring the Massachusetts Congressional District unconstitutional, proposed to the committee that Taunton, Fall River and New Bedford be included in one Congressional district and that social and economic interests should be considered.

A verbal tug of war erupted at the hearing attended by only 29 persons when Rep. Dave Vigens (D-Springfield) declared, "I feel that redistricting is a major issue, and I think we should work out a compromise with the Governor as soon as possible."

Sen. George Kenneally, Jr. (D-Dorchester) the chairman, interrupted with, "You are assuming that a compromise is needed. I think the problem we face is coming up with a decision acceptable to the court."

Kenneally said Monday's hearing probably would be the only public session held by the committee. Three recesses were called during the hearing for lack of witnesses.

Members of the Massachusetts Congressional delegation whose future may be determined by the redistricting were conspicuous by their absence. Sen. Kenneally said that all had been notified about the first public hearing on reapportionment.
COMPUTER-AIDED GOVERNMENT

It was Massachusetts which invented the gerrymander (the dictionary still uses a classic picture of an 1812 Massachusetts district to illustrate the definition). The Commonwealth now has a chance to be the first to do away with gerrymandered districts with the help of a computer. If so, much of the credit will go to Dr. Chandler H. Stevens, a state representative and visiting social scientist in the Center for International Studies.

In the Computation Center MITey Mouse appears on the display scope announcing that the computer is ready to go to work. A second later a map of Massachusetts comes on with lines depicting the present twelve congressional districts. With further programming, the computer could graphically display any number of ways to achieve redistricting in accordance with the Supreme Court’s directives. But, though it cannot yet show redistricting possibilities, the written program allows the computer to evaluate many factors leading to districts equal in population and compact as well. This could be a major factor in preserving cooperative regional planning. New Bedford and Fall River, for example, share common problems, but are now in two different congressional districts.

Dr. Stevens takes naturally to applying data processing techniques to governmental problems since he was a computer specialist before becoming interested in politics and government. A graduate of Georgia Tech, he has been studying part-time at MIT since 1960, and just recently received his Ph.D. degree in economics. He’s been practicing his trade for five years, first as a selectman in Bedford, where he lives, and since 1964 in the Massachusetts legislature. Campaigning as an independent, Dr. Stevens was the first to win a seat in more than 50 years. He is also one of the representatives most accessible to his constituents. He carries a radio receiver to alert him instantly when someone wants to get in touch with him. Being a computer-man, he calls this "time-shared communication" and prefers it to the more usual "batch process" method.
Computer to Test Plan on Redistricting

By JIM SLEDD
Standard-Times Boston Bureau
BOSTON — Legislators in both parties have praised as “fair” the proposed congressional districts in Massachusetts, but today an M.I.T. computer will take an electronically impersonal look at the plan to see just how fair it is.

The sophisticated machine will disclose the “Gerry Score” of each of the 12 proposed districts. That’s short for Gerrymander — which in the political lexicon means the manipulation of voting district to favor a particular party or individual and is a term named for a Massachusetts politician.

Offers Know-How

Offers Know-How

The computer session is being sponsored, appropriately enough, by the only member of the Massachusetts House who belongs to neither the Democratic or Republican parties, Rep. Chandler Harrison an independent from Bedford.

Stevens also is a computer expert and a visiting social scientist at M.I.T. He offered his technical know-how and the use of the non-partisan computer to the legislature’s special redistricting committee during its four-month deliberations but was politely ignored.

Stevens’ interest is in proving the effectiveness of his method of redistricting, whereby a computer console is tied into a television screen displaying a map of the state. An ingenious feature of the setup is that the screen will accept “instruction” from an electronic pointer, making it possible to move district boundaries around at will — while the computer notes consequent shifts in population and other pertinent data.

“Each plan or modification will be evaluated not only for compactness,” Stevens notes. “Competitiveness” within districts, a prime consideration, will be shown by tabulations of the number of enrolled Democrats, Republicans and Independents in each district.

Stevens plans to evaluate the plan submitted to the legislature last week by a majority of the special committee and also to flash on the screen alternate plans, such as the proposal by Bristol County members on the committee to unite New Bedford and Fall River into a single district.

Matter of Opinion

Matter of Opinion

Compactness should be an essential feature of the new districts, Stevens believes, as well as an adherence to the population balance necessary to conform to court-ordered “one man—one vote” edicts. But compactness can be a matter of opinion and is not necessarily indicated by a tidy geographical appearance, according to the computer-minded Stevens.

“The computer calculates a measure of district spread — the opposite of compactness — which indicates whether the population is close to or far away from the population center of each district,” he said.

Gerrymandered districts thus receive a high score on this spread scale which is also called the Gerry Score.”

He said that he can “instruct” the computer to improve compactness of any proposed district.

Stevens has invited members of the congressional redistricting committee to attend his demonstration.

Also invited are members of the Joint Committee on Election Laws, which will soon hold hearings on the redistricting committee’s plan, and the special committee on legislative reapportionment, which is currently engaged in a similar effort to realign the state’s 240 House seats.

Congressmen from Massachusetts have also been invited, since they will have an interest in their district’s “Gerry Score.”
Computer Put to Work On Congressional Redistricting Question

By RUSSELL M. KEITH

BOSTON—A computer is as good as its programming and that is exactly how useful it can be in redistricting matters.

Newsmen were invited to see one check out present and proposed congressional districts Friday.

One result is that this reporter is programmed with a great deal of awe for the machine, but not yet programmed to cheer without reservation for it.

Stevens' Idea

Extending the invitation to see the scope on which a map of Massachusetts is projected and districts for 32 members of Congress outlined in numbers for each of the two districts, in the edge communities was Rep. Chandler H. Stevens of Bedford, Independent, of Bedford.

The 760 computer at Massachusetts Institute of Technology has been programmed to show population count, whether districts are contiguous, and by Rep. Stevens' definition, compact.

For the compactness element or "moment of inertia" or "Gerry index." Rep. Stevens explained that population centers are established for each district. Then, the squares of the distances from the population center of each district to city or town and these results are totaled for each district, then for all the districts. This gives a Gerry index to each redistricting proposal.

Stevens' field of vision is the same as the machine's, but without reservation for it.

Says compactness is serious question. Compactness also has a visual aspect. For instance, by the computerized Gerry index, the huge C-shaped present district of U. S. Rep. Philip J. Philbin, D-Clinton, has a lower or better number than does the proposed new district for him which is only north of and not all around Worcester, although the proposed new district runs all the way east to Newton.

Using a square of distance times population produces this sort of result. The use and value of what the computer puts out is dependent upon what goes into it.

Rep. Stevens, using the new redistricting proposal in the computer, obtains a 0.254 etc., moment of inertia or Gerry index for the district of U. S. Rep. Silvio O. Conte, R-Pittsfield; a 0.225 etc., Gerry index of the district of U. S. Rep. Edward P. Boland, D-Springfield; and a Gerry index for the whole plan of 0.24132 etc.,

Figures Change

If, as Reps. Boland and Conte suggest, Boland takes back West Springfield and Agawam from Conte and gives Conte South Hadley, Granby, Belchertown and Ware, the Conte district Gerry index becomes 0.066 etc., and the Boland Gerry index, 0.2355 etc. The Gerry index for the entire plan becomes 0.24051 etc.

Only thing about that is that the deviation from the normal sized district in population which is proposed to be no more than 1.65 per cent becomes 1.8 per cent in the Conte district and 1.72 in the Boland district. So, Rep. Stevens put still another switch into the computer, moving Palmer into the Conte district from the Boland district.

It took the computer six seconds and some 12 pages, each about 12 inches by 18 inches printed in the present to show all the districts, their perimeters, contiguity, population deviations, and "moments of inertia." At the same time, the results, below the map of the state appeared on the television screen like scope.

Population Deviation

They showed a Conte district Gerry index of 0.231 etc., and population deviation of 0.81 per cent and a Boland district with a Gerry index of 0.208 etc. and a population deviation of minus 0.89 per cent. That gave a redistricting plan with a total Gerry index of 2.434 etc. A better population deviation gives a worse Gerry index.

By way of comparison, the present Conte district has a population deviation of minus 0.86 per cent and a Gerry index of 0.513 etc. The Boland district has a population deviation of minus 9.46 per cent and a Gerry index of 0.570 etc. The maximum population deviation of the current districts is Conte's. The total Gerry index is 2.729.

MIT COMPUTER SCANS PLANS

Robot Upsets Redistricting

An MIT computer found Friday that three other proposed Massachusetts congressional redistricting plans were more compact in population than the plan recommended by the Special Joint Legislative Committee on Redistricting.

Rep. Chandler H. Stevens of Bedford, the only Independent in the Legislature, and a computer analyst at MIT, also revealed that the "electronic brain" noted the other three proposals as well as in "population equity" as the plan recommended by the legislative committee. All three plans jump together Fall River and New Bedford in a single district. The committee's recommended plan does not.

At a computer demonstration at MIT, Rep. Stevens also contended that the committee's plan is not any more compact than the current congressional districts.

Stevens indicated that before the congressional redistricting, which has been ordered by the Federal Court, has been completed, he may come up with a plan devised by the brain of the computer.

The four proposals evaluated by the computer were the committee's proposal, the plan of Rep. Aaron Shinberg (D-Haverhill), that of Rep. Freyd Koplow (R-Brookline) and an alternative plan considered by the special legislative committee.

BOSTON—Rep. Stevens maintains that the committee's plan can be made more compact and demonstrated this with the computer. He commended the committee, however, for getting the population deviation in proposed districts down to one percent. The present deviation is some 12 percent.

In combining Fall River and New Bedford the other three plans fall in line with the aims of Dist. Atty. Edmund Dinis of
GERRY IS GONE

A few months back, WEEI editorialized on the subject of re-drawing our state's congressional districts. We admit now that we were quite gloomy. The prospects for a fair and equitable division of voters seemed notably dim at the time. Today we are happy to eat a few words—the whole editorial, if you like. For what is far more important than our minor embarrassment is the acknowledgment of the most objective, statesmanlike function of government this year.

The ghost of Governor Elbridge Gerry, who invented the Gerrymander back in 1812, must be loping through the cemeteries of the North Shore this week, thanks to the 21-man bipartisan committee which accomplished this difficult task. The result of their work is that every incumbent has a fair chance to retain his seat, and every district retains its essential political complexion.

As you might expect, not everyone is happy with the results. Congresswoman Margaret Heckler and Congressman Hastings Keith find themselves in nearly as much peril from a strong Republican contender in the primary as from a Democrat in the election. But neither faces the stone wall that would have been erected in favor of a Democrat if Fall River and New Bedford had been put into the same division. Congressman Philip J. Philbin's new district may produce trouble for him from candidates of both parties. But with 12 terms behind him, and seniority on the House Armed Services Committee, Congressman Philbin can survive either fight if he puts both fists into his campaign.

The whole process of re-districting seems to WEEI to be an example of the strength of the two-party system, in contrast to some of its weaknesses. There were 16 Democrats and five Republicans on the committee, and they worked under the threatening gun of the courts dividing the state if they didn't do it well. Before the division there was a spread of 102,962 voters between the largest Bay State district and the smallest. The difference between the largest and smallest has now been cut down to 8717 voters. That comparison testifies to the effectiveness with which the committee did its job.

A minor irony of the work is that Bristol County District Attorney Edmund Dinis, whose federal court re-apportionment suit caused the new division, did not benefit politically. If New Bedford and Fall River had been put into the same package, he would have been the logical Democrat to win.

WEEI hopes the General Court will accept the new divisions. If it does, we are prepared to announce that we are broadcasting in the most fairly-apportioned state in the union.

WEEI editorials express the views of the station's management on matters of interest to the community we serve. WEEI welcomes an exchange of opinion on important issues and will give responsible spokesmen for opposing viewpoints an opportunity to be heard. We welcome your comments on these and other WEEI editorials.
WEEI is correct in stating that the congressional districting plan which is now before the legislature has met the one-man one-vote criteria in that the twelve districts are within one per cent of being equal in population. However, WEEI’s editorial has given the mistaken impression that this means that the obnoxious practice of gerrymandering has been abandoned. The gerrymander is still with us, but like the chameleon, it has changed its color to better blend into its new court-imposed environment.

The districting committee should be commended for meeting the one per cent deviation objective which can, however, be achieved a great number of ways. At the districting committee’s public hearing, I explained that with the aid of a computer, the committee could also easily develop a set of compact districts. The courts have said that districts should be compact as well as equal in population. We must keep in mind that gerrymandering has nothing to do with population equality. In 1812, the gerrymander was born in Massachusetts when Governor Gerry’s party drew an election district shaped like a salamander. Gerrymandered districts are non-compact districts—districts which not only have sprawling shapes, but also which split natural concentrations of population.

I have developed a computer program which can be used to evaluate quickly any districting plan in terms of compactness as well as population equality, contiguity, and political competitiveness—the latter being an indication of the number of Democrats, Republicans, and Independents in each district. This program, which displays its results visually on a TV tube, has clearly demonstrated that the congressional districting plan now before the legislature is not compact. Much greater compactness and even greater population equality is found in proposed plans put forth by Representative Koplow and Representative Shinberg, and in an intermediate plan which the committee developed, but then put aside when other practical considerations arose. It is interesting to note that in most of these alternative plans, each incumbent Congressman has “a fair chance to retain his seat”—which WEEI and some others seem to favor. It is possible to give incumbents a fair break and at the same time achieve more compact districts of equal population.

Thus far no serious attempt has been made to meet the court’s criteria of compactness. Contrary to WEEI’s editorial, the ghost of Elbridge Gerry is still with us. Political agreement among the party chieftains is not enough. When are we going to try to draw compact districts with which an alienated citizenry can better identify? With redistricting efforts underway for the elected offices of Congress, the state legislature and the Governor’s Council, Massachusetts has an excellent opportunity to dig the grave for that monster it brought into the political world in 1812. Let’s really bury the gerrymander!

R-67-13
Stevens Would Show Redistricting by Computer

By Loring Swain, Jr.

STATE HOUSE — Bedford's Representative Chandler Stevens hopes that Massachusetts — the state which gave the nation the "gerrymander" — will now become the state which effectively "buries that concept forever."

Rep. Stevens has invited the Special Committee on Congressional Districting to be his guest on Thursday before a high-powered computer at MIT.

The idea is to demonstrate to the committee the feasibility of developing a completely impersonal and unpolitical redistricting plan which meets all the criteria now being called for by the courts.

Stevens extended his invitation to House Speaker John F. X. Davoren over the weekend and made it public this morning.

The Bedford Independent says the computer can demonstrate a district which is "compact" far better than any of the plans put forward by the special committee.

In fact, he claims the present districts are better than the ones designed by the committee — in terms of compactness.

The newly designed districts, revealed last week by the committee, do very well as far as population deviation, he said.

Stevens worked with computers which would draw district lines on the basis of compactness, he said. The Thursday showing will reveal uniformity in relation to the optimum closeness to centers of population in the districts drawn.

"THE STATE which gave birth to the 'Gerrymander' could now well become the state to dig the grave of that term and technique," Stevens told the Sun.

This can best be done, he said, through reference to impartial computers which would put forward plans to the computer, and the computer to set up the new districts for the state's 12 congressional districts are more compact than the new districts proposed by a special legislative redistricting committee.

Stevens, in a letter to House Speaker Davoren, said that if a computer were used in the drawing of the lines, the districts could be made compact as well as proportional in population.

The legislature was recently ordered by a Federal court to redraw the congressional districts to make them more nearly equal in population.

Stevens invited Davoren and the members of the legislature's Joint Rules Committee, which is now considering the proposed redistricting plan, to attend a computer demonstration at MIT Thursday at 10 a.m.

The use of the computer, Stevens said, would allow "on-the-spot modifications" of the proposed plan and two alternative plans that individual legislators have recommended.

In Essex county which, to newsmen, had the appearance of a salamander. It was designed, he said, to help a particular candidate win election. The nation was thus introduced to the newsmen's term, the gerrymander.

In a telephone interview this morning, Stevens said that back in 1812, a Gov. Gerry of Massachusetts arranged for the formation of a voting district
A Computer? Never!

By TIM TAYLOR

If a computer can be used to make dates and match mates, why can't it be used to carve up the Commonwealth into neat and compact Congressional districts?

It could—as Rep. Chandler H. Stevens of Bedford demonstrated to a few Rules Committee members at MIT Thursday morning.

But it won't—as legislative leaders of both parties indicated quite clearly Thursday afternoon.

Because the men who have accumulated vast stores of personal political savvy aren't about to surrender any of their hard-won prerogatives to any such upstart gadget as a computer.

"There's something about the smell of sweat and cigar smoke, and the sight of baskets full of crumpled scratch paper and gnarled pencils which lends human authority to a redistricting plan worked out the hard way by a half-dozen politically sensitive public servants.

"How could you possibly expect a computer to appreciate the political implications of its actions?" a moss-covered political observer asked.

Rep. Stevens, the Legislature's lone Independent, contends that one of the computer's main assets is that it doesn't care about "political implications," that it is simply an impartial tool which is fed facts and spews forth facts.

A button-down-collar suburbanite, Rep. Stevens is a graduate of Georgia Tech, a holder of a PhD in Economics from MIT and a veteran of three years work on computers in the Pentagon.

To him, there's nothing particularly mystifying about a computer-drawn or computer rated redistricting plan.

"We feed data such as registration and population statistics, center-of-population information and the like into the machine, together with a formula to judge 'compactness' of districts, and then the computer makes its calculations," he points out.

Stevens pressed several keys on a typewriter-like console, and the computer whirred and winked and flashed a picture of the state's congressional districts on a small television screen.

By either typing in new information or using a light pen to re-draw district lines, Stevens demonstrated how the computer could instantaneously calculate the effect on "compactness, contiguity and equality" of any switch of cities or towns from district to district.

The computer, he said, had determined that while each of the several redistricting plans prior to Thursday's House action met the tests of contiguity and population equality, they failed in compactness.

They were so far from being compact, he said, that they were actually "more gerrymandered" than the present set of congressional districts.

The test of compactness (population density centered in the middle of a district) was made by the computer along guidelines spelled out by a mathematical formula balancing distance and population.

"The 'Gerry' factor, or the degree of compactness, is similar to a mathematical figure known as the 'moment of inertia,'" Stevens explained to his audience in the air-conditioned home of MIT's "360" computer.

"Moment of inertia?" someone asked. "I didn't realize you were talking about the Legislature. And if you are, it's not 'moment,' it's months."

Lawmen's observations aside, Stevens is sure that computer-aided redistricting could be done faster, fairer and more accurately than is presently possible.

And while the House has already passed and sent to the Senate a redistricting plan, Stevens will meet Saturday with a group of Delaware scientists who will unveil a completely-computer-devised plan for realigning Massachusetts U.S. House seats.

Stevens doesn't really expect that anyone on Beacon Hill will pay any attention to the plan.

But if they don't—and they probably won't—he is considering an appeal to the U.S. District Court panel which ordered the redistricting to throw out the plan because it fails the test of "compactness."

"The day is coming," Stevens said, "when a plan will be put forth for redistricting the entire Congress on a nonpartisan, computer-determined basis."

Massachusetts could be in the forefront of such an electronic revolution.

Some suspect that the computer would be more acceptable to the "old pros" if they were allowed to rub its shiny outsides with under-arm sweat and maybe blow some stale cigar smoke into its innards.
A special committee of the Massachusetts Legislature has proposed these 12 new congressional districts to conform to the United States Supreme Court's 'one-man one-vote' districts. The plan is subject to approval by the Legislature as well as a three-judge federal district court panel which ordered the reapportionment on the ground that the present districts vary too far above and below the ideal population of 429,048 per district.
Two Republican incumbents, Mrs. Margaret M. Heckler, Republican freshman member in the 10th District, and veteran Rep. Hastings Keith in the 12th District, are in that category. Mrs. Heckler would lose Newton from her district. It was Newton which gave Mrs. Heckler most of her winning margin in 1966.

Mr. Keith loses some Republican towns and picks up Weymouth, which elects two Democrats to State House of representatives.

In addition, Rep. F. Bradford Morse (R), 5th District, finds the Democrats strengthened in his area by the various changes proposed. He loses heavily Republican Melrose, Winchester, Lynnfield, and Stoneham, while picking up Democratic Methuen among the changes in his district. However, Mr. Morse is regarded as a sure thing for reelection.

The proposed districts would go into effect for the 1968 election. Another reapportionment would be required after the 1970 federal census for the 1972 election.

Congressman Philbin's district is heavily altered. As the result of a GOP-fashioned gerrymander many years ago, the present district is C-shaped and runs from the New Hampshire to Connecticut borders, circling around the 4th District in central Massachusetts.

The proposed new district would stretch from north-central Massachusetts into Newton in Metropolitan Boston.

Challenge possible

Rep. Sidney Q. Curtiss (R) of Sheffield, House minority leader and a GOP member of the special committee, regards the district as still Democratic. Observers believe, however, that Mr. Philbin might well face a serious challenge in the Democratic primaries. In addition, there is some feeling that a strong Republican could give Mr. Philbin a good run in the proposed new district.

Because of the necessity of adding population to the two western districts, the 1st and 2d, Mr. Philbin lost 36 communities to surrounding districts.

His communities in the southern part of his district were divided between the 2d and 4th Districts, where Rep. Edward P. Boland (D) is the incumbent, and the 4th District, in which the incumbent is Rep. Harold D. Donohue (D). Most of these communities are Democratic. Thus the Boland and Donohue districts are given added Democratic strength.

Political alterations

The new Donohue district would stretch down to the Connecticut border and would become a truly central Massachusetts district. Previously it ran into the metropolitan area to include Watertown and Waltham, which would be shifted to the proposed new Philbin district.

On the basis of the proposed revamping, both Democratic and Republican members of the reapportionment committee expressed belief that the incumbents would gain reelection. But some may be pressed harder than in the past because of the changes.
lenge Congresswoman Heckler in the GOP primary. By taking Newton out of her district and adding seven towns to it, several in the southern or "Parker" area of the district, the committee has made the district more attractive to Senator Parker.

For many years Senator Parker wanted to run for the seat but would not do so while Rep. Joseph W. Martin Jr. (R) remained the incumbent. In 1966 Mrs. Heckler jumped in against Mr. Martin and defeated him in the GOP primary.

But most important to both Mrs. Heckler and Congressman Keith is the fact that the special reapportionment committee decided against placing Democratic Fall River and New Bedford in the same district. Fall River remains in the Heckler district and New Bedford in the 12th.

This decision is certain to be fought by Edmund Dinis, Bristol County District Attorney, who filed the suit which forced the reapportionment at this time. Mr. Dinis has demanded that Fall River, New Bedford, and Taunton be placed in the same district because of kindred economic interests. If such a district were formed, he undoubtedly would be a candidate.
The Joint Committee on Rules of the Massachusetts Legislature has revamped slightly a proposed reapportionment of the state's 12 congressional districts recommended by a special legislative committee. The changes were made to placate Rep. Philip J. Philbin (D), whose existing third district would be radically altered under the redistricting plan. The Rules Committee recommended giving back to Mr. Philbin the Democratic community of Marlboro, which had been included in the fourth district, shifting Winchendon back to the third district from the first district where it had been placed under the special committee's plan, and returning Westford from the fifth to the third district.
By Edgar M. Mills
New England political editor of
The Christian Science Monitor
Boston

Full power of the Massachusetts Democratic and Republican leadership is being thrown behind a revamped congressional reapportionment plan.

The proposed revamping of the 12 congressional districts has just emerged from the Joint Committee on Rules. It is a slightly revised version of a plan fashioned by a special legislative committee.

Democratic and Republican leaders are agreed on a program to push the measure swiftly through both houses.

Meanwhile, a suit has been filed in the Federal District Court at Boston urging a three-judge panel to block any congressional reapportionment by the current Legislature on the ground that the General Court itself is malapportioned and therefore unconstitutional in makeup.

The suit was filed by Edmund Dinis, Bristol County District Attorney. It was Mr. Dinis who filed another suit which resulted in a three-judge federal court panel's order to the Legislature to reapportion the congressional districts immediately because, the current districts violate the one-man, one-vote edict of the United States Supreme Court.

Community interests

Sen. Maurice A. Donahue (D) of Holyoke, President of the Massachusetts Senate; Rep. John F. X. Davoren (D) of Milford, Speaker of the House; Sen. John F. Parker (R) of Taunton, Senate Minority Leader; and Rep. Sidney Q. Curtiss (R) of Sheffield, House Minority Leader, expressed agreement that the court would rule against the latest Dinis bid.

Their contention is that the panel which ordered the Legislature to reapportion the congressional districts is not likely now to rule that the Legislature cannot undertake the task.

Behind the Dinis move is a desire by the district attorney to run for Congress himself. But he has made it clear that he wants a southeastern Massachusetts district in which the two heavily Democratic cities of New Bedford and Fall River are combined. Now they are separated, with Fall River in the 10th district and New Bedford in the 12th district.

The 10th and 12th district seats are occupied by Republicans, Mrs. Margaret M. Heckler of Wellesley and Hastings Keith of West Bridgewater respectively.

Mr. Dinis contends that any fair and equitable apportionment must place New Bedford and Fall River in the same congressional district because of their community interests.

He admitted that had the apportionment plan under consideration placed the two cities in the same district he "probably would not" have filed the latest suit.

Federal standards

Mr. Dinis said that if the court upholds his suit it might order the Legislature to suspend business and order the holding of a popularly elected constitutional convention to rewrite the apportionment provisions as far as apportionment of state legislative districts is concerned. Mr. Dinis contends that present provisions of the state constitution make it impossible to comply with the United States Supreme Court's one-man, one-vote orders.

But legislative leaders insist that the court will uphold the pending reapportionment plan as complying with the standards set by the federal court for apportionment on the basis of one-man, one-vote.

The proposed districts vary only infinitesimally from the ideal norm of 429,048 population per district. And in the main the districts are fairly compact.

However, the changes made by the Rules Committee make the Third District, represented by Rep. Philip J. Philbin (D), less compact than that favored by the Kenneally committee and could open charges of a gerrymander because of the proposed district's elongated shape.

Rep. Chandler H. Stevens (Ind.) of Chelmsford, a computer expert, insists that even greater compactness and better districts could be achieved through the use of computers. Twice he has urged the Rules Committee to view various apportionment plans on computers made available at the Massachusetts Institute of Technology. The Rules Committee thus far has failed to accept the Stevens order.

Changes in districts

The Rules Committee plan includes changes to ease apportionment pressures on Representative Philbin.

His district is the most drastically altered of the 12 under the plan framed by the special committee headed by Sen. George V. Kenneally Jr. (D) of Boston.

At the insistence of Rep. Thomas F. Fallon (D) of Clinton, the Rules Committee shifted several communities to make the proposed new third district more politically palatable to Mr. Philbin who was unhappy about the Kenneally committee's new third district.

The Rules Committee plan shifts Democratic Marlboro from the new fourth to the third, where it is currently, Winchendon from the first to the third, and Westford from fifth to the third.

Pepperell and Groton go from the new third to the new fifth district.

Sudbury and Wayland would be shifted from the third to the fourth district, where they now are anyway, and Hubbardston and Princeton would be shifted from the third to the first district.

All other proposed changes, many of which were advanced in the Rules Committee session, was beaten down. The leadership on both sides have agreed to buck any further revision.

The leadership hope is to present to the federal three-judge panel a plan approved by the Legislature and signed by Gov. John A. Volpe. In that way the court will have a specific plan in front of it on which to make a determination.
And Rep. Chandler H. Stevens (Ind.) of Bedford, a computer expert, insists that the districts could be made far more compact through the use of computers. Mr. Stevens would have the districts drawn up in relation to centers of population and the population makeup of communities to preserve communities of interests.

But the lawmakers have shown a great lack of interest in the use of computers. Several times Mr. Stevens has invited lawmakers to the MIT computer center to view various plans on a computer television screen. Through the use of a formula designed to prove compactness Mr. Stevens has shown the compactness or lack of it in the various plans.

Plan criticized

He contends that the redistricting plan now pending in the Senate is the least compact of all the plans which had been drafted.

Mr. Stevens today said that he is exploring ways by which he can enter the pending reapportionment case before the three-judge panel. He desires to show to the court the results of his studies and to offer the court use of computers to do the job.

Only a few House members took up Mr. Stevens's offer to view the plans on a computer-operated TV screen at MIT. And no Senate members showed up.

In a demonstration yesterday Mr. Stevens showed a redistricting plan developed by Computer Research on Nonpartisan Districting of Delaware through the use of computers. Although Mr. Stevens emphasized the plan did not take into consideration important political factors, he said it showed what could be done to achieve compact districts.

Many lawmakers are concerned that the court will use computers to develop new districts if it is dissatisfied with the Legislature's product. They are apprehensive that various political and other considerations which are factors in the current plan would be ignored by the court.

Status quo undisputed

There is little dispute that the present plan is basically designed to preserve the status of the incumbent seven Democratic and five Republican congressmen while producing districts extremely close to the population norm.

But critics such as Mr. Stevens argue that while the districts are even populationwise and contiguous they are not as compact as could be achieved.

The Senate battled out the apportionment plan yesterday. Action on congressional re-

apportionment came after the Senate passed a House-approved bill allotting to each county its share of the 240 state's House of Representatives seats on a population basis. The actual drawing of new state representative districts is to be done by the county commissioners in each county except in Suffolk County where an elected board of apportionment is to do the job.

The county groups are to be given 30 days from the bill's signing by Gov. John A. Volpe to draw up the new districts.

The Legislature itself will draw up new state senatorial districts.

Amendment beaten

On the congressional apportionment issue the Senate beat back all efforts to amend the House-passed bill to satisfy the desires either of individual congressmen or individual state senators.

The big skirmish came on the proposed amendment offered by Sen. Mario Umana (D) of Boston to return Boston's Ward 3 from the proposed 9th Congressional District to the proposed 8th Congressional District. His desire is to reunite Boston Wards 1 and 3, the East Boston and North End sections, in the 8th districts.

Despite the vigorous opposition of Senator Kenneally, the move at first was approved by a 21-to-15 roll-call vote. Later, however, on a reconsideration motion, the proposal was rejected by a 18-to-17 roll-call vote.

Senator Kenneally argued that the addition of Ward 3 to the 8th Congressional District would boost the population total in the 8th District to more than 5 percent above the desired norm and reduce the 9th District about the same amount below the norm. He said the court would throw out the plan and do the redistricting job itself. His arguments finally persuaded the Senate.

Plan rejected

The Senate also turned down a plan proposed by Congressmen Silvio O. Conte (R), 1st District, and Edmund O. Boland (D), 2d District, that several communities be shifted between the districts to preserve communities of interest. The plan was offered by Sen. George D. Hammond (D) of Springfield. It would have returned Agawam from the 1st to the 2d District and Brickettown, Granby, and South Hadley from the 2d District to the 1st.

Likewise Sen. William X. Wall (D) of Lawrence failed in his bid for a new congressional apportionment plan which would have grouped Lawrence, Lowell, Haverhill, and other Merrimack Valley communities into a new 5th district and developed a new 12th district in southeastern Massachusetts including Fall River and New Bedford.
Bay State Senate weighs redistricting plan

By Edgar M. Mills
New England political editor of
The Christian Science Monitor

Will the Federal District Court at Boston put its approval stamp on the congressional apportionment plan being pushed through the Massachusetts Legislature? That is a big question on Beacon Hill as the plan redrawing the 12 congressional districts along one-man, one-vote lines nears a final passage.

Final Senate passage may occur today. The plan already has won House approval. It could reach the Federal District Court's three-member panel before the week is out.

Court approval is vital. The three-judge panel ordered the reapportionment on the grounds that the present districts, drawn in 1962, violate the one-man, one-vote edict of the Supreme Court of the United States. The panel retained jurisdiction with the implied threat that the court would draw up the new districts itself if the Legislature failed to produce an acceptable plan.

Sen. George V. Kenneally Jr. (D) of Boston, chairman of the special committee which drafted the pending plan, has argued hard that the new districts, carefully adjusted to keep the districts close to the ideal norm of 429,048 population, will win court approval.

Arguments advanced

His position is that the proposed districts are as nearly equal as they can be, are contiguous, and are reasonably compact.

Others are uncertain about the court's approval. They contend that concessions made to Rep. Philip J. Philbin (D), veteran congressman from the 3rd district, have produced a gerrymandered district which will not pass court muster.
Bay State
districting
advances

By Edgar M. Mills
New England political editor of
The Christian Science Monitor

Boston

A Massachusetts congressional reapportionment plan alternately blasted as a "gerrymander" and praised as "beautiful" now awaits Bay State Senate approval.

Swift Senate passage is anticipated along with a measure to allot to each county its share of the 240 seats in the House of Representatives preparatory to reapportionment of the districts.

In all counties except Suffolk County the actual districts will be drawn by the county commissioners. In Suffolk County the work will be done by the elected Board of Appor-tionment.

Both the congressional and state representative measures were rammed through the House on Thursday under suspension of rules.

Court action both on congressional and legislative reapportionment spurred the swift processing of the plans.

Whether or not either or both will survive later court scrutiny remains to be seen.

Injunction denied

Meanwhile, in federal district court a three-judge panel refused a bid from Bristol County District Attorney Edmund Dinis for a temporary injunction to bar the Legislature from proceeding with congressional reapportionment. He contends the Legislature is malapportioned and therefore illegal.

Still to be heard by the court is the main Dinis case against the Legislature's legality.

The Senate Democratic and Republican leadership plans to have the congressional reapportionment plan in the hands of the court before it considers the Dinis main case.

It is understood that Gov. John A. Volpe has agreed to sign the leadership-backed congressional redistricting plan quickly once it reaches his desk.

The three-judge panel earlier in the year ordered the Legislature to proceed immediately to reapportion the state's 12 congressional seats to conform with the one-man, one-vote edict of the Supreme Court of the United States. This spurred the Legislature into almost record speed on the complicated issue.

Protests heard

Despite the massing of Democratic and Republican House and Senate leaders behind it, not every lawmaker was happy about the plan.

It conforms almost exactly to the one-man, one vote Supreme Court standard with no district being more than 1.03 percent away from the ideal norm of 429,048 population per district.

Unhappy were legislators from the New Bedford and Fall River area and the Lowell and Lawrence area. They want changes to preserve community of interests and to make election of a Democrat likely in Republican-held districts involved.

Also unhappy was Rep. Chandler H. Stevens (Ind.) of Bedford who insisted that no real effort was made to make the districts compact.

Mr. Chandler had offered the use of computers to produce compact districts. But his offer was not taken up by the Joint Committee on Rules which fashioned the

* Please turn to Page 2
Continued from Page 1

The plan backed by the legislative leadership.

Some lawmakers and observers questioned the basis by which Mr. Stevens, a computer expert, arrived at compactness among the districts.

But particularly unhappy about the congressional redistricting plan was Mr. Dinis. The latter originally filed his two court suits on congressional districts the ground that Fall River and New Bedford must be placed in the same district in any fair and equitable reapportionment.

Party lines hold

As a prospective candidate for Congress himself, he told the press that he "probably would not" have filed his latest suit had the plan placed both Democratic cities in the same congressional district.

During the long debate the Democratic and Republican leadership held their forces closely in line as they beat down amendments proposed by lawmakers in the southeastern and northeastern sections of the state.

The amendments would have linked Fall River and New Bedford and placed Democratic Haverhill in the same district with Democratic Lowell and Lawrence.

The only amendment adopted was one approved by the Joint Committee on Rules making a number of shifts to placate Rep. Philip J. Philbin (D) veteran 3d District incumbent. He had been unhappy about the vast changes made in his district.

The principal changes were to give Mr. Philbin back Democratic Marlboro and some other towns he usually carries and to take out some Republican towns which had been added to his district.

On the measure for reapportionment of the state House of Representatives, the Democratic leadership successfully beat back all attempts to revise it.

Under the allotment of seats on the basis of population, Suffolk County loses 7 of its present 40 seats, all the losses coming in Boston. Norfolk County is the big gainer, going from 21 to 25 seats.

The by-county allotment follows:

<table>
<thead>
<tr>
<th>County</th>
<th>Present</th>
<th>Proposed</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barnstable</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Berkshire</td>
<td>7</td>
<td>6</td>
<td>-1</td>
</tr>
<tr>
<td>Bristol</td>
<td>19</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Dukes</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Essex</td>
<td>28</td>
<td>27</td>
<td>-1</td>
</tr>
<tr>
<td>Franklin</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Hampden</td>
<td>10</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Hampshire</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Middlesex</td>
<td>55</td>
<td>57</td>
<td>+2</td>
</tr>
<tr>
<td>Nantucket</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Norfolk (except Cohasset)</td>
<td>21</td>
<td>25</td>
<td>+4</td>
</tr>
<tr>
<td>Plymouth (including Cohasset)</td>
<td>11</td>
<td>13</td>
<td>+2</td>
</tr>
<tr>
<td>Suffolk</td>
<td>40</td>
<td>33</td>
<td>-7</td>
</tr>
<tr>
<td>Worcester</td>
<td>28</td>
<td>28</td>
<td>0</td>
</tr>
</tbody>
</table>

Constitutional issues

Rep. Sidney Q. Curtiss (R) of Sheffield, House minority leader, made an unsuccessful attempt to amend the bill to base the seat allotment on legal voters, as provided in the state constitution, rather than on population.

He pointed out that the Democratic-backed plan for apportionment follows the constitution in allotting one seat each to the island counties of Nantucket and Martha's Vineyard even though the communities do not have enough population to warrant a seat on a one-man, one-vote basis.

At the same time, he said, the majority plan violates the constitution by requiring the division on the basis of population.

Rep. Robert H. Quinn (D) of Boston, House majority leader, supported the plan, saying apportionment by population would more nearly conform to the Supreme Court's edict.

The majority plan's provision giving Suffolk County one more seat than it is entitled to on a strict population basis and giving Middlesex County one less seat than it is entitled also was attacked by Mr. Curtiss and defended by Mr. Quinn.

But this provision may wind up in court along with the issue of whether or not seats should be allocated to the island counties.