COMPUTING AT A LARGE NATIONAL LABORATORY

1. INTRODUCTION

I would like to talk to you today about computing at a large national laboratory. Right away you may ask yourself, "Why~~s~~ why does he want to talk about computing at a national laboratory to us? Computing is more or less the same at any large laboratory!" And you are of cource correct. Well perhaps one laboratory has different computing machines - or one has ~~less~~ fewer people in the systems programming group - or maybe one computing department is organized slightly different than another. But general scientific computing is very similar at most large research laboratories.

So one asks again, why talk about computing at a national laboratory? Well, I am not going to talk about programming languages, nor operating systems, nor bits or bytes - but rather I want to talk to you about administrative decisions, organizational structures, and that sort of activity with respect to computing.

When I was a young man, attending the university, studying mathematics and physics, it never occored to me that politics had anything to do with science. Of cource I was aware of the field of political science - but not scientific politics. As I think back now, I certainly was nieve.Sure- some scientists do not get heavily involved in politics, but I think it can be very difficult to avoid. Even in requesting support for a research project, there can be a certain amount of politics.Many papers and books have been written on the subject of science and politics. (ref)

I make these few remarks about politics because some of you may choose to interpret parts of what I am going to say from that viewpoint. Although I played a role in this story, I can now be objective about it.

I am going to tell you about the changing emphasis of a national laboratory - and the resulting effects this change had on the computing department. I will try to ~~emphacize~~ cover the changes that took place within the computer department from the point of

AS IT WAS 1970
AS IT CHANGED
AS IT DIVIDED

view of the department management, of the department staff, and of the users of the services the computer department provided. So this is a sort of historic overview.

First, I will set the scene for you as it was in 1970, just before the changes took place. Second I will talk about the change that took place at the laboratory. Then, I will tell you about the administrative decisions that were made within the Mathematics and Computing Department and some of the things that happened as a result of those decisions.

2. AS IT WAS IN 1970 .

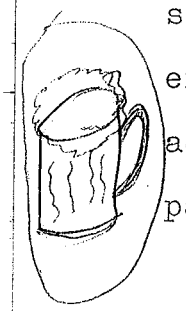
Bridge

Ernest Lawrence, the inventor of the clyclotron, secured funds from the Federal Government, gathered together some scientists, and established what was then called the Radiation Laboratory in Berkeley California. Although there was some activity in the classified area during World War II, the Radiation Laboratory ~~was~~ had since then been ~~mainly~~ engaged in basic research. The Laboratory was operated under a contract between the University of California and the Atomic Energy Commission. Various particle accelerators had been built, both linear and circular. When Ernest Lawrence died, the lab. name was changed to Lawrence Radiation Lab. - then again to Lawrence Berkeley Laboratory - LBL.

The overall working philosophy set by Lawrence was quite simple. 1) establish research teams made up of several scientists, one designated was the group leader, and 2) handle the administrative matters seperately and centrally controlled in a manner that would isolate these necessary details from the working scientist. The whole idea being to maximize the amount of scientific effort that was devoted to research.

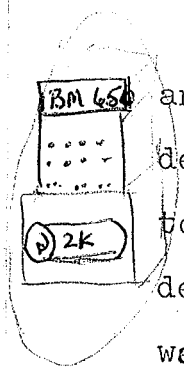
While the group research philosophy survived, the idea of not burdoning the scientist working with administrative matters has long gone by the boards.

The laboratory had research programs in chemistry, biology medicine and so on - but the dominant research effort through the late 1960's was in high energy physics. Infact at one time the

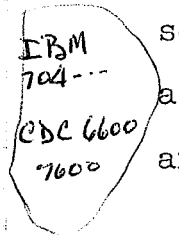


single largest research effort was a group doing experimental high energy physics, led by L.W. Alvarez. This group used the particle accelerator and the hydrogen bubble chamber to study elementary particles.

The Mathematics and Computing Department of LBL began with four or five graduate students doing hand calculations using Frieden calculators. This activity was part of the Theoretical Physics Group and was mainly centered around accelerator design problems.



In the mid 1950's this group acquired a mechanical differential analyzer that was used to calculate particle orbits for accelerator design and experimental research(beam set-up). In 1956 they took delivery of an IBM 650 computer. From then on, the group developed quite rapidly and the pattern of computer acquisitions was similar to that of many other research laboratories. The IBM series 704, 709, 7090, 7094(of which they had two). Then there was a switch to Control Data computers, installing a CDC6600 in 1965, and a second in 1966. In April of 1971 a CDC 7600 was delivered to LBL.



During the period from the late 1950's through 1970, the expansion of the computer department was driven by the data analysis needs of high energy physics. In fact the Alvarez Physics Group alone used up the time of one CDC 6600. Also a large number of programmers at the Lab. were engaged in activities associated with bubble chamber data analysis. Both 6600's were fully utilized and the CDC 7600 was justified based on predicted growth in demand from physics.

Although it wasn't realized until later, there were not many administrative problems in those days. As long as the Mathematics and computing Department kept high energy physics happy, everything was OK. There was a great deal of activity - late hours - week end work - etc.

3. AS IT CHANGED BEGINNING IN 1971 .

During the later part of 1971 the picture began to change. Funding Support for high energy physics research at Berkeley started to decrease. The 200GEV

accelerator at Batavia(Fermi Lab) and the Stanford Linear Accelerator were beginning to eat into the total dollar budget for high energy physics from the AEC., and the funding for some of the existing laboratories was being reduced.

Some years earlier, the Mathematics and Computing Dept., administratively part of the physics division, had been put on a re-charge basis. The idea being to force the scientist to be aware of how much money he was spending on computing. So - when high the energy physics budget was cut back, the Math & Computing Dept. was heavily impacted. Not only did the Physics Division begin to back off on their use of the computers, but they also needed less support from the applications programming group. Fortunately, this turn of events was we realized what was developing early enough in the budget year to avoid an early disaster. So what can one do in such a situation?

Some people suggested that the Math & Computing Dept. be cut back to a level that the Laboratory could support by reducing staff and machines releasing computing. Perhaps that certainly was a possible answer would have been the best answer, but some others saw the situation a little differently. Many of the laboratory on-going research programs needed the computational power of the CDC 7600, but at the same time there was excess capacity. Furtermore, it is difficult to develop good staff if one begins to cut.

Finally it was We decided that if the computing resources could be sold outside the laboratory, then one could accomplish the following desireable results:

1. High quality computer services would continue to be available to the laboratory research staff.

2. Those services could be provided at costs that the laboratory users could afford to pay.

3. Those same services could be offered to other Government Agencies and Government contractors thus saving the tax-payers money.

and 4th. Computer services would be available as new laboratory programs research developed. (this I believe was an important consideration).

An outside services program was launched. At the outset many laboratory scientists were not ready for such a program. They had agreed that math & Computing should provide computer time to non-laboratory groups that were engaged in high energy physics research, but to go beyond that was for some a hard pill to swallow.

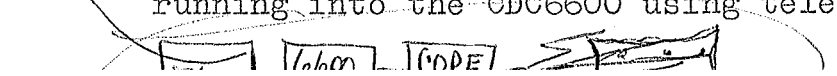
For the first year of operation, upper management agreed to establish a policy of guaranteed support laboratory for the computer center portion of the Math & Computing Dept. The various divisions were forced to spend as much on computing for that year as they had spent during the previous year. Although it was painful for the research divisions, it was felt to be absolutely necessary in order to maintain the level of services until there was time to build up the outside support. Following that first year the laboratory has been on a free market policy for computing. The divisions only pay for what they use.

INCOME

Outside income for the Mathematics & Computing Dept. did in fact grow. As the total usage of the computers began to increase it developed that everyone wanted to use the machines during the week days, and the week ends during the machines sat idle. An offer was made to charge only half of the regular price for computer time used on the week ends. The result was that the load promptly leveled out over the entire week.

The applications programming group also began to seek outside support. This effort took a little longer to get started and some support from computer income was used for a while.

Luckily, there was included with the purchase of the 7600, a remote batch controller. A COPE controller, the only off the shelf device of that sort that could be found at the time. It had been justified ~~based on~~ to provide service to the physics community outside the Lab. Without too much difficulty, ~~there~~ was a network developed, running into the CDC6600 using telephone lines and modems attached



to the COPE controller.

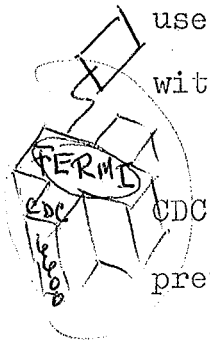
It wasn't long after outside customers began to use the computing machines that the need for additional consultants programming, better program documentation and additional accounting services became apparent. While it is relatively easy for people inside the laboratory to get help when they need it , the situation is quite different for remote users. So a Users services group was formed to take care of these additional needs.

USERS SERVICES

Some of the members of the Math & Computing staff had been quite active in computer user groups such as SHARE and VIM over the years. Some had also questioned the usefullness of such groups. Nevertheless, once the department had become a supplier of services, it was decided that the customers would form a LBL users group.One of the more active members of vendors user groups led the way to forming RUM(remote users group.)It was quite interesting to be on the other side of the fence for a change.You might be surprised to see how quickly some people are able to assume the vendor role in such situations. Some of the answers the users got at the meetings were -- We are working on that problem -- We are discontinuing support for that version after 11 May(the date then was 12May) -- that is impossible to do , etc. Amazing.

RUM

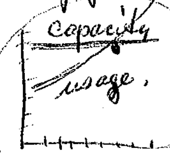
I believe it safe to say that there was no real difference between the needs of the outside customers and the needs of those within the laboratory. This was a surprising result to those who feared that the outside users would place demands on the Computer Dept. that would conflict with the desires of the laboratory users.



The service bureau endeavor was beginning to grow. One of the CDC 6600's was transferred to Fermi Laboratory according to a previous agreement.

The General Services Administration(GSA) an agency of the Federal Government runs a sharing program for the computer users that have

support from the government. They (GSA) look for installations with government owned computers that have excess capacity, and try to match it up with some users requirements. Once GSA found out about the availability of machine time at LBL, they began to refer customers and advertize the services that were available. Under a Federal law called the Brooks Bill (named for Senator Brooks from Texas) the General Services Administration is authorized to establish and to operate Federal Data Centers. These Federal Data Centers are to be available to any User that has money for computing from the Federal Government. This legislation includes the provision for a revolving monetary fund which may be used to purchase equipment for such Data Centers. The center would repay the fund over a number of years. As I recall, GSA had not set up their own Federal Data Center but instead - as also permitted by the Brooks Bill - they had designated one or two existing Government owned computer Centers as Federal Data Centers, In such cases the center continues to be operated and Administered by its original agency, and is able to apply for money from the revolving equipment fund. LBL was by far the largest center in the country that was providing services to several government agencies.



The GSA gave awards to a computer center that saved the government 100thousand dollars ~~worth of~~ computer time ~~in one year and~~ The LBL center was in the million dollar class. The GSA suggested that the Berkeley computer Center be designated as a Federal Data Center.

The management of Math & Computing Dept saw no reason not to accept such an offer. In fact it had been projected that the installed equipment would be saturated and it was thought that this would be a way to acquire additional hardware and at the same time cut the costs for computing for all of the users, including the laboratory users, through economies of scale. The idea was informally explored with laboratory management and GSA and in fact a draft of an agreement between GSA, the laboratory, and the AEC was prepared for the establish-

The draft agreement provided for Berkeley control, escape clauses and that the center concentrate on scientific computing since there was no desire by Math & Computing to support heavy administrative computing ~~at the center~~. Anyway, the concept seemed to be proceeding, at least in an informal way in early to mid 1973

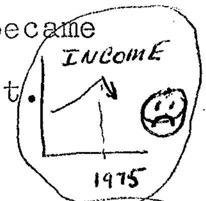
In late 1973, ~~roughly eighteen months~~ a little more than two years after the Computer center began to seek outside customers, the laboratory received a request from AEC Headquarters in Washington D.C. to explain why it needed two CDC 6000 computers. There was a 6600 and a 6200 . After some effort the answer was accepted. No sooner had the dust settled ~~and~~ when there was a second inquiry from Washington DC. This time they wanted to know why LBL needed a 7600 computer. Clearly the laboratory was being asked to rejustify its computer requirements. As it developed, this was only the beginning of a series of such requests concerning the use of the CDC7600 at Berkeley.

Another interesting developmnet ~~began~~ had its beginning in 1973. Members of the General Accounting Office staff appeared to do an audit of the computer center. ~~Who~~ keeps the books - how is the accounting done - how much do you charge the users - how do you arrive at the rates- nothing unusual for an installation that is supported by Government funds. However, instead of the normal audit ,they decided that they were more interested in the service that was being provided to customers.The GAO personnel spent many months at the laboratory talked to ~~many~~ a number of the computer users, and gathered all sorts of data by means of a questioneer that was sent to every computer user. They wrote a report stating that the LBL computer center should be designated by GSA as a Federal Data Center and presenting projected computer requirements.

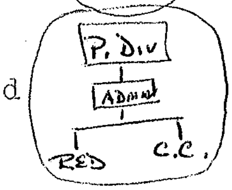
By around mid 1974 the situation was as follows. About 20% of the money required to support the Math & Computing Dept. ~~is derived~~ was being paid ~~from~~ by the laboratory ~~sources~~ and the remaining 80 % ~~comes~~ from outside sources [illegible]

~~programming renamed)~~ had ~~developed~~ contracts with the Department of Labor, Bureau of the Census, etc. The installed computer hardware ~~will~~ soon be saturated and this projected situation ~~is~~ beginning to be a cause for concern for many users. The Service Bureau that had been developed had begun to introduce its ~~own burrocratic~~ problems.

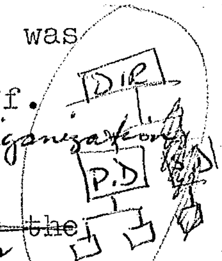
Then during 1975 the use of computer time began a downward trend. The ~~only~~ reason for this change ~~that seems plausable is~~ that the outside users , who had no guarantee of continued computer availability , began to find alternate sources as saturation became evident. Because of ~~a lack of funds~~ , the Math & Computing Dept. was forced to undergo a reduction in force.



The organization of the department ~~at the time~~ was: an administrative section and two functional sections, one called research and development and the second the computer center. Research and developmnet ~~is~~ made up of a group providing applications programming services to laboratory and non-lab groups using the main computer center and a second group providing support on mini computers and a ~~group~~ of mathematicians computer researchers. The computer center had systems programming, users services, and computer operations. It ~~might~~ be noted here that the data handling group operated the FSD/Hough-Powell machine had joined Math & Computing during fiscal year 1973 after it became obvious that high energy physics no longer needed ~~that~~ service. Attempts were made to find new applications for this group and they digitized some spider webs and some maps but had not developed a large new program. Hence , when budget problems struck the department, this group was absorbed into the other two sections and the FSD ~~and~~ turned off.



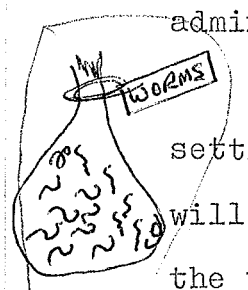
4. <u>AS IT WAS DIVIDED</u>.



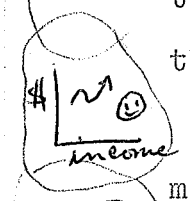
In January of 1976, the Physics Division decided ~~to split the~~ Math & Computing department into two parts , with each ~~one~~ reporting separately to the head of the Physics Division. The two ~~parts~~ were the computer center and the research and development group.

The reason for such a reorganization was to permit computer science to be more formally recognized as a laboratory program.

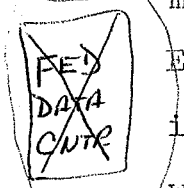
Almost immediately, the mini computer group split off from Research and Development and joined the Support Division. This mini computer people group felt that they were more closely related to engineering, having worked on accelerator control systems, etc. The laboratory had, in my opinion, through this group, just begun to get a handle on how to control the mini computer proliferation, i.e., through the efforts of central administration.

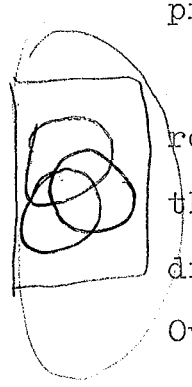


As one might expect, it took some time for these organizational changes to settle in. Many administrative problems had to be worked out. I will not go into the details here. In any case - by mid 1976, the use of the large computers had built up once more do mainly to the efforts of the computer center staff. Some of the staff that had been cut were brought back on board.



For a number of reasons, it was decided by laboratory management and the funding agency (now changed fram the AEC to ERDA- energy research and developmnet agency) to not accept the idea of a Federal Data Center as formally proposed in the report by GAO. Some of the reasons were 1)projected growth in demand from the Energy Division at LBL 2)Need for computer time at other ERDA labs that could not be satisfied immediately because of constraints on computer money in the ERDA budget. 3) projected needs for PEP project and 4) the proposed National Resource for Computation in Chemistry.





During 1977 the picture became more evident to some ~~of us as~~ regarding future computing developments at the laboratory. There were now three seperate computer groups, and one of them was in a seperate division. Each group was acquiring hardware and developing systems. Overlap and duplication of effort existed and would continue to expand. CSAM (R&D new name) was developing a system based on DEC 11 /70's for the Dept. of Labor plus they had a real need for mass storage facilities for a large cencus data base. RTSG (the mini computer group renamed) had a system of minis at LBL and would be involved

in a computer control system for the PEP project. The Computer Center needed to upgrade the interactive service, replace the mass storage system and begin to replace the 6000 computers with mini computers in a distributed network .There were attempts made for cooperation between the three groups but nothing substantial came of them. Rivalries developed, competition for personnel and for projects also existed.

Some of the staff felt that there were sufficient reasons to reconsolidate the three groups and in fact a plan for the creation of one laboratory computer division was concieved and proposed. It turned out that two of the groups were in agreement basically with the proposal, but the third group was negative. The only way that the plan for reorganization could have been carried out was by direct order from the Lab Director, and it was decided that such action would not be taken at that time.

5. IN SUMMARY. Two additional computer groups have since been formed. What future development will be I don't know.

During the period from 1971 through 1978, the laboratory underwent a change in main emphasis from high energy physics with the AEC to energy research for the DoE. During the same time span, the Math & Computing Dept. changed from being totally supported through laboratory programs to a service bureau type operation obtaing support from multiple sources., and then was seperated into three individually managed groups.

Math & Computing management was kept quite busy during these six and 1/2 years with a variety of administrative issues, as I hope I have pointed out. The programming staff and operations personnel went through several fluctuations in morale, real highs and extreem lows, reacting to the events that took place. The computer users , I believe, faired best. The computers remained at the laboratory and the costs for computer time were kept within reason. The outside users were able to use the services much cheaper than they could obtain elsewhere. The one annoyance that all of the users had to contend with periodically was the uncertainty

of the situation. That is to say, they were not sure that the service would remain available. This uncertainty ~~also~~ to be sure was the cause for some frayed nerves within the computer department too.

I hope that you ~~XXXX~~ feel that the time you spent listening to this bit of history was in some way worth while. I know that all sorts of interesting and exciting things happen in computer departments at all laboratories. I think that this particular chain of events is not typical, and I thought that you might like to hear about them. Some of the earlier developments that I talked about were presented at two meetings of AEC computer managers in 1974 and 1975. In case you want to read them II think that they are available from LBL.

THANK YOU

THAT IS THE STORY,

I want to ~~leave~~ add with one personal final comment. We believe that the development and utilization of computers and computational devices & techniques will continue for many years. As this technology grows - it brings with it an increasing social impact. Not only in the sense of providing easy access to information, or de-humanizing business transactions, but as the possibility of a social impact on the structure and methodology of our organizations. I have heard more than one corporate executive say that issues surrounding computing and information processing easily arouse the emotions of his associates. Nevertheless, the dependence on computing is becoming more & more deeply embedded in our every day lives. I believe that only through central management of computer activities can an institution hope to maximize the benefits that future developments in information processing can be achieved from.