Bits

You have all heard the repartée attributed to Walter Reuther when he was shown a very impressive automatic machine in the Ford plant. His proud host is said to have challenged, “Let’s see you organize that worker,” to which Reuther is supposed to have rejoined, “Let’s see you sell it a Ford!” Now whether Reuther made such a smart-aleck remark or not, it is good for a chuckle. Trouble is it’s so clever that it is accepted a priori as a profound truth. Actually it is only a superficial truth. It is true that you cannot sell a Ford to the machine, but because of the machine many more Fords can be sold to people because the automobiles can be made at a price many more can afford.

If we sound philosophical this month it is probably a hangover from working on the tape recording of the May meeting of the Western Simulation Council. This meeting was typical of some which cause us occasionally to be called the Simulation Council. We settled nothing—did not expect to. The recording sounded like a bunch of people thinking out loud, not always coherently. There were some silly remarks, but there were also many worthy of serious consideration. We have not cut the text as drastically as usual because we think that the contrasting points of view—the variations on the theme of “Optimization”—are thought-provoking, stimulating!

Pieces

Forty-two representatives of 19 organizations assembled amidst architectural and natural beauty for the May meeting of the Western Simulation Council. The location was the new Motorola Research Laboratory on the outskirts of Riverside, California. The building, like the new plants of Beckman in Fullerton, Consolidated Engineering in Pasadena, Librascope in Glendale, Ramo-Woldridge in Los Angeles, and others, is an inspiring example of the combining of beauty and utility. And as if this were not enough, Motorola is surrounded by orange groves—in bloom when we were there.*

Otis Updike (US Naval Air Missile Test Center, Pt. Mugu, Calif.) opened this, his last meeting as Chairman, by introducing John Hart, who welcomed us on behalf of Motorola. Hart regretted that he could not explain the work of the Laboratory because ours was an unclassified meeting, but added that we would be able to get a good idea of their capabilities and field of operation on the tour of the facilities. They have been in their new laboratory for about five months.

Referring to the announced topic, “The Use of Computers for Systems Optimization,” Otis guessed that there were probably as many definitions of system optimization as there were groups present. Therefore, he started the discussion by asking Norm Irvine (Aerojet-General Corp., Azusa, Calif.) what his idea of system optimization was.

Irvine on Optimization

Norm said that would depend on the type of problem you are considering—that Dr. Franz Zwicky, a consultant to Aerojet-General, has a technique involving morphology (the science of forms and their variations). Norm said if we have a production type of system it might be optimized in one way, whereas with a simple servo system we might be interested in different criteria such as getting a minimum rise time with a minimum amount of overshoot. If the system is linear there are certain definite lim-
iterations as to how much it can be improved. If nonlinear techniques are used, as Dr. R. S. Neiwinder has used them at Aerojet, simulation proves extremely useful.

Norm, illustrated by sketching a second-order system on the board in which he specified the percent overshoot to a step function and the decay time. If the optimum with the linear system is not good enough, it cannot be improved because if the rise time is decreased, the overshoot will increase, as will the decay time. But nonlinear systems can be designed to have a fast rise time, no overshoot and, consequently, low decay time.

But what, asked Norm, does this do to your sine-wave response? He said he tried it with a computer servo system and got fairly good frequency response with a linear system which produced reasonably good sine waves. Then they modified the system to be nonlinear and applied sine waves. When the traces from a Brush recorder were compared, without careful measurement, it seemed that there was no difference. Optimization, Norm says, depends on what you want to get out of a system.

Oitis remarked that a definition of optimization involves a certain amount of philosophy, and how you define the problem. Linear programming has some relationship to system optimization. In both cases there is first a survey of the technology to determine the limitations within which one must work, then a statement of the objectives. For example, in a missile system the objective may be to minimize mass distance, or it may be the best envelope of positions from which the missile can be fired. The sequence is to set up the limitations, establish the objectives, and then determine the criteria of success.

Mike Foley’s Comments

Oitis asked Mike Foley (Western Precipitation Corp., Los Angeles 15, Calif.) if he had any ideas on the subject. Mike answered that there are two forms of optimization, one in which you attempt to build the best mousetrap under a given set of conditions. In the other you attempt to build a machine that will do the best that can be done no matter what the conditions may change to.

Oitis remarked that this was a higher order of optimization, wherein a machine would continuously follow the optimum. To him there appeared to be several types of optimization. In one you might wish to optimize the configuration to perform a given function. Here you wish to change the flow of energy within a system; this is the circuit design problem. In another system you might wish to determine the optimum initial conditions. In a third you may wish to optimize parameters within a system. These appear to be three major cases from a more general group of operations.

Bill Waddell on Criteria

Bill Waddell (Giannini DATEX Corp., Pasadena, Calif.) said that if we keep on talking about “optimum” we “ain’t going to talk about puttering at all.” It must be broken down into the set of criteria by which you are going to operate.

Oitis got a good laugh by paraphrasing Bill’s observation—“Optimizing the criteria for optimization.”

Bill said there were definite criteria, and referred to “Optimizing Criteria” by Dunston Graham.*

“When a person simply says optimize,” Bill continued, “he could mean anything. For instance, when I say optimize I mean take all possible equipment. I want the least amount of equipment that will give me a ‘yes,’ whether it is a precise answer or not.”

Oitis went to the board to list possible criteria, suggesting that Bill’s minimum equipment might be one. Bill said he was not worried about cost—“that is the accountants’ problem.” Oitis insisted that cost would have to be a criterion, because cost cannot be allowed to go to infinity, but that Bill could put a small coefficient on it if he wished. To make it simple, he continued, if you have a three-variable problem the boundary

*We have a letter from Bill mentioning “The Synthesis of ‘Optimum’ Transient Response: Criteria and Standard Form” by Dunston Graham and R. C. Lathrop, Paper No. 53-249, as well as “The Principle of Optimizing Control Applied to Analog Computers,” master thesis by Lieutenants Seusy and Heerman. These papers can probably be obtained by writing Dr. C. Zeiman, Head, Electrical Engineering Dept., Resident College, U.S.A.F. Institute of Technology, Wright-Patterson Air Force Base, Ohio.

conditions on these criteria may be represented by areas on a map. There should be a region of overlap satisfying all three criteria. This area of overlap can then be searched for an optimum.

Oitis asked for some more criteria for his list. The suggestions which followed indicated that some were inclined to group criteria and come up with something like performance, whereas others wished to subdivide as far as possible. The final list looked something like this:

Simplicity
Reliability
Cost
Accuracy
Speed (frequency response)
Size
Weight
Power (efficiency)
Development and Production Time
Material Availability
Serviceability

Looking at the list, Oitis said the reason for spending so much time on it was that determining criteria is surely an important, and possibly the most difficult, problem of optimization.

McLeod asked Oitis if he was trying to suggest that some engineers should stop and ask themselves: “What the heck am I trying to do?”

Oitis replied that he thought it might be a good idea.

There were shouts of “Unfair!” but Oitis, undaunted by the cries of the multitude and entirely heedless of his own popularity*, said not only that they should do this, but that they should do it at “optimum” intervals!

Gehrig Suggests Simplification of Criteria

J. J. Gehrig (Northrop Aircraft, Hawthorne, Calif.) suggested that just the words “effectiveness” and “cost” could replace all these things we were talking about, cost being taken in the largest sense to mean man hours, weight, or whatever you might have to pay to accomplish your objective.

He agreed that there are two ways to optimize—for example, if a proposal is to be submitted for an interceptor, the Air Force might specify certain boundary conditions or they might leave the question wide open. But in either case you must always consider the price, because if you want badly enough to do a job and you are able to pay the price you can always do it.

Waddell claimed that at the beginning you should not consider the cost

*He is not running for reelection.
at all. You should consider whether or not it is possible to build an optimum system.

Mike Foley pointed out that perhaps we were assigning the same value to each one of our criteria, whereas in actual practice it is necessary to assign different values.

Otis agreed, and illustrated by saying that if we called these criteria A, B, C, D, etc., they would be related by an equation in which each had a coefficient and an exponent. It might develop that some of the coefficients will be zero, or negligibly small, as for instance the criteria of size and weight of ground equipment. This is easy to see if there are two or possibly three related criteria, and there are even techniques for handling them if they are multi-dimensional.

Yopp Postulates a Specific Problem

W. B. Yopp (Douglas Aircraft Co.), who suggested this topic at the last meeting, said that, as computer people, we were not interested primarily in the design of the components nor primarily concerned with the technology. He postulated a problem more in his line. There is an airplane with a certain pay load, range, and speed, and they must put an autopilot in it. The autopilot must do such and such. The computer man has a number of variables to take into account. What Yopp wants to know is how he can get the best compromise between his feedback and the other parameters already defined.

Otis observed that how much a computer man is concerned with what criteria is a matter of where he works and what kind of problem he has. Sometimes he may be able to say nothing about the parameters which are presented. But there are other times when the computer man can and should play a part in determining these parameters.

Gehrig said Yopp’s problem was no different from anyone else’s! (Cries of “Hear, hear!”) He thinks that we should generalize the problem because we always have the boundary conditions.

Otis agreed, saying that in some cases we may be working with a very limited part of a block diagram, but that there should be some feedback of design information, as well as feedback. Anyone is handicapped with too many constraints.

Bemer on Over-all Perspective

Bob Bemer (Lockheed Aircraft Corp., Missile Systems Division, Van Nuys, Calif.) agreed, saying that you might have a multi-variable system in which some constraints are not known to the other people; they do not know whether the maximum peak exists within the specified area or not. You may optimize and come up with a little local peak, whereas if they had some feedback from you there may be a big peak that you can get to if the original constraint can be modified. Sometimes it might be possible to vary each one 1% and get a 10% over-all improvement.

Concurring, Otis illustrated with his diagram of areas, showing possible improvement if there should be some latitude to the constraints—a powerful argument for the systems approach!

McLeod asked Bemer whether he was suggesting that we find a way of evaluating the constraints rather than going into a problem with set constraints. If we can devise a method for evaluating constraints, then we have opened up an entirely new area.

Bemer answered that if you are concerned with a parameter study you certainly should consider all of the fringe areas beyond the given boundaries.

Bill Waddell said that he handled such problems from the systems design point, and that the first thing to evaluate in every problem is the ranges of the boundary conditions.

McLeod observed that the trend of the meeting was to keep coming back and focusing attention on criteria and the weighting of the criteria. If you can do that you have most of the problem beat. Is not the problem of optimization really the determination of the criteria and then the evaluation of the coefficients and exponents?

Irvine Asks For Specific Techniques

Norm Irvine said he would like to change the trend of our philosophical discussion. Instead of attempting to determine what optimization is, let’s just assume that we wish to come as close as possible to a certain goal. Then how do we handle the computer program to know when we have accomplished this? Going back to the second-order servo system, suppose we launch into a computer program to try to optimize some of the parameters. Is there some established technique by which we can accomplish this, or do we just go in blindly, changing variables systematically in a brute-force method? Is there some quicker technique?

Bemer suggested that we use our heads. (Heresy again!)

Otis said he had intended to come back to that after we had dived into the philosophy enough to be sure we knew what we were talking about. We receive or devise criteria, then we search for a way to locate the maximum or minimum of a criterion. Here the calculus conditions our thinking. Then, perhaps, we should go one step farther and see how big an area we have around our chosen point in which we do not depart further than the noise level of our data. In other words, do we have a very sharp and sensitive peak, or do we have a broad plateau so that we can set our variable for an optimum and then normal production tolerances and maintenance variations will still leave us optimized?

Norm said he could partially answer the question he originally raised. The morphological approach as far as he knows allows you to go through all possible combinations and rule out certain areas. Does anyone know any other way of approaching the problem?

Otis said it boils down to this: we set up objectives and criteria, and determine our constraints from technology and elsewhere. Then we find

Jerry Jacobs (standing) discusses a practical case of optimization, evoking deep thoughts in Myrtle Knauft of Motorola (A), Mike Foley of Western Prec. Corp. (B), Bill Waddell of Giannini (C), Niels Christensen of Firestone (D), W. Yopp of Douglas Aircraft (E), and S. Cooper of Motorola (F).
ourselves with some fields mapped out in which we believe our optimum or optima lie. What is the best search technique? What is the optimum search for optima?

Bemer, our "head" man, again suggested that drawing a few curves and making some predictions works out pretty well. Using a computer to optimize this optimization search would take so many years that we couldn't afford it.

McLeod said this wasn't necessarily so. You might often be confronted with problems of the same type, but with different values of constraints and criteria. In such a case it might pay to take the time to set up the computer so that thereafter all you would have to do would be to drop in a different deck of cards or change the adjustment on some pots to get your optimum.

Otis said we can build on experience and thus get a nonlinear gain in knowledge. We can find methods for solving standardized problems and then devote our brain power and time to improvement of the programs.

Bemer said one of the better methods of searching is to lay a coarse net over the map and assign each variable maybe three values and take those in combination. This gives you a rough topological map wherein you can search locally. This the computer can do.

"If we apply the theory of games," Otis asked, "would we not perceive that instead of laying a net we should pick random points and examine these?"

Bill said he considers search techniques in two classes: the intuitive and the mathematical. It doesn't matter which you do first.

Otis added that actually you often alternate between the two.

Mike Foley said you would probably use the intuitive search first to find the region of interest, then use the mathematical search. If you start with a mathematical search it might be next year before you begin to see the picture. Mike said they have been able to make quite a few short cuts by using graphic analysis as much as possible. Then you are able to see the picture as a whole, instead of the minute quarters which you might be concerned with in mathematics.

Otis observed that most of us are probably geometry-minded; certainly he is.

Refreshing Intermission

An intermission was then called, and we all went out to the canteen for refreshments, which were served in a unique manner. The canteen is mechanized (as is fitting and proper), and it takes dimes to get things. But Motorola said we should be their guests, so when we went out we found lovely ladies with a great many dimes, which they obligingly shoved into the designated slots to serve us. Thanks, Motorola!

Otis opened the second half of the meeting by explaining to those who had not attended a Simulation Council meeting before that we do not mind sounding off even when we don't know what we're talking about. "Shuck your shyness and let us hear from you," he said. "Your comments, even though they prove naive, may serve to bring out the answers to questions from others."

Jacobs on Practical Possibilities

He then asked Jerry Jacobs (Hughes Aircraft Co., Culver City, Calif.) to tell us some of the discussions he had had during the break. Jerry replied that he thought optimization should be put in terms of an economic man, defined as one who seeks pleasure and avoids pain, masochists notwithstanding. With computers and systems it should be the ratio of effectiveness to cost. Our discussion has been unrealistic in that it assumes that we can list n or n+1 factors which are important, and knowing how they are functionally related one can use deterministic procedures of mathematics and find a maximum. This is never the case with any practical system because nobody can completely specify a system. The best you can do is in the hyperspace of n dimensions is to divide the hypervolume into two hypervolumes; one wherein the specifications are given and the other where they are not. Besides this simple division no optimum actually exists. Having done this you can devise new specifications to limit the volume still further—and if you ever diminish the volume to a point we will all be long dead. So we should break off this philosophical discussion and start worrying about two or three variables. How do you then find the region where people are happy and the other where they are not, using a computer?

Otis agreed that it was time to get to practical cases.

S. E. Cooper (Motorola) said it seemed from conversations during the break that everybody thought optimization should produce the best possible system obtainable. He doesn't feel this way. For instance, consider a passive linear network wherein you want a given response for a given excitation. Let's say that you are able to arrive at your exact response with 18 elements. If you wish to arrive at that response with the least number of elements, then you must look for superfluous elements. Suppose you can cut the number to nine—that still doesn't mean you have reached the optimum. If you can approximate the response with fewer elements, then that might be the optimum.

Agreeing, Otis showed how this fitted in with the idea of applying coefficients and exponents to our previously listed criteria.

McLeod thought that Jacobs and the others who urged a return to practical problems were right, so he suggested that Jacobs lead off by showing us how he would handle his two- or three-variable problem, in terms some of us might be able to understand.

Bill Waddell asked what type of search technique we were talking about. If we take a square root with a digital computer, we get a solution $a_n$, then a solution $a_{n+1}$. The magnitude of the difference may be a criterion. If the difference is less, the solution is good enough. Is that the type of specific thing we are talking about?

This pitched us back into a discussion of the philosophy of what optimum means, whereupon Otis observed that "the Greeks, who were pretty good at this sort of thing, argued for centuries as to the nature of truth. Optimism is a similar sort of thing."

A Filter Design Problem

Jerry got back to his example and considered the design of a filter having three variable parameters. Specifications limit the percentage overshoot under a given set of conditions as $K$, $T_1$, and $T_2$ are varied. He then asked Irvine if in his nonlinear servo illustration the performance was limited to a certain-sized step input.

Norm said generally yes, that it depended on the system.

Jerry specified transient less than $n\%$ and that the system be stable. He sketched a three-dimensional space, the ground plane being the two time constants $T_1$ and $T_2$, and with the gain vertical. Considering only the
first criterion, there is a certain volume in this three-dimensional space which defines values of these three parameters wherein the overshoot is less than n%. Then if we consider only stability we will get another volume which defines combinations of the parameters for which the system is stable. So if the two volumes intersect within that region, combinations of the parameters will satisfy both criteria. To further select the point defining the best parameters to use would require more criteria—for example, a minimum static error, or at least m% tolerance on the time constants. Because we could go on forever inventing new specifications, we can never completely specify the system. Therefore, to put down all criteria first and then try to define a point is prohibitively complicated. He advocates selecting two or three criteria to get under way and then limiting further as we go along. In practice, families of curves rather than three-dimensional drawings are usually used.

**Updike on Possible Computer Technique**

Oitis complimented Jacobs for a fine discussion of an attack on a concrete problem. But he would like to get even closer to our problem and consider the computing hardware that has been used. Many problems of this nature, where the discontinuities of constraints dominate the picture, would undoubtedly not warrant setting up the computer. But certainly some would. There are a couple of papers in which this sort of thing has been touched on, one in the proceedings of the Wescon of 1954 by Louis Wadel (Chance-Vought Aircraft, Dallas, Texas) and the other presented at the 1955 Western Computer Conference by Wadel and Wan, dealing with automatic iteration with analog computers. If criteria could be put in suitable form, computers could thus search a region and test to see if criteria have been met.

Oitis suggested that as an example, in the examination of a filter such as had been described, a repetitive computer may be used and the response curve displayed on a scope face masked to fit the tolerances. If the desired response curve, plus-or-minus tolerances, were masked off and watched with a photocell, any solution showing light outside the mask could be discarded.

Norm observed that in his case the "mask" had been a human being. Oitis said yes, that seems the usual practice at present.

Bill Waddell said something similar was done by Askania Regulator Co. in Chicago, and by Dick Lathrop at Wright Field.

Oitis said that if we could set such a problem up on an analog machine with servo pots, or fixed resistors and stepping switches, we might push a button at four o'clock, stand around for half an hour to see that everything is OK, then leave. Next day we would return to find the region that fits the conditions recorded.

Gilbert Kemp (Convair, Pomona, Calif.) wanted to know how Oitis would make the machine know which way to step the relay. Several methods were discussed, depending on the criteria.

**Brute Force Vs. Brain Force**

Oitis reminded us of what had been referred to as a brute force method wherein a coarse grid is laid out and the computer is caused to step along it, then go back and make successively finer investigations. This technique reminded Oitis of the game "Salvo" in which, if you go along correcting your blind shots at the target according to a perfectly uniform coordinate grid, you are likely to lose the game. There is a better strategy which might be derived from game theory.

Waddell said we should set up a digital computer to select the strategy and then run the problem on an analog computer.

Bemner agreed that this was not at all unsound.

Oitis observed that if you have a computer which will run very fast you can whip out thousands of solutions by brute force methods. Then the problem boils down not so much to how you set it up as to how you examine it to see if criteria are met. With slower equipment you must be more subtle.

Hans Meissinger (Hughes Aircraft Co., Culver City, Calif.) referring back to the mask method, remarked that it might be feasible to set up a function which meets the requirements and play it into the machine, compare it with the repetitive solutions, and evaluate the error integral.

McLeod observed that unless you have a very fast machine, so that the number of "experiments" which you can run is unlimited, you must use some statistical method for planning the experiment. But if you do have a fast machine you can go ahead with what we have contemptuously referred to as "brute force" methods and take advantage of the power that we have in the computer. Sometimes this might be best.

Bob Bemner, still in favor of using our heads, demurred. "If you have, as somebody mentioned, an 18-parameter problem and you examine it half as finely as you otherwise would, you are saving 218 searches. Even on a very fast computer that to a high power makes the method unfeasible as compared to using your head. You can never afford a direct brute force method.

Oitis said there were many techniques that could be discussed. Perhaps we should get into such things as linear programming, regression analysis, and combinatorial analysis, but that we would have to continue this discussion some other time.

**Politics**

With this meeting Norm Irvine, elected Vice-Chairman of the Steering Committee six months ago, succeeded to the Chairmanship, as is our practice in the Western Simulation Council. After an unsolicited and unappreciated campaign speech in which your editor pointed out that Bill Waddell, as a great proponent and practitioner of our way of siring half-baked as well as other sides, would be an inspiring leader for the less vociferous of us, Bill was elected to the Vice-Chairmanship, to succeed Norm.

**Information (Without Theory)**

Each month we have been hoping to be able to give you the story of an extremely interesting and important panel discussion, "Possible Effects of Automation On Our Way of Life," sponsored by the Industrial Analysis and Control Council and the Engineering Department, University of
California at Los Angeles. Your Secretary made a tape recording of it, and after having worked like mad putting the act together, Stuart Schy (Librascope, Glendale, Calif.) was gracious enough to offer to have it transcribed. But Stu, like the rest of us, has been too busy. So if you are interested in hearing what a representative of the Junior Chamber of Commerce, an economist, an engineer-president, and a labor spokesman have to predict about the impact of automation on our way of life, we will lend you the tape if you will have your Gal Friday transcribe (not edit) it for us.

And speaking of Automation brings to mind the cartoon by Lichten showing a personnel man speaking to the President of Toolte Valve Company: “A guaranteed annual wage, a guaranteed annual bonus, a guaranteed pension plan is fine with the employees, chief . . . Except they would like a guarantee you won’t go broke . . .”

We (not the editorial, we, but Suzy and me) went to the Electronic Components Conference banquet in the Cooconut Grove last month. A debate “Resolved: Transistors Will Soon Replace Most Tubes” was scheduled, but our real interest in going was to dance to Xavier Cugat and see his floor show. The dancing and the floor show were tops in his field, but were second-rate entertainment compared to the show put on by Simon Ramo as moderator, Harper North and Louis Ridenour for the affirmative, and W. R. G. Baker and C. S. Irvine for the negative. “The results,” as Dr. Ramo so aptly put it, “were debatable,” but the performance was excellent. I would like to be their agent!

Thots (to think about)

Heard over a tequila in Hays’s Cantina way down in Baja California, Mexico, a remark which might appropriately be made at some “conferences” we have attended. “We can speak freely, unhampereed by the facts.”

Which, for some not-at-all appropriate reason, reminds us of a quotable quote from the SAE Journal: “Technology advances by creating a realization of new areas of ignorance,” and the statement by W. W. Smith of GE: “The greatest value of the computer to date has been its stimulus to creative thinking.”

Computer Events

Western Simulation Council
Date: Tuesday, 23 August 1955, 1:00 P.M.
Place: Berkeley Scientific Division of Beckman Instruments, 2200 Wright Avenue, Richmond, Calif.
Subject: “High Precision Techniques”. This is expected to cover such aids to precision as automatic setup, the incorporation of digital methods, and checking techniques. No Security Clearance required.

Western Simulation Council
Date: Thursday, 10 November 1955
Place: Beckman Instrument Co., Fullerton, Calif.
Subject: “Simulation with a Human in the System”

Midwestern Simulation Council
Date: Monday, 15 August 1955, 1:00 P.M.
Place: Wright Air Development Center, Wright-Patterson Air Force Base, Ohio
Subject: “Cute Tricks in Simulation”—Demonstrations of equipment will be featured. Contact: Dr. L. M. Warshawsky, C/O Commander, Wright Air Development Center, Attn: WCRRU, Dr. Warshawsky, Wright-Patterson Air Force Base, Ohio.

University of Wisconsin—Summer Session
Dates: 1-12 August 1955

University of Wisconsin
Dates: 17-19 August 1955
Subject: “The Computing Laboratory in the University”. Contact: Preston C. Hamer, Numerical Analysis Laboratory, University of Wisconsin, Madison, Wis.
Symposium, sponsored by Stanford Research Institute and National Industrial Conference Board
Dates: 22-23 August 1955
Place: San Francisco, California
Subject: “Electronics and Automatic Production”. Contact: Stanford Research Institute, Palo Alto, Calif. or the National Industrial Conference Board, 247 Park Avenue, New York, N. Y.

Massachusetts Institute of Technology
Dates: 22-August-September 1955
Place: Cambridge, Mass.

WESCON
Dates: 24-26 August 1955

Association for Computing Machinery
Dates: 14-16 September 1955
Place: Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Penna.

Fourth Annual Louisiana Polytechnic Institute, Institute Instruments Conference
Dates: 3-4 November 1955
Place: Ruston, Louisiana. Contact: School of Engineering, Louisiana Polytechnic Institute, Ruston, La.

Eastern Joint Computer Conference
Dates: 7-9 November 1955
Place: Hotel Statler, Boston, Mass.
Subject: “Computers in Business and Industrial Systems”. Chairman of the program committee, Dr. I. Travis, Burroughs Corp., Paoli, Penna.

Second Computer Clinic
Dates: 15-17 November 1955
Place: Navy Pier, Chicago, Ill.
Feature: Six 2-hour demonstrations and lectures on various computers. Fee is $5.00. For registration: 2nd Automation Exposition, 845 Ridge Ave., Pittsburgh 12, Penna.

National Simulation Conference
Dates: 19-21 January 1956
Place: Dallas, Texas
It is expected that most of the papers will fall into the analog computer category, but papers on the use of digital computers in simulation will be strongly encouraged. Deadline for 100-word abstracts and 500-word summaries is September 10. Contact: J. R. Forester, 2104 Huntington, Arlington, Texas.

Western Joint Computer Conference
Dates: 8-10 February 1956
Place: San Francisco, Calif. Contact: Byron J. Bennett, chairman of the technical program committee, Stanford Research Institute, Stanford, California.