

ARCHITECTURE MACHINATIONS

A weekly newsletter of the Architecture Machine Group, Department of Architecture, M.I.T., Room 9-518, Trilla Ramage, editor.

Vol. III., No. 7

February 15, 1977

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THIS WEEK AND BEYOND:

Wednesday, 16th of February
3:00pm

4:00pm

Animation Meeting. System Status and Conventions; short-term goals. Refreshments.

Next in the raster-scan series: the Vagaries of the 85 with guest speaker Bennn McCann. UROPers and others in attendance. Rm 9-451.

Thursday, 17th of February
2:30pm

Nicholas at NBC.
Second Mapping by Yourself planning meeting (RB, CFH, MC, RM, WD, PAP, and any others interested).

Friday, 18th of February

Nicholas at NBC.

Tuesday, 22nd of February

All day meeting. Lunch will be served.

Friday, 25th of February

Interdata brass visit.

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PROPOSED ALL DAY MEETING by Nicholas Negroponte.

Tuesday, the 22nd of February, is one of the Leon Groisser holidays, when there are no classes. This means that we do not have to navigate around everyone's class schedules in order to hold a meeting. I recommend that we have an all day meeting with everybody or as many people as possible attending, on a number of topics including: MAGIC 6.0, Animation, NSF work, Spacial Data Management, Xerox progress, Hardware, and general gripes. In some cases this will be for the purpose of presenting ongoing work in greater detail than a Machinations' blurb. In other cases it will be to debate questions of hardware and software. Please let Naomi know if you can come. Lunch will be served in a room to be found. Everybody is welcome. It will preclude the need for an issue of Machinations that week.

VISIT FROM WILLIAM MITCHELL by Guy Weinzapfel.

As prophesied, Bill Mitchell arrived Thursday afternoon to speak with Mike Gerzo about SAR and with the ABY crew about his survey of 3D data bases for the Corps of Engineers. In preparation for the later meeting, students working on ABY had spent an hour with Chris Herot, Monday, getting briefed on the basic issues of 3D data bases.

The contrast between the two briefings was interesting. Chris presented a rather machine oriented view of the subject; Bill spoke on a broad conceptual level. Chris outlined the topic relative to:

- 1). What Makes It Interesting:
i.e. complexity, need for trade-offs in size of structure access time, etc.
- 2). General Structure:
i.e. object=volumes=faces=edges=verticies;
the need to double store pointers;
...
- 3). Functional Capabilities:
abilities to compute the intersections of planar, cylindrical, revolutionary & B surfaces.
- 4). Some major systems/approaches:
Eastman's BDS,
PADL, and
Baumgart's "winged edge" poly hydria.

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VISIT FROM WILLIAM MITCHELL continued.

By contrast, Bill outlined the topic according to:

- 1). Levels of Modeling:
 - a) Symbolic - building expressed internal to a machine as symbols, sets, ...
 - b) Geometric - objects and operations performed on them.
What vocabulary? (planes, polyhydria)
What operations?
 - c) Architectural - objects with specific meaning manipulated via a specific, high level command language, either formal with well defined syntax and vocabulary (i.e. post, beam, panel with their possible associations) or natural (no existing examples?)
 - d) Special Views - i.e. M.E.'s want to see flow systems; C.E.'s want to see structural joints; this all presenting problems of:
 - 1) abstract representation from detail information,
 - 2) aggregation of disparate data;
 - 3) derivation of implicit data,
 - 4) reorganization, and
 - 5) consistency checking.

Bill then went on to outline two entirely different approaches to data base development: data storage and procedural storage. The former is obvious and similar to most of Chris' presentation. But Bill's explanation of procedural representation was the interesting part. Assuming the reader knows the difference, I will eschew elaboration. Some interesting news, however; Warnoc, working at Evans & Sutherland in Palo Alto (Mountain View?) has developed a completely procedural 3D data base for design of drilling rigs, refineries, and so forth. The work was done for the Flore Corporation (correct spelling unknown) which has a \$10B(!) construction backlog. Warnoc's DB is, of course, connected to the E&S display system. It conjures staggering power in my mind.

Bill noted that Martin Newell at Utah has also developed (or is developing) a fully procedural DB. There followed much discussion of the relative merits of procedural vs storage approach. And then, a few questions about his probable recommendations to the Corps. His response will be:

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VISIT FROM WILLIAM MITCHELL continued.

"If you want something now, then A.

"If you want something soon, then B.

"If you want something eventually, then C."

I omit A,B,&C to be fair to Bill. You should read it in his hand.

I was sorry that Mazzie and Peter were unable to attend; it was a useful overview - for everyone.

WHY IS THE COBBLER'S SON BAREFOOT? by Nicholas Negroponte.

The following has no specific news, message, or conclusion with the exception of sharing concerns about our current computing resource and its growth. We have to make some serious decisions in the next 30 days about where to invest our next wave of hardware funds. (some of the purchases of which can arrive as early as May). To put this in relation to the last three years, you should know that we have been receiving in excess of \$100,000 per year of capital equipment. This figure does not include an almost equal amount of "materials and supplies" in the form of GP boards, IC's, cables, power supplies, and the like.

I was recently told that our current four user processors are no more in number than in 1972, when, if my memory does not fail me, we had two model threes, a model five, and the model 70 (yes, the same one). This remark surfaced in a conversation about the shared bus. And, yes, MAGIC 6.0 will be a year late.

The complexion of our forthcoming question looks something like the following: Should we proceed toward one 8/32 or 9/32-like machines with lots of memory, or, should we target a handful of smaller machines? My answer is (as usual): both, by getting something like an 8/32 with a modest amount of memory (less than 256K) and several 7/32 or 7/32-like machines. Some of these should have dedicated disks.

My aversion to time-sharing is well known, documented in The Architecture Machine (written in 1968!), and need not be repeated. At the same time, it is quite ridiculous to have to sign-up for a computing resource, especially in cases that require precious little computing (like: program preparation). So, what do we do?

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WHY IS THE COBBLER'S SON BAREFOOT? continued.

I see the I/O processor as a disk controller. Maybe it services a machine that itself can support a number of "light" users, like: 4.20 or 4.201 people editing, compiling, and running short programs. Similarly, the I/O processor might drive things like the Imlac or the Owl, with their own text buffers and local editors, for text preparation (documentation, proposals, articles, etc.). Finally, it supports user processors, some with and some without their own disks.

The user-processor disks can be 2314's on three user-processors (if we buy the currently rented interface and if we use our current drives). This would mean that a wise decision would be to cancel the latest 2314 order and put that money toward a large Trident or Trident-like machine, of 3330 technology, in the 300 megabyte range. Three or four such drives should hold us for a while. Also, this would give us an extra 2314 (even leaving the CV machine as is) which could live on the 85, making it possible for Donelson to instrument his redundant picture scheme for his "infinite sheet".

Going back to processors, I would like to share Craig Fields' observation that we are short on processing power (with the possible exception of the 85, but that's only 16 bits). We should start thinking seriously of special purpose 3D display equipment and an associated fast processor, maybe the Lippman machine. What I would like to avoid is getting a metabyte 8/32 and have it swallowed up by the file-processor or even time-sharing chores.

FORCE-FEEDBACK by Dave Gorgen.

My exertions during January have resulted in one-dimensional force-feedback running on the CV machine. It employs the Interact II and a special interface that allows the force applied to the joystick to be read by the Nova, and runs under CADDS3/OS. Using this setup, one can tactually explore a piece of "terrain" (actually it is more like a section of a roller-coaster track). One pushes the plotter arm "uphill" and encounters resistance; there is less resistance on the level, and the thing will roll "downhill" by itself. Inertia is now implemented and is adjustable.

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FORCE-FEEDBACK continued.

The basic workings are as follows: the program causes the Interact to draw vectors at a constant rate. Varying the length and direction of these vectors varies the force exerted. This force is the vector sum of the force exerted on the joystick and the force exerted on the virtual roller-coaster car by the virtual track due to the presence of the virtual gravitational acceleration (got it?). The plotting arm is constrained to move only in the horizontal direction, and only the x-component of the above forces is considered. If you want to get a better idea of how this works, you are free to play with the device - it won't break your wrist, I swear! Ask me to set it up for you.

This scheme of implementation has one major drawback - the motion of the plotter arm is not smooth. This is because the hardware that controls vector-drawing accelerates the arm for the first half of the vector and decelerates it to stop for the second half. This cannot be circumvented short of sabotaging CV's Input-Output System that drives the graphics devices, or building our own Interact II controller. I am assured that the first alternative is impractical; the second is appealing for several reasons, but involves getting new hardware and software and is not straightforward enough for me to want to stake my graduation on its timely completion. There is also the consideration that the same person ought to develop both the Interact controller and the higher level, force-feedback software, for reasons of efficiency and comprehensibility.

On the other hand, as matters stand, our force-feedback is too jerky to be acceptable (in particular, acceptable to ARPA); and since vector-drawing is the only means we have to move the Interact's arm, we are stuck. This leaves me with the opportunity, indeed the necessity, of executing a mid-stream change of steed: I will enter the wonderful world of ARPA sound. This does not mean that we are abandoning force-feedback, only that it will proceed to its conclusion without me, and after the smooth-motion problem is solved. I leave behind me our present implementation, which together with a few oddments comprises the contents of directory DAVID on the CADDS 3 New Dev Pack; documentation of some sort; and the demonstration program using the 85 and TV that is the subject of my article in the Christmas issue of Machinations. Also my condolences for any successor of mine who may have to develop software on the CV system.

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SOFTWARE DRIVEL by Seth Steinberg.

First some good news about MAGIC Six and the PL/I compiler: the PL/I compiler is running in rudimentary form under MAGIC Six. The code it produces actually executes which is very impressive. We are now working on stuffing it into a new domain but have not succeeded yet due to some minor bugs in the domain mechanism.

Other news is from the MAGIC Four front:

-all four machines can now run under the remote system (if 5.EXEC. on the central pack is right, see pack F for details).
NEWPROC - IPL SnnRM can be used to run the remote system where nn is 16 or 32. If time allows we will try and get the -RM option working.

-Rich Kovalcik has threatened/stated that it would be nice to rename ADD_ALIAS_NAME, CHANGE_REF_NAME, and CHANGE_DIR_NAME to some shorter forms, probably three letters each so that they can be typed in finite time by non-experts. This may be done by him and DM on all packs sometime in the near future. So, as they say in the trade, "You Have Been Warned".

-If you attach REMINT (aka RI) under a moving head system typing REMINT will enable your remote interrupt buttons to work. This facility is currently primitive but may improve with time.

Now that the central machine can read and write the memory of any of the remote machines, it would be nice if the central machine could also stop and start the remote machines from any arbitrary state (e.g. hung in microcode). The software team has suggested computer controlled Smokey Stover fingers to push appropriate buttons though this may not be feasible and a completely electrical (vs. mechanical) linkage may be preferable.

Rumors, bugs, and the like: The old condition name longer than eight letters bombs the PL/I compiler bug is still out there and threatened to destroy the Animation Group (node network). Partial structure referencing (e.g. b(i).c instead of a.b(i).c) can still be losing. BM and WCD will attest to this.

I am running a little low on drivel so rather than rant on, I'll can it here.

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SIGN UP STICKERS by Chris Herot.

With the start of the spring semester, the number of unfamiliar names on the sign up board has increased. The problem is compounded when new people, unknown to the rest of the project, use only their initials, or even more mysteriously, a symbol. While such distinctive symbols do have their advantages, it can be very disconcerting when no one on the floor can identify its owner.

Therefore, I am asking all new people to use their names in lieu of, or in addition to whatever sign they employ. Blank stickers can be obtained from Margaret Cheskin in Room 9-520. Also, please make sure that Margaret has your correct address and phone number.

This message is a request. In a few weeks, sign up stickers which cannot be identified as belonging to a person on the master list will be removed.

IDIOSYNCRATIC KEYBOARDS by Seth Steinberg.

Traditionally, a keyboard is a device made up of a set of switches which is used for the entry of alphanumeric data. Most keyboards have been loosely modeled after the traditional typewriter keyboard and result in the striking of a key causing the transmission of one character. This character transmitted is usually the character associated with that particular key. From this we can derive an n-to-n mapping of keys to characters which is displayed to the user by printing or engraving the standard (or one of the standard) graphic representations of that character on the top of the key. This convention has been adhered to even in relatively advanced systems such as Knowlton's Virtual Keyboard which involves a virtual image of these representations as opposed to a real one.

Knowlton started working in the right direction. Since the images on the keys can be updated dynamically, it is possible to change the characters transmitted by each key when the key is depressed in certain contexts. This can be taken a step further by changing the basic hardware of the key, as well as that of the image production. Instead of having each key cause some particular transmission, keys can be thought of as general purpose and therefore intelligent actors. Thus, when a key is depressed it first must decide what course of action it will take. To simplify initial research we have limited these actions to:

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IDIOSYNCRATIC KEYBOARDS continued.

- 1) do nothing,
- 2) transmit the appropriate character,
- 3) transmit some arbitrary character,
- 4) transmit the character associated with the last key hit,
- 5) perform 2,3, or 4 several times in random combinations.

The implementation involved the use of a standard Imlac keyboard (in this case the one on Imlac 3C) with no modifications whatever. Initially, we thought that some modifications might be necessary but none were needed. Once the system was working we attempted to see how the idiosyncracies of the device would be used by various users. Most users just got discouraged by the machine and refused to use it. (The fact that the screen was behaving idiosyncratically as well as refusing to display at times would further increase the probability of users giving up. There will be a report on idiosyncratic displays nextweek in A.M.) Those users who stuck with the keyboard and mastered it learned the joys of an intelligent keyboard.

These include the simple fact that both the human and the machine can make typing mistakes, thus decreasing the onus of typing errors. Therefore, a user who forgets the E in ASSEM may find it automatically corrected or (more likely) find that the machine lost one of the S's. In the former case the user would start to delete the word by using the erase key which like many other keys has an idiosyncratic effect on the line. Thus, instead of typing ASSEM in 5 simple strokes it turns into an entertaining task and a full fledged battle against the unknown, complete with a pseudo random display much like Alice's game of croquet with the Red Queen. Once the user stops associating the marks on the keys with the characters transmitted by depressing them, typing is no longer a chore but a challenge. (Early attempts at breaking this association on Imlac 3A have been quite successful.)

From the study so far, we can reach several conclusions. A fixation on getting things done can result in missing the joys of idiosyncratic systems. There is more to an Imlac than meets the eye or fingers. And finally, that machines can de-optimize human typing patterns, though more work can be done on this in the near future. People who would like to try out Imlac 3C (or 3A) can do so almost any time in the machine room.

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A NOTE FROM THE TYPIST

The next paragraphs appeared on my desk following the typing of "On Being Creative with CAD". The note was sparked by the section which commented on the fact that American culture is composed of 'doers' and, in many respects, does not cultivate individual creativity. Whether or not this is true, Marshall's comments are interesting, partly because all of our good intentions are embodied in a very difficult to use and probably stultifying system. Also, for those of you for whom he will be typing technical documentation, you can enjoy a preview of what he might think about PL/I.

I had to redo page 1 and substituted "comradeship" for "camradery". There isn't any such word, although there is ofcourse cameraderie, which I'm going to go back and insert as its less political. So I've sbustituted, by the time you read this, cameraderie in italics for cameradery.

I wrote a much longer note on this subject, but I dont think you should keep on with the "Americans don't think" attitude in para. 3. Americans all too often reserved only a monkey-like facility at doing and abandoned all claims to there ever having been a thinking American back in Europe in 1958 when I was living there. That was nearly 20 years ago. It got so I could immediately blank out when I heard the words "Of course, American culture..." No one will deny that there was damned little coming out of the US during the renaissance or the Classical Eras but ever since about 1790 we've been a respectable contributor in the areas of political theory, especially democracy, pedagogics, especially in the area of educating every brain that gets born in this country so that everyone gets at least the fundamentals just in case they want them later (as opposed to Europe, which still more or less quits educating their children who are not part of the elite high scorers in the various baccalaureates and General Certificate or whatever tests at about age 12. There're a lot of kids in Europe right now working as delivery boys and maids at about age 15 who would still be in there getting their potential developed over here. Europeans have a long history and the bulk of its length is tribal. I'm just pointing out that the American tendency to denigrate American culture to Europeans was, to me, an invalid drag conjured up just in case whatever European you were talking to had had to endure some Uncle Sam type chauvinist recently. Sure, sure, da Vinci, yes, Balzac, yes, sorry, Goethe, no, of course not, we've all been drinking Coca-cola for 200 years back there its all we've got in the way of culture, you're quite right, etc., etc.. ad nauseum.

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NOTES FROM THE TYPIST continued.

Another thing is that there's a good deal of space in your paper devoted to the difficulties of the mechanics of computers, rather as if I wrote a paper stressing "it's really tricky learning to type fast". In short, you'll pick it up, or at least your audience will possibly assume that whoever's working on the terminal will pick it up and that with increased facility comes increased creativity.

All of the anecdotes are amusing and usually to the point but the use of anecdotes at all is generally accepted to have been developed before the marketing of Valium and discontinued since. You know what I mean. Personally speaking, I think the Jeep anecdote, the red typewriter ribbon anecdote and the Ø thing might be reevaluated. The Jeep story illustrates a phenomenon with which everyone is familiar and has remarked on and about which cartoons have appeared in the New Yorker and although it will amuse the reader or listener, it'll irritate them later that they were amused. Also, it doesn't quite interface with personalized computer systems, the next section. The red typewriter ribbon might bring objections on the grounds that you are personally deliberately refusing to use your own technology in the office or take it into account when working at home and besides, everyone hates to get messages with important words typed in red. Christ. Its awful. Getting rid of red and black ribbons was one of the best results of the introduction of the IBM systems of typewriters. So megalos, you know, those red phrases? Also, you will be addressing an audience of scientists and when you get to that part about o's and Ø's some lush may lurch up screaming, "Ees fawking ZERO, bourgeois Yankee dilettante, go back to school," and people may begin throwing their programs and refreshments at you. Fair warning.

On the other hand, that phrase about objects at night being "elements of form reduced to the hidden scaffolding for a sculpture of light." is really tasty.

The principal reason you're getting all this unrequested commentary from the typist is that when I showed up tonight the console wasn't in MAGIC and there wasn't a single, solitary person among the 3 people working here who could get it into MAGIC. So I can't enter any documentation and I went back to your paper and put in the headings. Then I redid page 1 because I hadn't brought the 2d column up even with the heading. Would you please spread it around thickly and thoroughly among those who can get the consoles into MAGIC that when The Idiot is scheduled to enter documentation they MUST LEAVE CONSOLE 3E IN MAGIC BEFORE THEY GO HOME. Next time this happens there won't be any leftover work on the IFIP paper for me to do and I'll have to walk all the way back to Beacon Hill in the freezing cold muttering "Golly gee shit" and I don't deserve it. I know its unusually presumptuous for any person to say they don't deserve whatever pain they get, so I'm probably wrong. Since none of these people could do it, apparently switching programs is too difficult to teach me to do either, but if it can be taught to me, please have someone teach it. There's too much wasted time because of the software as it is.

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NOTES FROM THE TYPIST continued.

Maybe you ought to just give this to Chris, since I'm sure this isn't what either you or MIT think you ought to be doing with your time. Still, if it gets to be a recurrent thing it will get annoying.

I'm scheduled tonight for midnight. LS will be using the console before me on Pack Ø. Please ask him to change it after he leaves.

As tonight is an almost total loss, please schedule me for 2 TWELVE HOUR STRETCHES THIS WEEKEND. With a reasonable amount of time in between. Judging from the notes on the board tomorrow is scheduling day and, like so many others, I won't be there. So can I get that request in now? 24 hours on the console during the weekend, any hours at all, but I've got to leave by about 9 o'clock Sunday night as I start a daytime assignment at the Space Research Center down the street on Monday morning. I'll still be working here at night, but with more emphasis on the weekends. That also means that next week I'll need to start in around six p.m. instead of midnight. Its just for a week.

VTY

Marshall

RAMTEK NOTES by Andy Lippman.

A new group of programmers is being assembled into the Ramtek development group. So far, this includes Craig Finseth and Mike Atwood, both newcomers of the Architecture Machine.

Now that the basic graphic support software is running, we expect the machine to be more heavily used, and more and more support will be required. One of the first tasks will be to implement the flood algorithm in the microprocessor of the Ramtek. We are anxiously awaiting the arrival of an in-circuit emulator so that we can write and debug these programs.

Also in the near future, you may expect to see a Summagrpahics tablet directly interfaced to the Ramtek, and the Vidicon up and running.

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THE SHAPE OF THINGS TO COME by Graham Copeland.

Following my meeting with Nicholas Negroponte on Friday, it is now resolved that I will be joining the SAR group.

XEROX PROGRESS REPORT by Andy Lippman.

Myron Tribus met with Nicholas, Paul, and myself last Thursday to discuss our color Xerox work and to plan the future of the project. We spent some time discussing the strobing problem, and Myron came up with some good ideas and insights. Here are the results:

For those of you not familiar with the project and the problem, strobing is the result of exposing the Xeroxgraphic drum to the repetitive flashes from the television monitor. It is precisely the same problem that occurs when you aim a movie camera at a TV screen: the two exposures rates are not the same, and beats appear. In movies they show up as horizontal bars across the screen. In the Xerox, they show up as 15 lines per inch density variations in the output copy.

The original scroll program did not attempt to correct this problem because we were only working with primary colors. That program merely calculated which lines to display on the compressed TV scan so that they would all overlap on the final copy. When we wanted to print black, we turned the beam off, and when we wanted to print white, we overexposed the drum. Now that we want to print grey tones, the exposure is critical. Since the Xerox is a high contrast reproducer, exposing the drum to even one extra frame of image can cause noticeable grey tone errors in the print.

Our first attempt at fixing the strobe was to rewrite the program so it would count the number of times each image line was displayed on the monitor. We did that last Christmas, and it failed. At that time we re-analysed the problem, and now we have a better feeling for what is really going on. This is best explained with reference to the illustration (at the end of this paragraph). The x's indicate the times that a particular image line on the drum is lined up with the electron beam in the CRT. In the first frame, it is

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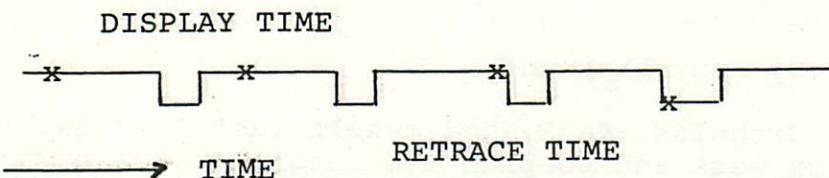
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XEROX PROGRESS REPORT continued.

near the top, and it moves progressively closer to the bottom of the screen. Sometimes, it is lined up exactly while the beam is in the vertical retrace interval, and thus does not get exposed.



There are three parameters that we can vary to control where the x's fall on the TV sweep. They are (1) the screen size; (2) the number of active lines in the display; and (3) the vertical refresh rate. The first parameter effectively moves the x's either closer together or farther apart. The second affects the ration of retrace time to display time, and the third affects the time scale of the entire display. The object is to make the display interval a multiple of the spacing between the x's or display points on the drum.

We have already experimented with the first two parameters, with limited success. Problems are that they cannot be varied with enough resolution to insure repeatable and accurate results. We are not sure the tolerances to which we have adjusted the screen size, and it is possible that we may have to fix the display lines at a non-integral value. We have not yet implemented the third value.

Myron suggested that we make quantitative calcualtions of the precision required for each parameter, and then determine if any of them are controllable to within the limits required for successful copies. One of the complications is that the Xerox itself is not precise in its rotation, and thus the parameters may have to be dynamically varied during an exposure pass. If we build a sensor into the machine, the vertical sweep rate may be able to be controlled to this precision.

He also suggested that we try several experiments to definitely prove that the strobing is an exposure problem. One is to expose the drum to a strobe light, and vary the rate. We should be able to see the 15 line per inch variation change as the strobe rate changes. A second is to expose a sheet of film instead of the drum, and develop it outside of the machine. This will insure that no strobing is due to errors in the Xerox development cycle.

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XEROX PROGRESS REPORT continued.

We are prepared to move along with the strobe light experiments this week, and hopefully we will have some good news to report soon.

PAINT MANUAL AVAILABILITY

There are a limited number of first draft copies of the PAINT Manual available in Margaret's office. Anyone wanting to interface routines to PAINT can now refer to this documentation which should make the task rather painless. Problems of clarity or general questions should be referred to Ben McCann.

DARWINISM AND CULTURE

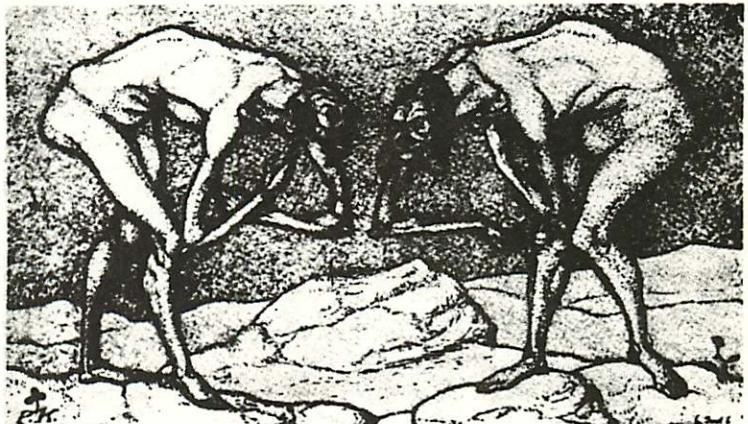
The Impact of Evolution on the Modern World View

A weekly seminar for the entire MIT Community during the Spring Term, 1977, to be held on Thursdays, 4:00-5:30 p.m. in Lecture Hall 9-150.

Conveners: Stanford Anderson, Professor of History and Architecture
Alvin C. Kibel, Professor of Literature

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| February 17 | EVERETT MENDELSON, Professor of History of Science, Harvard U.
"THE ARGUMENT OF DARWIN'S ORIGIN AND ITS CONTEMPORARY RECEPTION" |
| February 24 | JOHN C. GREENE, Professor, Dept. of History, U. of Conn. Grad. S.
"DARWINISM AS A WORLD VIEW" |
| March 10 | RICHARD C. LEWONTIN, Alexander Agassiz Prof. of Zoology, Harvard.
"DARWINISM AND THE SOCIAL PROPENSITIES OF MAN" |
| April 7 | GEOGRGE W. STOCKING, JR., Professor Dept. of Anthropology,
Morris Fishbein Center for the Study of the History of Science
and Medicine, U. of Chicago.
"THE EVOLUTION OF HUMAN COMMUNITIES: DARWINISM AND THE STUDY
OF CULTURE" |

continued.



ARCHITECTURE MACHINATIONS

A weekly newsletter of the Architecture Machine Group, Department of Architecture, M.I.T., Room 9-518, Trilla Ramage, editor.

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DARWINISM AND CULTURE, The Impact of Evolution on the Modern World View
continued.

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| April 21 | JARED M. DIAMOND, Professor of Physiology, UCLA School Of Medicine
<i>"THE EVOLUTION OF NATURAL COMMUNITIES: DARWINISM AND ECOLOGY"</i> |
| May 5 | MARJORIE GRENE, Professor of Philosophy, U. of Cal., Davis
<i>"DARWINISM, INTELLECTUAL HISTORY AND THE GROWTH OF KNOWLEDGE"</i> |
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