High tech gadgetry just keeps rolling off the line — its salesmen, like the doorman kings, king look-
ing for another hole to fill. And sooner or later they all converge inside the schoolhouse door, dazz-
iling the uninstructed with their magic paraphernal-
ia.

But there is danger here. Computers can be big guns but with low aim they are just expensive drill instructors. Performance conscious school chiefs will program to fit their rigid, fact-oriented curricula — taking advantage of the hardware's efficiency but ignoring its meta function as a partner in the learn-
ing process.

Fortunately some settlers on this frontier have mapped out a man/machine interface bearing fruit for personal growth in school and beyond. I called the following information from reports and projects developed by Dean Brown at SRI with Alan Kay and Janet Lederman, Palo Alto teachers and gestalt trainers, and a host of others.

The two projects mentioned here include an experi-
mental summer school session with first through sixth graders and a second project somewhat larger in scope — the remapping of the educational system in Spain.

- RK

Education is the realization and the unfolding of the limitless potential of the mind. The teacher is a creative artist, a sculptor who helps the student to release his person from rough-hewn formless potential. The com-
puter can be a chisel in his hands — one tool among
many of his kit of tools, to be sure, but one which
is quite different from all the others, one which can serve
him in a way that no other can.

The mind functions at many levels; each level respond-
ing to and influencing all of the others. We might view
these functions in a certain hierarchy: sensory-motor,
cognitive (including contrastive sets and technical and
so-cio-cultural facts), techniques, world views, self-images,
and self-knowledge. Everyone can remember from per-
sonal experience some gifted teacher who possessed the
art of teaching at all of these levels simultaneously. Some-
times these levels were taught explicitly. More often, per-
haps, they were communicated implicitly from innate
wisdom. The truly great teachers succeed in conveying
the process of human development in its essence and
thereby pass on the art of self-education to their students
for each to develop independently toward his own goals.

Much of this same spirit can be conveyed in computer
teaching programs and the computer can thus become a
valuable tool for the teacher. It can serve as a medium
for the creativity of the teacher and for communication
between teachers and students in the total educational
process.

When computers are considered within this broader
concept of education, we immediately discover a multi-
tude of applications beyond the conventional drill and
practice, tutorial, rate learning programs that have occu-
panied the major part of research to date. Indeed, the term
"computer-aided or assisted instruction" contains two
concepts that betray this larger goal. The computer can
do more than "aid" and "instruct". It can teach directly,
just as a good book can teach.

A question is priceless, like a fine pearl.
An answer would dissolve it.
Rather, it should be admired
and polished and given back.

The summer project emphasized developing the stu-
dent's internal self-sufficiency and inner-directedness. One
of the researchers participating in the project suggested
three reasons for using the computer in education:

- The computer can provide a nonverbal experience;
thinking, concepts, and ideas can be approached
without that intermediate level of communication
called language.
- The machine is nonjudgmental; it neither approves
nor disapproves of a student's decisions; reinforce-
ment for the student's effort lies in the experience
itself, the process of learning.
- The computer makes possible activities for which
the child has not yet developed the mechanical
skills, coordination, or information necessary for
independent participation; with the machine per-
forming these mechanics, the child is freed in the
use of creative energy, making possible, for example,
the writing and performance of a symphony com-
pared by a six-year old.

The underlying motif of the summer program, both in
the computer component and the classroom component,
was discovery. The children were encouraged to try what
they liked, discover what they could, and proceed on an
undirected course through their thoughts, following their
curiosity. This imposed a requirement in the structuring
of the computer software to make the material stimulat-
ing and encouraging to maximum discovery.

The CDC 3300 system was used, comprising the CDC
operating system and the DD1 display console. The lan-
guages used were EUCLID, NLT, FORTRAN, and COM-
PASS. EUCLID is an SRI ALGOL-like compiler with
commands to operate the display console. It is a language
that requires little computer technology and can be
learned in several hours. The programs written to operate
on the CDC 3300 allowed the students to define the
parameters controlling the machine's response. The stu-
dent observed the machine's response and then introduced
new demands on the machine, progressively probing deeper
into the nature of the program, into the man-machine
interaction, into the stimulus-response relationship under-
lining the project, into the methods of inductive reasoning.

The programs merely provided the framework and
allowed the student to build around this structure. He
could write a story, describe the mountains, write a poem,
describe his environment. It was possible to create many
stories from the same framework or program. The frame-
work was typed by program control in PILOT language;
when a student was asked for input, the Teletype would
start a new line of print, wait for the student to fill the
structure, then continue to provide more of the frame-
work.

Programming material for (this) open-format teaching
is simpler because no particular emphasis is placed on
"right" answers nor the legging and analysis of student-
responses with reference to the teacher's expectations.
"Wrong" answers are encouraged so that the student can
pursue blind alleys and test "unreal" situations that allow
him to place "correct" results in broad context. It took
twenty centuries for man to reject some of the axioms of
Euclid and develop Riemannian geometry!