# Remembering Roger Hill



Taken at HHC 2022

# Remembering Roger Hill

*Richard J. Nelson*

## Introduction

My memory isn't exact, but I met Roger when he first attended a PPC meeting at the PPC Club house in Santa Ana California in the early to mid-1970s. For this short article I won't repeat information that is covered in the various Appendices. Its purpose is to provide perspective and details of Roger's "west coast" life.

## Two states, two worlds, two cultures

As a multi decade professor at Southern Illinois University Edwardsville, SIUE, Roger had summer and winter breaks that he often spent in Altadena California where he was raised and completed Caltech (college) for his PhD. This practice meant that he had two different sets of friends and interests. I was part of this West Coast group.

As you may read in Appendix A & B, he had a wide range of interests and belonged to many groups in California. Here is what AI returns about Roger.

Did you mean: ***Professor*** Roger C. ***Hill obituary***

AI Overview

**Dr. Roger C. Hill**, Emeritus Professor of Physics at Southern Illinois University Edwardsville (SIUE), passed away on **November 5, 2025**, in Altadena, California at the age of 84. Southern Illinois University ...

**Life and Career Summary**

- **Academic Tenure:** Joining the SIUE physics faculty in 1970, Dr. Hill taught for four decades across various advanced physics subjects before retiring in 2010.
- **Research & Contributions:** His research specialized in quantum field theory, current algebra, and quark models, alongside authoring a quantum mechanics textbook.
- **Early Life & Background:** Born in Pasadena, California, he earned his PhD prior to his long academic career.
- **Personal Interests:** He enjoyed diverse hobbies including astronomy, computing, 3-D imaging, languages, model railroading, and playing the Bulgarian gaida. Southern Illinois University ...

If you are looking for specific **service information**, a copy of the **full family tribute**, or details regarding **memorial donations**, please let me know so I can help find those specific elements for you.

He was a member of PPC, an HP Calculator User's group. In the early days of the 70's and early 80's we held weekly, monthly, and currently annual meetings in Orange and Los Angless county's – Santa Ana and West Los Angeles. Roger attended these meetings up to the time of his passing. He had planned to attend in mid-December 2025, but didn't show up. We had not heard of his passing until later.

## Event conflicts

Until recently PPC members traditionally met on Friday evenings. I don't know of the early decades, but the during last decade Roger was torn between his Train group meetings and ours. In recent years – since

2007 when I retired in Mesa Arizona – we held annual (December) meetings and I would make the seven-hour drive to attend them. For the last few years, I changed the meetings to Saturday noon and this worked very well for everyone, especially Roger (Friday Train meetings).

## Roger's many interests

Roger had many interests. This list is a mix of those I knew, and those from Appendix A & B.

3-D imaging.
Astronomy.
Calendars and Calendar Math. *
Early Computing.
HP-Calculators. *

Instrument Playing, intuitive without training.
Languages (Serbo-Croatian, Macedonian, Bulgarian and Hungarian and others).
Model and rolling stock railroading. *
Music in general, especially Medieval Renaissance Music.
Photography, especially Astronomical. *

Publishing and Advanced Formatting Software
Road Signs, especially unusual ones. *
Tuva Throat Singing.

* These are the activities I was routinely involved with Roger i.e. asked, supported, and learned from him.

## Roger was an excellent Programmer

Computer/Calculator programming was easy for Roger. At our HHC Conferences we had programming contests with some very nice prizes. Roger was often a winner. See the next section.

### Contributions to PPC & CHHU

Roger was an active member of PPC often contributing his expertise and special talents to various activities – The PPC ROM Project and Conferences – as well as an occasional article in our Newsletter. In the August issue of the 1979 *PPC Journal* I proposed that PPC, as a group, to program a group of routines – finished with 153, 122 Global – that would be part of a custom HP-41 8K ROM. Roger decided that he would take time from SIUE to help work on this world class project. Here are two quotes from the 500-page PPC ROM Manual (20,000+ copies printed).

Page iv: "We had an unofficial fifth committee member, Roger Hill (4940). Roger spent hundreds and hundreds of hours of his time programming, debugging, and documenting ROM routines. His mark on the synthetic group is bold and bright. He has literally contributed ideas and programs to all four groups. It was obvious to all committee members that we dedicate the *PPC ROM User's Manual* to him. I am sure that all 4,000 PPC Members want to say, thank you Roger."

Page vi: "And, of course, Roger Hill (4940), who seemingly had a hand in cleaning up every routine in every section, and for programming 'under pressure' whenever the need arose."

Roger liked the HP-41 and really learned about the topics of syntenic programming. He even asked his sister to make a sketch for him for the Journal. Note "her member number".




"HE SAYS HE'S DISCOVERED A NEW 'SYNTHETIC FUNCTION'."

PPC Calculator Journal V8N1 PAGE 32 Jan./Feb. 1981

I found a calculator Survey on my computer that Roger filled out. I do not know the date, but he mentions the HP49G+ so it has to be after October 20, 2003. I copied it below.

**Survey - Roger Hill**
**Professional Use of a Scientific or Graphing Calculator**

1. **What is your profession?** *University Professor*

2. **Do you own or use a Scientific or Graphing Calculator?** *Yes*

   **If YES, Which type, make and model?** *HP-67, 41C, 48SX, 49G, 49G+*

   **If NO, why not?** _____

3. **Did you use the same machine while in school?** *No (They didn't exist then!)*

4. **How often, an estimated average, do you use your machine?** *About twice per week*

5. **What kinds of problems to you use your machine for?** *General calculations; statistical analyses of exam scores; alarm clock; recreational programming*

6. **What computer software do you use to solve mathematic/design problems?**

   *Quattro Pro; Excel; PentaCalc Pro*

7. **What is the most common use(s) you have for your machine?** *A, D, E, F in the list below*

**Examples.**
**A. Simple four function math (balancing the check book).**
**B. Conversions, especially English-Metric.**
**C. Interest calculations.**
**D. Repetitive calculations done with a short simple program.**
**E. Statistical calculations.**
**F. Higher level math calculations involving logs and trigonometric functions.**
**G. Very high level or advanced math functions such a integration, Bessel functions.**
**H. Specialized calculations involving complex dedicated programs.**
**I. Symbolic math calculations.**
**J. Analysis of data or functions that requires plotting.**

8. **Considering spread sheet programs, e.g. Excel. Do you see more use of a computer when dealing with multiple data compared to a calculator?** *Yes (except for simple situations)*

9. **Would you say that symbolic math programs such as Maple, MathCad, etc. are mostly used in your profession instead of calculators?** *Possibly (but not by me so far)*

10. **Do you use a calculator (emulator) program on another machine, computer, PDA, etc.?**
    *Yes: PentaCalc Pro (an old but very nice program for the PC; can be set to RPN mode; has unlimited stack; keys can be moved and redefined; macros can be programmed and assigned to keys; input and output shows on simulated tape; input data can be changed and resulting*

*calculations automatically update as in a spreadsheet; however, no conditionals or branching)* __

***Feel free to write any comments, observations, etc. regarding calculator usage on the back.***

*I find a calculator more convenient than a desktop computer for keying in and doing quick calculations or entering data like exam scores, etc., which are not already in a file. Of course, a calculator is also more convenient when away from a desktop computer. I used to use a calculator (particularly the HP-41C) for practically everything, but have gone to desktops and spreadsheets more nowadays. For tables and graphs I like spreadsheets better as they have a large screen and allow printing out more easily.*

*I also use my HP-48SX (and formerly used my HP-41C) as a backup alarm clock, as its alarm is just about the right loudness for me.*

*For school, I have not emphasized symbolic math on calculators in my courses, as a significant part of the goal of the courses is to get practice in doing algebra correctly. However, I do encourage the use of integral tables and welcome the use of calculators in doing symbolic integration if the students have it available. For numerical work and graphing I have encouraged the use of spreadsheets like Excel.*

*In labs, I used to have them do at least one statistical calculation by hand, and then have them find out how to use the statistical functions of their calculators for future calculations. Lately, along with other instructors, I have been showing them how to use Excel for calculations and graphing.*

## Personal Experiences

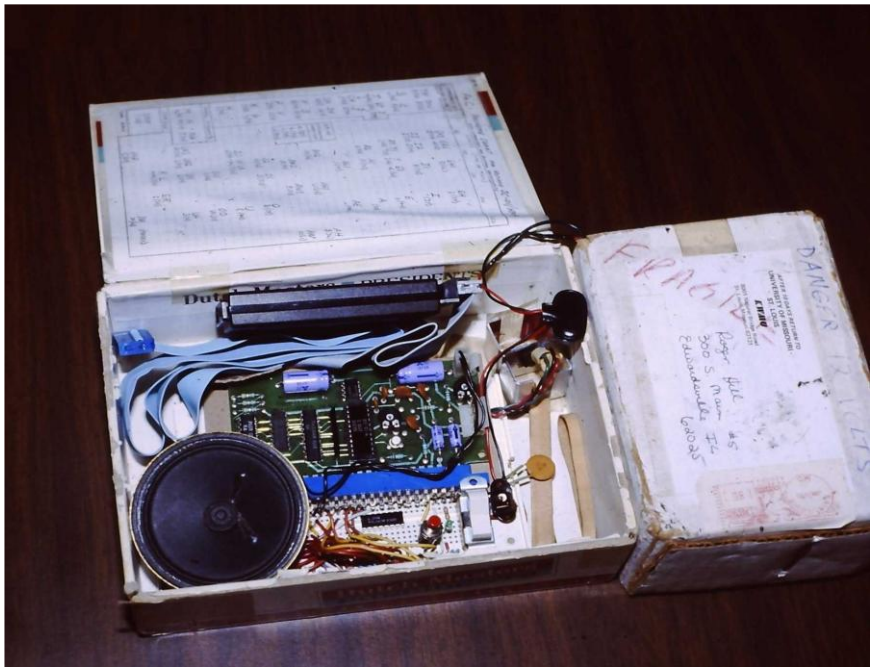
I often put a problem on the PPC Club House board – we had a blackboard in our meeting room. He would come in, see the question/problem, thought about it and then he would **always** write the answer. It was a fun exercise "we" did for many months. I don't know if he ever knew that I was – usually, after some unknown person started with the first one - the person putting the problem/questions on the board.

Roger Hill was an exceptional human being in both brilliance and with a calm low-key friendly personality. I asked him many questions over 40+ years, and he always answered them – accurately and correctly. One time I was working on a writing project involving an AC clamp meter with regards to a circular clamp, and I observed that it was not critical that the wire be in any particular position; center, midway, or against the clamp. Many clamp meter manuals suggested to center the wire. He disagreed, but shortly afterwards sent me another email saying that I was correct. I guess it was a nice theory vs practice situation. Note: Most clamp meters have unusual clamp shapes to match particular situations and the manual recommendations apply for the best accuracy.

Someone at one of our LA/OC PPC/CHHU meetings asked what was the center depth of a one-mile diameter flat concrete slab. Everyone reached for their calculators to calculate how many inches it was. Roger thought about the problem and gave the correct answer. No one believed him because he did not use a calculator. He spent the next $15^{+}$ minutes explaining the process and approximations that he used in his head.

In my experience most well-educated people when asked about a serious problem would just suggest a resource or give a general approach. We have/had a lot of brilliant people in our group, but I put Roger at the top of the list because of what I described above. Roger once gave an HHC presentation of an HP-41 unusual alphanumeric output to speech interface. He had no experience soldering anything, he analyzed all the circuitry, studied electronic logic circuits, and analyzed the two basic methods of making the

electronic signal to audio conversion, and he built a device. It worked perfectly with very clear annunciation. See Appendix D. The video is available on Jakes website, and I did not include it here for space reasons. He mentions that he had originally planned on putting it in a plastic case, but the "cigar box" made a better presentation. See the photos below.



*First HHC presentation in 1982.*



*Second HHC presentation in 2001.*

We frequently exchanged Christmas gifts. He usually gave me a special calendar, but I surprised him one year with a block of wood with four "pipes" that when blown gave a very nice emulation of the whistle of a train. After researching Roger's love of trains, I can better understand why he especially appreciated it.

## Observations and conclusions

I only knew Roger as part of his "Western life." Reading his obituaries I realized that I only knew a small part of that Brillant and wonderful person he was. I sent a very recent photo that Roger had taken of a Vanderberg launch of a Rocket to a friend, and he was very impressed with it. I talked about Roger and his abilities and accomplishments and his comment was that he must be a polymath. I asked AI about polymaths and perhaps he was.

## Appendices


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## Appendix A - Obituary by Southern Illinois University Edwardsville – Page 1 of 1

# Roger C. Hill, Died Nov. 5-2025; Professor Emeritus



Roger C. Hill, PhD, emeritus professor in the Southern Illinois University Edwardsville Department of Physics, passed away on Nov. 5, 2025, in Altadena, Calif. He was 84.

Born and raised in Pasadena, Calif., Hill earned a bachelor's degree in physics in 1963 and a doctorate in physics in 1969 from the California Institute of Technology. His doctoral thesis, "Relativistic Quark Models and the Current Algebra," contributed to the emerging landscape of particle physics in the late 1960s. Before joining SIUE, he served as a research associate and lecturer at Northwestern University from 1968–70.

Hill joined SIUE faculty on Sept. 16, 1970, as an assistant professor of physics. He advanced through the ranks to associate professor and professor, and for four decades taught courses in classical and modern physics, quantum mechanics, mathematical physics and advanced dynamics. He was beloved by his students.

Hill's scholarship included work in quark models, current algebra and quantum field theory. He authored a textbook on quantum mechanics, published numerous articles and delivered presentations at conferences and workshops throughout his career. Hill retired on Aug. 31, 2010, and was granted emeritus status in recognition of his distinguished service to the University.

Beyond his academic work, Hill was known for an expansive curiosity that shaped a wide range of interests from astronomy, early computing and 3-D imaging to music, languages and model railroading. He shared these passions generously with colleagues, students and friends, often bringing the same careful attention and enthusiasm to his community pursuits that he brought to the classroom and laboratory. Memorial contributions may be made to the Southern California Railway Museum at socalrailway.org.

**PHOTO: Professor Emeritus Roger Hil**

## Appendix B - Southern California Railway Museum Obituary – Page 1 of 2.

### Roger C. Hill, Died Nov. 5-2025; Professor Emeritus

Posted 5 December 2025, 4:30 PM



*Roger C. Hill*

R**oger C. Hill** of Altadena, CA passed away November 5th, 2025 at age 84. He was born and raised in Pasadena, CA and achieved a Ph.D. in physics at California Institute of Technology in 1969. He was a Professor at Southern Illinois University at Edwardsville from 1970-2010.

Roger was a mathematician who wrote his Ph.D. thesis on "Relativistic Quark Models and the Current Algebra" and also wrote a textbook on the subject of quantum mechanics. He was a Research Associate and Lecturer at Northwestern University from 1968 -1970. At retirement, he was named an Emeritus Professor at SIUE.

Roger was an expert in and a historian of Hewlett-Packard handheld calculators and participated annually in the Hewlett-Packard Calculator Conference. He studied astronomy, was an accomplished photographer, a member of the Los Angeles Science Fantasy Society, an expert on 3-D movies and 3-D imaging, loved Medieval Renaissance music, Tuva throat singing and folk dancing with a University City group.
He had an almost savant-like ability to pick up almost any instrument and play it, especially wind: recorders, flutes and a Bulgarian bagpipe made from a complete lamb skin. He was also a linguist and was able to communicate in several languages: Serbo-Croatian, Macedonian, Bulgarian and Hungarian to name a few.

He had several international friends and was able to speak with them in their own language.
Roger was also a dedicated model railroader, working on a Los Angeles trolley car HO layout for years. He contributed to the Southern California Railway Museum (formerly OERM) in Perris, CA, working on their website, organizing their collections of historic photos and doing painting, clean-up and maintenance on the museum's full-size collection of rolling stock, street cars, interurbans, steam trains and diesel locomotives.

Roger studied frogs and toads, their natural and humorous aspects. He also was amused by the ludicrous misspellings and placement of old road signs, which he encountered on his travels. He dubbed them "Road Thingies". He also was a *Star Trek* and especially a *Doctor Who* fan. Roger was a gentle soul who

appreciated people and making friends with them as he grew older. Even casual acquaintances such as waitresses and rental car dispatchers formed friendships with him.

## Appendix B - Southern California Railway Museum Obituary – Page 2 of 2

In January 2025, Roger's family home in Altadena was completely destroyed by wildfire. He lived his last ten months at the Embassy Suites Hotel in Arcadia, where he made even more friends around the breakfast table. He started working on a new American Flyer model railroad layout, that was meant to go into a condo in Sierra Madre, where he was preparing to move, but that was not to be. Like Will Rogers, Roger "never met a man he didn't like," at least most of the time.

We'll miss his habit of being chronically late for dinner and his wonderful annual Holiday Slide Shows. Donations to the Southern California Railway Museum, on behalf of Roger Hill, would be gratefully accepted (socalrailway.org*)*. He is survived by his sister Catherine, brother-in-law Mark Kausler and many good
friends.

**Roger C. Hill September 29, 1941 - November 5, 2025**
*Train Club Memberships:*

- **Train Collectors Association**
- **Toy Train Operating Society**
- **Southern California Railway Museum**
- **Electric Railway Historical Association**
- **Illinois Railway Museum**
- **Pacific Railroad Society**
- **Illinois Railway Museum**
- **Illinois Traction Society** - *Steve Waller photo*

## **Appendix C – Selected Photos** – Page 1 of 2

Palmer Hansen ran the TI User's Group and there was a challenge to PPC. The photo at the right shows Roger and Palmer shacking hands because of the Great Calendar Race that was essentially between the two of them. Roger eventually won. Palmer did not normally attend HHCs and he passed shortly after the HHC 2012 meeting. Gene remembers this and he took the photo. While Roger's initial entry was very efficient Palmer had a bloated program that printed a years' worth of a calendar. Roger rewrote his version that stored many of the graphics required so that the printer printed the calendar so fast that it was only 1 second slower than if the printer only printed.






*Fig. 1 - Roger Hills Camera.*

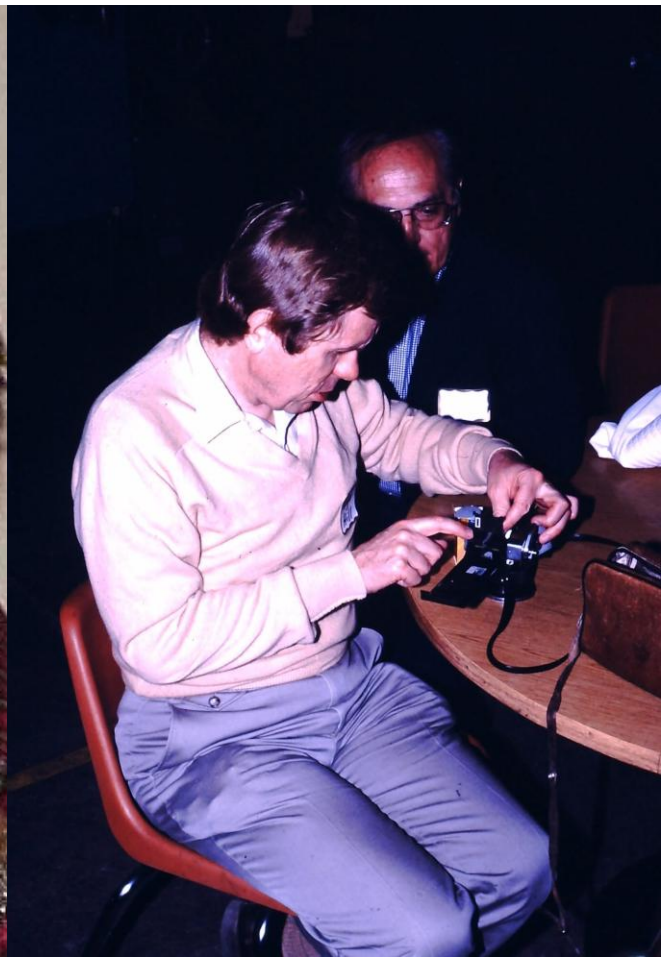


*Fig. 2 – Roger Hill at Triton college 1999.*

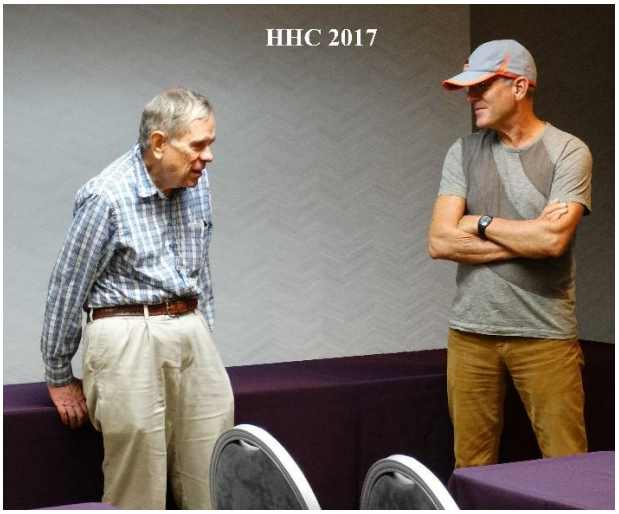
Recent TI-59 discovers have discovered faster methods of evoking the fast mode and the TI calendar printing program was revised. Gene sent me an email with all the details, BUT Rogers Speed record still holds – not by many seconds, but a race is in seconds and Roger still holds the record.

## **Appendix C – Selected Photos** – Page 2 of 2

Here are a few photos of Roger taken by Jake Schwartz at various HHCs.




*Fig. 1 – Bill Butler (Canada) and Roger.*




*Fig, 2 – Joseph Horn and Roger.*



*Fig, 3 – Roger as 2001 Best Speaker .*



*Fig. 4 – Roger with Ted Kerber in 2006.*

# Appendix D – Roger's HP-41 Speech Interface Page 1 of 13.

**A Voice for the HP-41**
**by Roger Hill**
**Presented at the PPC Philadelphia Conference in 1982**

This is a preliminary article on my experiences in interfacing the HP-41 with a speech synthesizer --- the Micromint Sweet Talker, which uses the relatively new Votrax SC-01 CMOS Phoneme Speech Synthesizer integrated circuit. As this article is being written (for the Philadelphia PPC Conference), I am still working on and refining the hardware as well as software, and so there will undoubtedly be more to report on in a future article.

This excursion into synthesizing speech all started around the end of February at Southern Illinois University at Edwardsville (where I am on the Physics faculty) during an open house put on by the Engineering Department. Among the demonstrations there was.one set up by Leonard C. Jones of the Electrical Engineering faculty, interfacing the Sweet Talker with a Mostechnology Kim-1 microprocessor and rigged up to say, "Hello humans; welcome to the SIDE Engineering Open House" whenever one walked into the room. I was intrigued by the way words could be built out of the 64 basic speech sounds or "phonemes" that the synthesizer could produce, and spent a while experimenting with different ways to say "hello", etc., with the available phonemes. Giving the synthesizer a 6-bit code, from 00 to 3F hexadecimal produced each phoneme. Words and phrases were obtained by storing a sequence of the 6-bit codes in the microprocessor's memory and having it output them to the Sweet Talker one at a time.

As the days went by following the demonstration, I began thinking more and more seriously about the possibility of interfacing the synthesizer with my HP-41C. For me this was a major undertaking, as I had had no experience whatsoever with integrated circuits, interfacing, or most of the other hardware aspects of computers. Although I did end up designing and building the interfacing circuits myself, I am indebted to Leonard Jones as well as James E. Dunn (the physics lab manager) and Louis J. Labash (the electronics technician for science and engineering) at SPJE for numerous conversations on interfacing, the selection and use of integrated circuits, and loan of equipment for breadboarding and testing the system --- and, of course, Richard Nelson, for putting up with my many questions during my self-inflicted "crash course" on digital electronics.

The Votrax SC-01 (produced by Federal Screw Works, 500 Stephenson Hwy, Troy, Michigan 48084) is a 22-pin CMOS chip containing its own clock, phoneme generator, filters, etc. It accepts a 6-bit parallel input when triggered by a strobe pulse, and outputs a voice signal ready to be amplified and sent to a loudspeaker. The 64 phonemes (see Tables 1 and 2) can be used to make any English word, as well as words in quite a few foreign languages. This is in contrast with most other "speech chips" in which inputting a code number causes an entire word or phrase to come out but one is limited to perhaps several hundred words. Such IC's with "canned words" do tend to produce more natural sounding speech (using "linear predictive coding" or "waveform digitization") than the "phoneme synthesis" approach used by the Vorrax SC-01 which gives somewhat mechanical-sounding speech. However, the "Mechanical" speech is quite intelligible and sounds like just the sort of thing one might expect from a computer. Besides, the phoneme synthesis method only needs a low rate of data input to maintain continuous speech, less than 100 bits per second, so the HP-41 can easily keep the synthesizer supplied with phoneme codes.

The Votrax 6C-01 also allows any of the 64 phonemes (actually 61 plus two silent pauses and a "stop"

code) to be produced in four different pitches which are controlled by two "inflection bits". The inflection bits can be changed to make the voice rise and fall or to simulate several different voices speaking. Votrax has also built an "automatic inflection" into its speech: even if the overall pitch setting of the inflection bits is not changed the exact pitch of the output will vary slightly from phoneme to phoneme, helping to prevent a monotone effect. (For example, an "AH" is lower in pitch than a "U" sound.) The variation of pitch with phoneme can be as much as 10% or so. With the "factory setting" on the sweet talker board, the four pitches obtainable by changing the inflection bits are (very roughly) 73, 87, 104, and 123 Hz, putting the voice definitely in the male bass range. The overall clock frequency is adjustable by varying a potentiometer on the Sweet Talker board, which will vary the rate of speaking as well as the pitch, overtone envelopes, etc., but increasing the clock frequency very much starts to produce a "chipmunk" effect; for a natural-sounding voice the frequency setting will have to be pretty close to the "Factory-set" one.

What I actually bought (and what the Engineering Department) had used in its demonstration) was the "Parallel Sweet Talker", a 2-1/2" x 4-1/2" circuit board, fully assembled and tested, containing the Votrax SC-01 along with the necessary circuitry for compatibility with a typical parallel computer output, and also an amplifier for the speech output ready to be connected to a loudspeaker. Micromint, Inc makes it. (917 Midway, Woodmere, N.Y. 11598) and sells for $139 plus shipping. (Another version of the Sweet Talker is also available which can be plugged right into an Apple II.) The board plugs into a 44-terminal card edge connector (not all of the terminals are actually used), and has a separate 2-pin plug for the speaker output. The SC-01 chip itself runs on 7 to 14 volts DC, and other components on the board convert the input and output signals from and to TTL levels (transistor-transistor logic, which runs on 5 volts DC). Among the terminals on the Sweet Talker board are the six phoneme bits (PO through P5), the two inflection bits (I1 and I2), an input which, when grounded, enables the buffer on the board sending the phoneme and inflection bits to the SC-01, a strobe input (STB) on which a rising voltage triggers the SC-01 to accept a phoneme code, an alternative input on which a falling voltage triggers the SC-01, a "ready" output (A/R) on which the signal goes high (i.e. near 5 volts) when the Sweet Talker is ready for the next phoneme code, and an alternative "not ready" or "busy" output on which the signal goes low (i.e. nearer to 0 volts) when the Sweet Talker is ready for the next phoneme. The Sweet Talker board is described in detail by its designer, Steve Ciarcia, in *Byte* Magazine, September 1981, p. 38-50. This article, which also contains references to other articles on the Votrax speech system, is a must for anyone planning on using the Sweet Talker. (Much of the article is also in the owner's manual that comes with the Sweet Talker.)

With the Sweet Talker available, the next question was how to connect it to the HP-41. Conveniently, HP had just come out with the HP-IL Loop Interface system, and one of the new loop accessories was the HP 82166A Converter, which converts the serial data on the loop to and from a parallel output/input signal suitable for interfacing with GPIO (general-purpose input-output) devices --- just right for interfacing with the Parallel Sweet Talker. This involved buying more accessories, but the loop would be useful for other things anyway (right now the Sweet Talker is the only loop peripheral that I have), and the converter could also be used for other things as it simply plugs into a 34-pin connector in my Sweet Talker Interface. (I used an AP Products 924014-36-R connector, which has a 34-pin female socket with 3 feet of color-coded ribbon cable; with the converter plugged in the right way the colors correspond to the last digits of the pin numbers on the converter. Only 16 of the lines are actually used for the present application --- see below.)

The HP 82166A Converter is a rather marvelous device. Besides performing the expected serial/parallel conversion, it contains a 32-byte buffer for holding data until it is used. As it applies here, the buffer holds bytes supplied by the HP-41 while the Sweet Talker gets them and speaks them one at a time; in the meantime the calculator is free to perform further calculations, similarly to operation with the printer. Only if the buffer is full and the calculator is trying to output more bytes to the buffer is the calculator forced to stop and wait. Outputting of bytes from the HP-41 is done by the HP-IL Module's OUTA instruction, which sends the contents of the alpha register out on the loop. If the Converter/Sweet Talker is the only device on the loop, it is automatically declared the "primary device" and gets the bytes. If more than one device is on the loop, it may be necessary to use the SELECT command (also in the HPIL Module) to make sure the bytes go to the Converter/Sweet Talker and not to a printer, etc.

The Converter has three lines for handshaking when data is being output (to the parallel side, as in this application), three more handshaking lines for inputting data, and a few other control or indicator lines, as well as the data lines. In the Sweet Talker application the only lines used are DAO through DA7 (the basic data lines, DAO holding the least significant bit), (the "data valid" output line) on which the Converter sends out a signal indicating that the data lines have a byte of meaningful data on them, RDYI (the "ready" input line) on which the Sweet Talker sends a signal into the Converter indicating that it is ready for the next byte, DACI (the "data accepted" input line) on which the external device sends a signal indicating that it has accepted the byte which the Converter just outputted (in this application the line is simply grounded, telling the Converter that anything it sends out will always be accepted), and the power and ground connections (see below). The bars over etc., indicate that "negative logic" applies to the signal, i.e. when the line is high then the Sweet Talker is not ready, while if the line goes low then the Sweet Talker is ready for the next byte.

This is the default option on all of the Converter's handshaking (but not data) lines, but it is possible to reverse the logic, as well as change many other features of the Converter's operation, by altering bits in the Converter's "control registers" (not possible using the HP-IL Module, alone, but possible with, say, the HP-IL Monitor ROM). I found no pressing need to vary from the default options and thus kept with them, in the interesting of making the voice synthesizer usable with a minimum of other accessories. (Note, incidentally, that the last letter -I or -0 on the symbols for the handshaking lines refers to which way the signal is going, relative to the Converter, and not whether the line is used during inputting or outputting of data.)

With all of the above information gathered and digested, it was then a matter of deciding what pins on the Converter to connect to what terminals on the Sweet Talker (actually the connections are from connector to connector). Fig. A shows the most straightforward way: the Converter's data lines DAODA5 go straight to the Sweet Talkers phoneme input lines PO-P5, the line of the Converter to the line of the Sweet Talker, and the A/R line of the Sweet Talker to line of the Converter.

The line of the Converter is grounded as mentioned above, and the line of the Sweet Talker is also grounded, thereby continuously enabling the buffer that takes in the data signals and converts them to CMOS levels for the SC-01. The two inflection lines of the Sweet Talker (I1 and I2) can be connected to switches for manual control (as I first did), or they can be connected to DA6 and DA7 on the Converter so that the upper two bits of the data controls the pitch. (My final design does neither --- more on this later.) One qualification of the above: it was recommended to insert a pulse delayer in the line from DAVO to STB due to timing constraints on the strobe signal in relation to the

data as received by the Sweet Talker. (When the strobe line voltage changes to trigger the Sweet Talker/SC-01, it has to have not previously changed for the last 100 msec, and the data on the lines has to have existed for the last .45 msec.) The pulse delayer is a "two-stage one-shot" made from a 74LS123 multivibrator chip; when a falling voltage occurs on the input, the resulting output is a pulse which starts 10 msec later and lasts for another 10 msec. Other ways of dealing with the DAVO pulse (and perhaps eliminating the pulse delayer) may be possible, but this method was simple enough and also fit conveniently with the more involved circuit described below.

As far as power supplies are concerned the Converter has two power inputs (VCC and VC1) which must both be connected to a +5 volt DC regulated power supply, and two grounds; a signal ground (duplicated on two pins) and a reference ground; it is vital that these two grounds be connected together, but HP recommends connecting them together close to the power supply to minimize static interference.

The Sweet Talker also uses the +5 volt supply and in addition another DC supply, Vp , which may be anything from +7 to +14 volts DC (needed to run the SC-01 itself and the voice output amplifier). For testing I started with a HealthKit Digital Design Experimenter which our physics labs happened to have around --- it supplies 5 and 12 volts along with a breadboard and various switches, indicator LED's, etc. --- but my plans (not quite finalized as of this writing) are to use 8 NiCd AA cells, giving around 10 volts for Vp, and using a voltage regulator to get the required 5 volts needed for the rest of the circuitry. The voltage regulator does waste the difference in voltage, but rather than tapping the batteries at "Intermediate points, I wanted to ensure that all of the cells got used equally and discharged at the same rate to avoid possible problems with polarity reversal, etc., when the batteries ran down. The main "juice hog" of the system is the Converter, which draws about 90 ma. With the Sweet Talker and additional circuitry as described below, my estimate is that the 500 ma-hr capacity of the NiCd AA cells should run the system for around 3 hours or so before recharging is needed. I also plan to make a plug-in recharger that will charge the batteries and run the system at the same time, similarly to many calculators.

Having connected the Converter and Sweet Talker together as described above and found that everything actually worked as planned (the first time too, to my amazement), I started working on some refinements to the system. The first refinement was regarding the control of the pitch of the voice, which I of course wanted the HP-41 to be able to do. With the system of Fig. A, the pitch of the voice will depend on which quarter of the hex table the byte lies in: bytes 00-3F will give all of the phonemes at the lowest pitch, 40-7F will give all the phonemes at the next lowest pitch, 80-BF will give the next pitch, and finally, CO-FF the highest pitch. For example, a long "AH" sound would be represented by the byte 24, 64, A4,.or E4 depending on the pitch desired; all of these bytes end in 100100 (24 hex, which means the phoneme will be "AH" --- see Table 1), while the leading two bits are 00, 01, 10, or 11 (binary) and control the pitch. This does form a concise way of cramming all of the information about the phoneme into a single byte, but did *not* seem to me to be the most convenient system to use with the HP-41 for several reasons: (a) Often it is desirable to work out the phonemes for a given word or phrase and worry about the inflection or pitch later, or try a word at various pitches, either of which would involve going back and changing the upper two bits of every character. (This could be done efficiently with microcode, but, as I mentioned above, I was trying to minimize the need for other accessories.) (b) Many characters don't display in a distinguishable way on the calculator, cause problems in printouts as far as reading them is concerned (in the case of the second half of the hex table), and don't work with the wand paper-keyboard bar codes, (c) The 00 (null) and 7F (append) characters sometimes don't behave like an ordinary character (e.g. Initial nulls are not outputted with OUTA, and an initial (- in a text

program line will perform the append function rather than get treated as an ordinary character. In other words, not all of the 256 characters can be just thrown around in the ordinary way.

For these reasons, I settled on a different scheme for controlling the pitch. First of all, only the bytes 20 through 5F are used to represent phonemes; these are all standard ASCII characters which display nicely on the calculator (though the "[" does look like a "C" --- but usually one can tell from the context), print nicely in text lines and printed output, and can be scanned by the wand using paper-keyboard barcodes. The bytes do not contain any pitch information, but the last 6 bits correspond to the 6-bit phoneme code in Table 1. Thus the bytes 20 through 3F from the calculator (ASCII characters: space, !, ", #, **...**, **=**, **>**, ?) get interpreted as the phonemes A, AY, Yl, UH3, ¼, AW, PA1, STOP while the bytes 40 through 5F (ASCII characters: @, A, B, **¼**, **]**, **-**, _) get interpreted as the phonemes EH3, EH2, EH1, **¼**, F, D, S. Figure C shows all of the phonemes arranged in a more logical manner, with the corresponding ASCII character under each phoneme as well as the decimal code for the character for use with the PPC ROM routines DC and LB , the Extended Functions Module XTOA, etc. The same correspondence between phonemes and ASCII characters also appears in the September 1981 *Byte* Magazine article referred to earlier, where some examples are given. Also, the resulting correspondence between the 6-bit code 00-3F and the 64 ASCII characters @ABC¼<=>? is the same as the encoding of characters in microcode (sec the table by Robert Groom and John McGechie, *PPC Calculator Journal*, V8N4P10). This method of encoding the 64 phonemes seems like a reasonable one to follow, having had a certain amount of precedent. As an example of making a word, the pronunciation of "hello", using the phonemes H, EH2, UH3, L, O, W, will look like CA#X& as ASCII characters before being OUTAed to the Sweet Talker.

Now for the pitch: The pitch is set by control characters elsewhere in the hex table. I decided to use the lower case letters a, b, c, d (hex codes 61-64, decimal 97-100) to set the pitches, "a" giving the lowest pitch and "d" the highest. These letters display nicely on the HP-41, are easy to key in, and form a natural sequence of characters with an obvious order to them, making the notation easy to remember. Outputting a control character among the ordinary phoneme character causes no phoneme to be produced, but instead sets the pitch from whatever it was to the one corresponding to the control character, and this pitch remains in effect until changed by the next control character if any. All of this is accomplished (see Fig. B) by logic gates (I used the "LS" or "low power Schottky" series integrated circuits, which are compatible with the Converter and the Sweet Talker and use much less power than the "standard" TTL integrated circuits; an output signal from the Converter can drive up to 5 single LS inputs) which detect whether the bits on lines DA5 and DA6 are both 1. If so, then the byte is a control character, and the pulse, instead of going to the strobe input of the Sweet Talker to trigger a phoneme, gets rerouted to trigger a latch (made from a 74LS74 Dual D Flip Flop) which holds the bits from lines DAO and DA1 for use by the following phonemes. The bits from the latch are fed to the inflection lines I1 and I2 of the Sweet Talker via three NAND's which convert the bits so that "a" sets I1 = I2 = 0, "b" sets I1 = 1 and I2 = 0 to give the next-lowest pitch, etc. At this point somebody is bound to notice that *all* characters between 60 and 7F (and those between EO and FF) will act as control characters, setting the pitch according to their byte values mod 4, but this need not be of any concern. (Besides, this is just the sort of "unsupported feature" that some other PPC member may find a use for someday ....)

As an example of the use of control characters, a "hello" with a falling pitch (starting with pitch "c" and falling to pitch "b" on the second syllable) may be obtained by entering the characters c[A#bX&- into the alpha register (the same sequence of characters as in the preceding paragraph but with the control

characters c and b inserted) and executing OUTA to hear the word. Or, the characters may be incorporated into a program as a text line with the OUTA command following it. (By the way, it should be noted that the letters a, b, c, d have nothing to do with musical scale notation, but simply denote four pitches, each one higher than the previous.)

The pulse that triggers the latch also gets routed back to the line of the Converter, triggering the Converter to send the next data byte. All of this happens within 1 millisecond or so, causing no noticeable delay. (The shortest actual phoneme lasts for 47 milliseconds.)

As a sub-refinement in the pitch-control system, four manual pitch-control push buttons can be added as shown in Fig. B, for convenience in trying out words and phrases at different pitches or selecting an initial pitch if a phrase has no control character in it. Pushing a button causes each half of the latch to be cleared (set, to "O") or preset (set to "1") according to the button pushed, so as to set the appropriate pitch.

The second refinement added to the basic HP-IL/Sweet Talker interface involves the phoneme "STOP" code (not to be confused with the HP-41 STOP instruction). If one tries putting the above "hello" sequence of characters in the alpha register and executing OUTA, he will notice a curious phenomena: After the "hello" will come a rather peculiar "nihhhhhhhhhh....." sound which will continue indefinitely until the user does something, such as turning the device off or inputting other phonemes. This bleating is not the Sweet Talker calling its mate, but rather is due to two unrelated features of the HP-IL/Sweet Talker system. First, the OUTA command automatically adds a carriage return character (hex OD) and a line feed character (hex OA) at the end of the alpha characters, for convenience when using a printer, unless Flag 17 is set --- in which case those two characters are suppressed. The two printer control characters are interpreted as phonemes, producing the above spurious sound. Setting Flag 17 before using OUTA will get rid of that outburst, and then one notices more clearly the second feature: Even though the Votrax SC-01 sends out a "ready" pulse when a phoneme's time is up, the phoneme will continue to sound indefinitely until another phoneme or a STOP code (represented by an ASCII question mark,?) arrives. Thus, we get "hellooooooooooo..." with the Sweet Talker stuck on the last phoneme (the "W"). This can be fixed by adding the STOP code to the character sequence, so that if we put c[A#bX&-? into the alpha register and execute OUTA with Flag 17 set, we will finally get the desired "hello".

However, why not kill two birds with one stone and have the carriage return and line feed both interpreted as a STOP code? We then will not have to worry about either putting a question mark at the end of every phrase or setting Flag 17 when trying out words. Flag 17 needs to be set only if we want to send out more than one alpha-register-full of characters without having a gap in the speech. Fig. B implements all of this in hardware by having *any* character in the first two rows of the hex table *(*i.e. 00-1F) interpreted as a STOP phoneme code by the time it gets to the SC-01". The logic gates check to see if the bits on lines DA5 and DA6 are both zero, and if so, the input to the Sweet Talker becomes high, disabling the Sweet Talker's input buffer. This causes all six bits of phoneme data into the SC-01chip to be 1's, because on the Sweet Talker board there are pullup resistors on each data line between the buffer and the SC-01, making each line high if the buffer is disabled. The strobe pulse still goes into the SC-01, however, so the synthesizer gets a STOP code which shuts it up.

To summarize the effect of bytes in the hex table: Bytes 00-1F (Which include the carriage return and

line feed) get interpreted as STOP phoneme codes, bytes 20-5F are interpreted as phonemes according to Figure C, and bytes 60-7F are interpreted as pitch control characters (only a, b, c, and d would be normally used). The second half of the hex table produces results identical to the first half, since data line DA7 is not looked at all by the interface.

A third refinement to the interface was to include a "quiet" or "reset" or "shut up" button (choose your favorite terminology), which, when pressed, reroutes the pulse triggered by back to on the Converter, thus emptying the Converter's buffer very quickly. Pushing the button also sets the STB line high on the Sweet Talker, triggering the SC-01 to accept one more phoneme. Over 99.9% of the time, the Sweet Talker's input buffer is disabled (it is enabled only when is low, which it is for about 50ms per phoneme, *and* bits 5 and 6 of the data are not both 0), so the SC-01 will get a STOP code and turn off any phoneme it happens to be speaking. Among the uses of this button are: (1) Pushing the button when the synthesizer is "stuck" on a phoneme will shut it up quickly. (2) If a program is stopped (by pushing R/S on the calculator), pushing this button will abort any speech still in the buffer. (3) If you are testing out a long program, pushing the button while the program is running will enable you to quickly skip over a section of speech; the calculator will run at full speed *(not* being stopped by the filling of the Converter's buffer), and when the button is lifted the speech will resume where the calculator is --- even with the correct pitch, as all pitch control characters continue to have their effect while the button is down. (There is a very slight chance that the button might have to be pushed twice when used in situation (2), if the button happens to be pushed during the very short time the Sweet Talker's input buffer is enabled. This has never yet occurred with me; key bounce probably takes care of the situation automatically. At any rate the circuit shown seems to work so well that I decided it not worth the extra circuitry to cover those remote possibilities.)

Figure B shows all of the above-mentioned refinements in one circuit. I have not shown pin numbers on the NAND, NOR, and AND gates; the best arrangement probably depends on the geometrical arrangement of the chips on the circuit board. Radio Shack's *Semiconductor Reference Guide*, Cat. No. 276-4005, has details of the pin connections of all of these integrated circuits, and most of the parts are available at Radio Shack except for the 34-pin connector for the HP-IL Converter. I originally implemented all of the logic with NANDS and inverters, those being the most fundamental components, and then after "finalizing" the circuit found that I could eliminate a chip full of inverters by replacing four of the NAND's with NOR's; use of the four AND's saves even more inverters. (For those not familiar with all this, as I was just a few short weeks ago, inverters come 6 to an IC while NAND's, NOR's, AND's, and OR'S come 4 to an IC) Those more experienced with integrated circuits and digital logic may find ways to improve the circuit of Fig. B, but this circuit does have one good feature: I have put it together and it works! (I have not yet put in the manual pitch selection buttons as of this writing.) With the AA cells powering it as mentioned above, I plan to build the whole thing into a box, around 4" x 6" x 2", Converter and speaker included, with the HP-IL ports accessible on one end.

With the hardware taken care of, there are two other areas which should receive attention: (1) how one builds words and phrases out of the 64 phonemes according to the Votrax system, and (2) how the HP-41 can be programmed to make use of the system in various applications. The first item is a big enough subject to fill many articles; among the references quoted in the *Byte* article are two articles, also in *Byt*e Magazine, by Kathryn Fons and Tim Gargagliano of the Votrax Division of Federal Screw Works. They are "Articulate Atomata: An Overview of Voice Synthesis" (February 1981, pp. 164-187), which. describes speech synthesis in general and the Votrax system in detail, and "A Votrax Vocabulary" (June

1981, pp.384-391), showing how to build 139 computer-related words out of Votrax phonemes (the "ASCII codes" quoted there, however, are not the same as the ASCII characters of Figure C of this article). A lot will be discovered, however, just by experimentation once the interface is built. I plan on reporting my experiences in Votrax speech synthesis and HP-41 speech programming later, once I have had a chance to work with the system for a length of time. In the meantime, Figure D shows a sample program using the HP-IL/Sweet Talker interface as described by the circuit of Figure B. In the works is also, a program, which will speak out numbers keyed in (within a certain range). One useful programming aid that I plan to make is a bar-code version of the table in Fig. C, so that one can simply look through the phonemes and scan the desired ones with a wand, loading the appropriate characters either into the alpha register or directly into a program. The Extended Functions/Extended Memory Modules are very useful components in this speech synthesis system, with their capability of storing and manipulating character strings in ASCII files and the ease of outputting the characters to the loop.

See Table 1 and figures A to D on the following pages.

Table 1. Phoneme Chart

| Phoneme Code | Phoneme Symbol | Duration (ms) | Example Word |
|---|---|---|---|
| 00 | EH3 | 59 | jacket |
| 01 | EH2 | 71 | enlist |
| 02 | EH1 | 121 | heavy |
| 03 | PA0 | 47 | no sound |
| 04 | DT | 47 | butter |
| 05 | A2 | 71 | made |
| 06 | A1 | 103 | made |
| 07 | ZH | 90 | azure |
| 08 | AH2 | 71 | honest |
| 09 | I3 | 55 | inhibit |
| 0A | I2 | 80 | inhibit |
| 0B | I1 | 121 | inhibit |
| 0C | M | 103 | mat |
| 0D | N | 80 | sun |
| 0E | B | 71 | bag |
| 0F | V | 71 | van |
| 10 | CH* | 71 | chip |
| 11 | SH | 121 | shop |
| 12 | Z | 71 | zoo |
| 13 | AW1 | 146 | lawful |
| 14 | NG | 121 | thing |
| 15 | AH1 | 146 | father |
| 16 | OO1 | 103 | looking |
| 17 | OO | 185 | book |
| 18 | L | 103 | land |
| 19 | K | 80 | trick |
| 1A | J* | 47 | judge |
| 1B | H | 71 | hello |
| 1C | G | 71 | get |
| 1D | F | 103 | fast |
| 1E | D | 55 | paid |
| 1F | S | 90 | pass |

| Phoneme Code | Phoneme Symbol | Duration (ms) | Example Word |
|---|---|---|---|
| 20 | A | 185 | day |
| 21 | AY | 65 | day |
| 22 | Y1 | 80 | yard |
| 23 | UH3 | 47 | mission |
| 24 | AH | 250 | mop |
| 25 | P | 103 | past |
| 26 | O | 185 | cold |
| 27 | I | 185 | pin |
| 28 | U | 185 | move |
| 29 | Y | 103 | any |
| 2A | T | 71 | tap |
| 2B | R | 90 | red |
| 2C | E | 185 | meet |
| 2D | W | 80 | win |
| 2E | AE | 185 | dad |
| 2F | AE1 | 103 | after |
| 30 | AW2 | 90 | salty |
| 31 | UH2 | 71 | about |
| 32 | UH1 | 103 | uncle |
| 33 | UH | 185 | cup |
| 34 | O2 | 80 | for |
| 35 | O1 | 121 | aboard |
| 36 | IU | 59 | you |
| 37 | U1 | 90 | you |
| 38 | THV | 80 | the |
| 39 | TH | 71 | thin |
| 3A | ER | 146 | bird |
| 3B | EH | 185 | get |
| 3C | E1 | 121 | be |
| 3D | AW | 250 | call |
| 3E | PA1 | 185 | no sound |
| 3F | STOP | 47 | no sound |

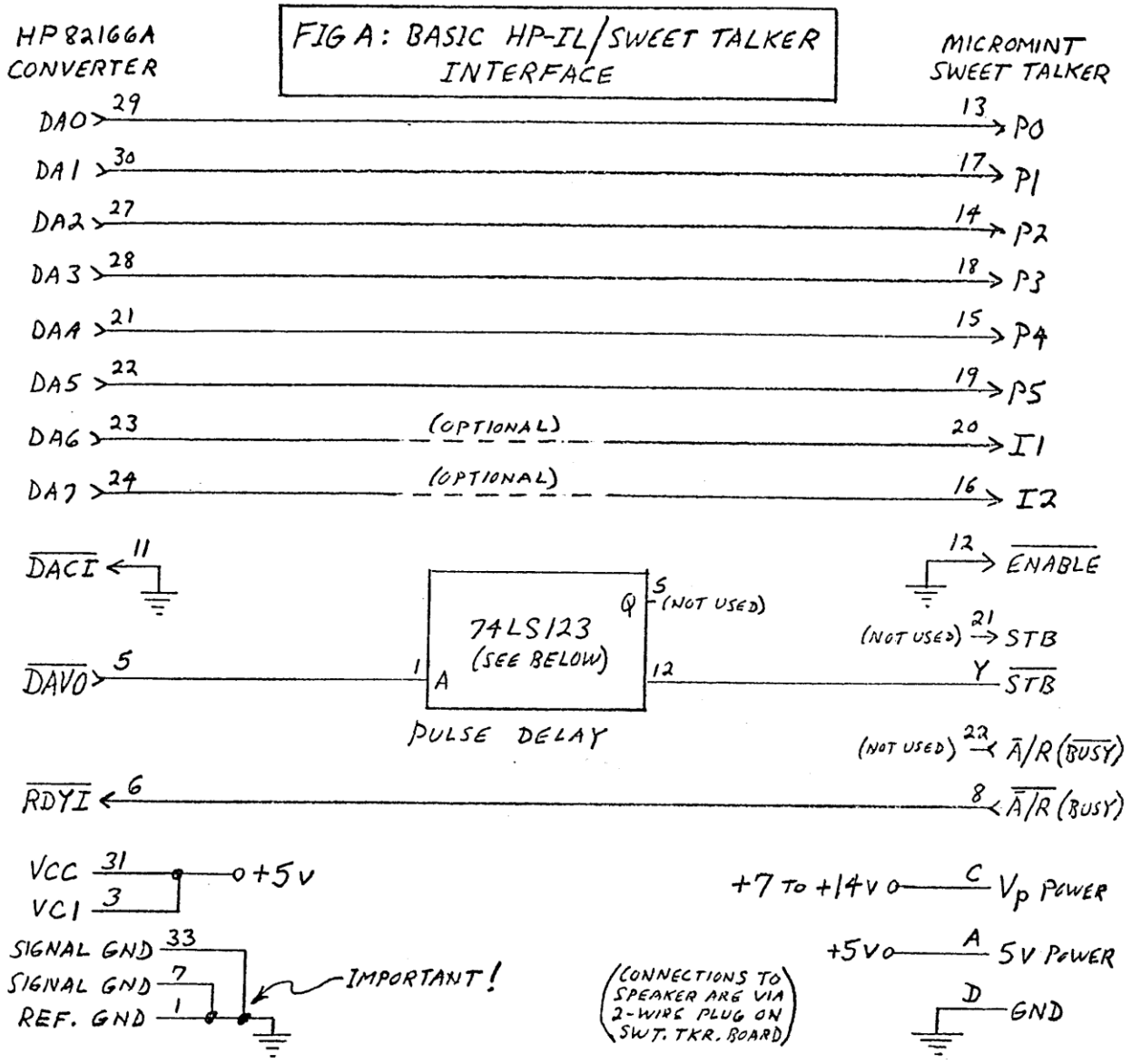
*/T/ must precede /CH/ to produce CH sound.*
*/D/ must precede /J/ to produce J sound.*

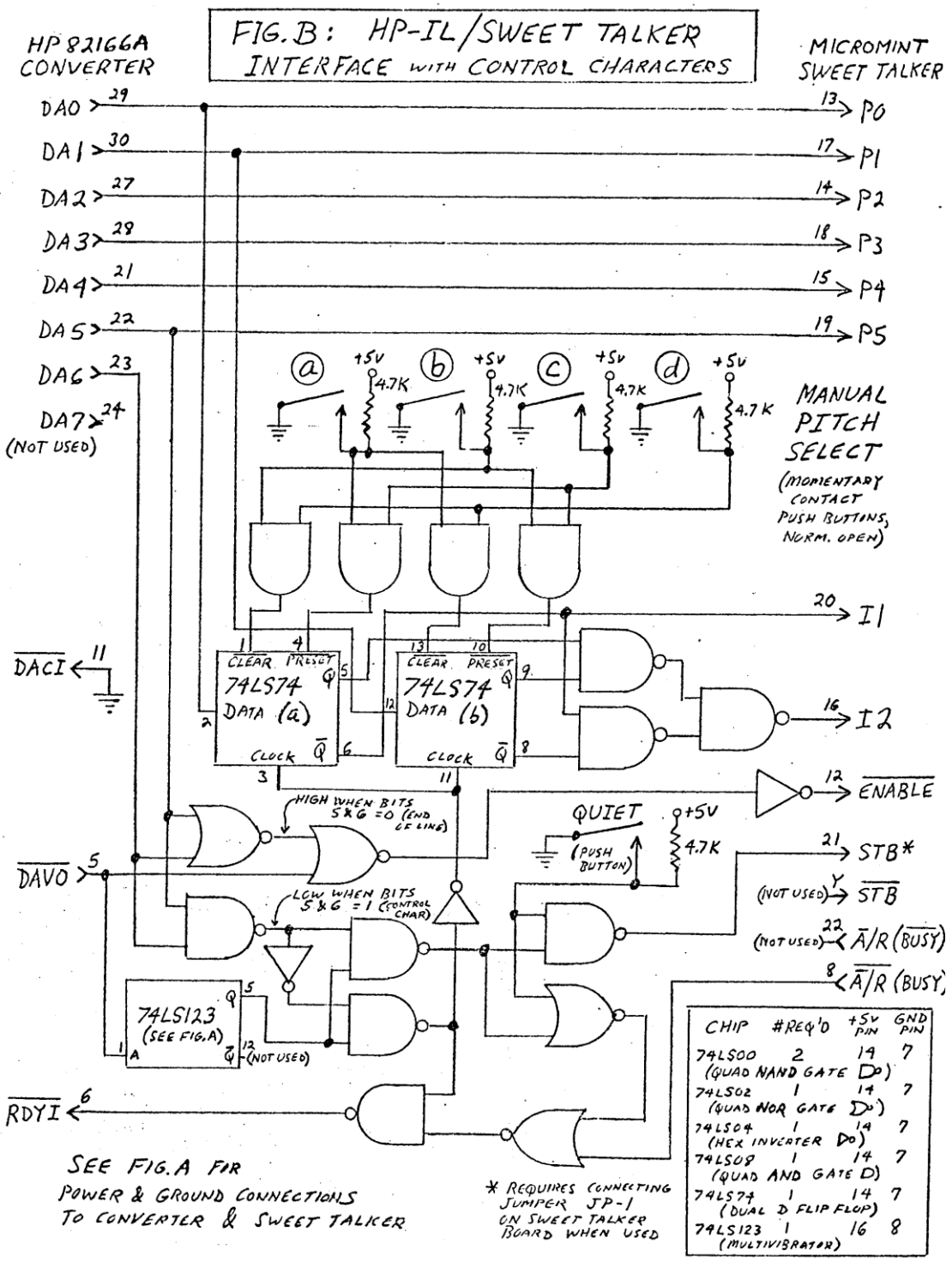
Table 2. Phoneme Categories According to Production Features

| Voiced | | | | | 'Voiced' Fricat. | 'Voiced' Stop | Fricative Stop | Fricative | Nasal | No Sound |
|---|---|---|---|---|---|---|---|---|---|---|
| E | EH | AE | UH | OO1 | Z | B | T | S | M | PA0 |
| E1 | EH1 | AE1 | UH1 | R | ZH | D | DT | SH | N | PA1 |
| Y | EH2 | AH | UH2 | ER | J | G | K | CH | NG | STOP |
| Y1 | EH3 | AH1 | UH3 | L | V | | P | TH | | |
| I | A | AH2 | O | IU | THV | | | F | | |
| I1 | A1 | AW | O1 | U | | | | H | | |
| I2 | A2 | AW1 | O2 | U1 | | | | | | |
| I3 | AY | AW2 | OO | W | | | | | | |

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FIG A: BASIC HP-IL/SWEET TALKER INTERFACE
HP 82160A CONVERTER
MICROMINT SWEET TALKER
DA0 29
DA1 30
DA2 27
DA3 28
DAA 21
DA5 22
DA6 23 (OPTIONAL)
DA7 24 (OPTIONAL)
P0 13
P1 17
P2 14
P3 18
P4 15
P5 19
I1 20
I2 16
DACI 11
DAVO 5
74LS123 (SEE BELOW)
PULSE DELAY
Q 5 (NOT USED)
A 1
12
ENABLE 12
(NOT USED) STB 21
Y STB
(NOT USED) Ā/R (BUSY) 22
RDYI 6
Ā/R (BUSY) 8
VCC 31
VCI 3
+5v
+7 TO +14v C Vp POWER
+5v A 5v POWER
D GND
SIGNAL GND 33
SIGNAL GND 7
REF. GND 1
IMPORTANT!
(CONNECTIONS TO SPEAKER ARE VIA 2-WIRE PLUG ON SWT. TKR. BOARD)
DETAILS OF 74LS123 USED AS PULSE DELAY
+5v
4.7K
.01µf
2.2K
POWER
16
14
15
2
1
3
13
74LS123 (SEC. a)
B
A
CLR
Q
GND
8
4 (NOT USED)
INPUT
V
0
TIME
10
9
11
5
12
74LS123 (SEC. b)
6
7
OUTPUTS
10 µsec
20 µsec


FIG. B: HP-IL/SWEET TALKER INTERFACE WITH CONTROL CHARACTERS
HP 82166A CONVERTER
MICROMINT SWEET TALKER
DA0
DA1
DA2
DA3
DA4
DA5
DA6
DA7
(NOT USED)
P0
P1
P2
P3
P4
P5
+5V
4.7K
MANUAL PITCH SELECT
(MOMENTARY CONTACT PUSH BUTTONS, NORM. OPEN)
I1
I2
74LS74 DATA (a)
74LS74 DATA (b)
CLEAR
PRESET
CLOCK
DACI
DAVO
HIGH WHEN BITS 5 & 6 = 0 (END OF LINE)
LOW WHEN BITS 5 & 6 = 1 (CONTROL CHAR)
QUIET
(PUSH BUTTON)
ENABLE
STB*
STB
Ā/R (BUSY)
74LS123 (SEE FIG. A)
(NOT USED)
RDYI
SEE FIG. A FOR POWER & GROUND CONNECTIONS TO CONVERTER & SWEET TALKER
* REQUIRES CONNECTING JUMPER JP-1 ON SWEET TALKER BOARD WHEN USED
CHIP #REQ'D +5V PIN GND PIN
74LS00 2 14 7 (QUAD NAND GATE)
74LS02 1 14 7 (QUAD NOR GATE)
74LS04 1 14 7 (HEX INVERTER)
74LS08 1 14 7 (QUAD AND GATE)
74LS74 1 14 7 (DUAL D FLIP FLOP)
74LS123 1 16 8 (MULTIVIBRATOR)

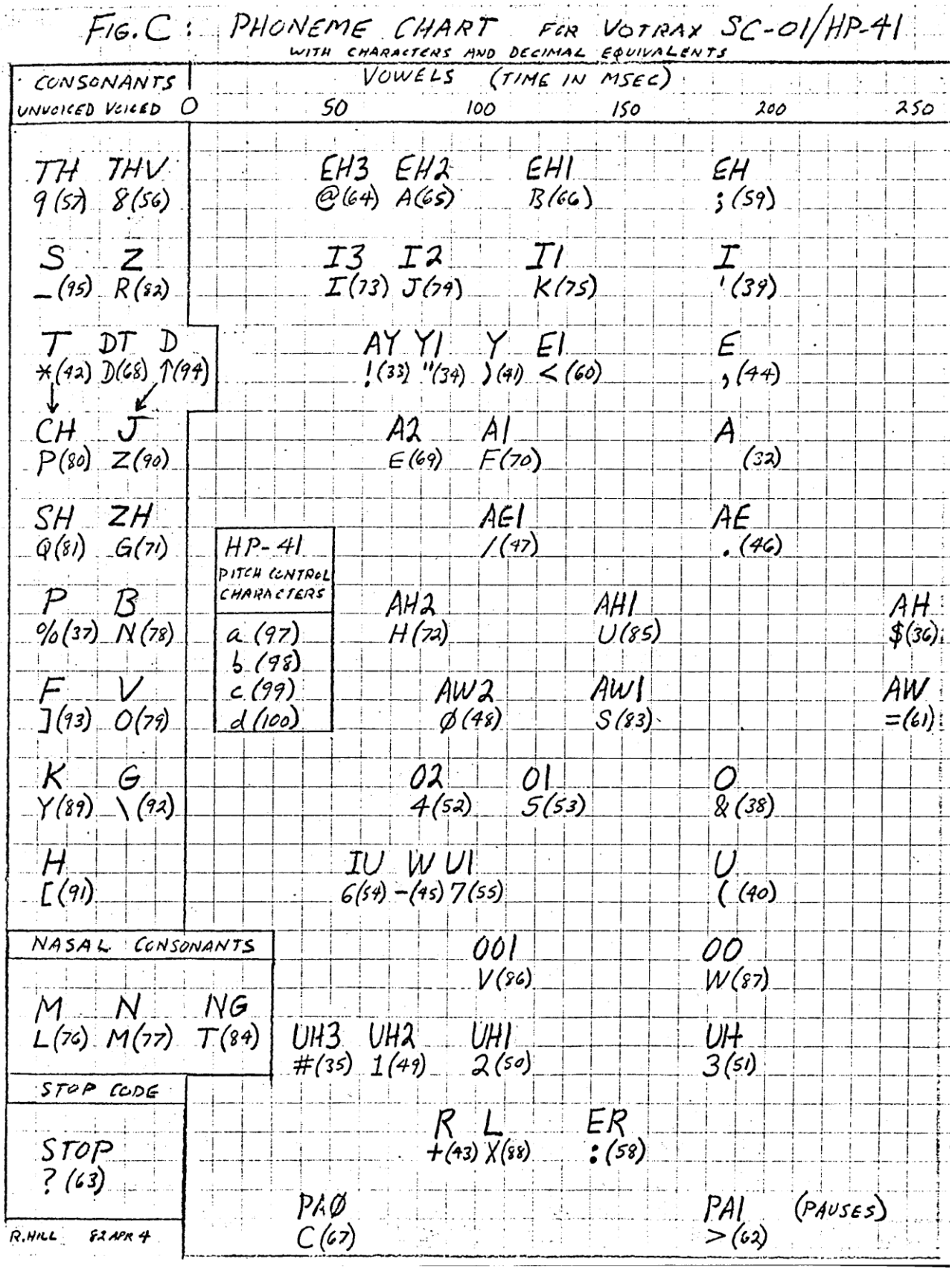

FIG. C: PHONEME CHART FOR VOTRAX SC-01/HP-41
WITH CHARACTERS AND DECIMAL EQUIVALENTS
CONSONANTS
UNVOICED VOICED
VOWELS (TIME IN MSEC)
0
50
100
150
200
250
TH THV
9(57) 8(56)
EH3 EH2 EH1 EH
@(64) A(65) B(66) ;(59)
S Z
_(95) R(82)
I3 I2 I1 I
I(73) J(79) K(75) '(39)
T DT D
*(42) D(68) ↑(94)
AY Y1 Y EI E
!(33) "(34) )(41) <(60) ,(44)
CH J
P(80) Z(90)
A2 A1 A
E(69) F(70) (32)
SH ZH
Q(81) G(71)
AE1 AE
/(47) .(46)
HP-41 PITCH CONTROL CHARACTERS
a(97)
b(98)
c(99)
d(100)
P B
%(37) N(78)
AH2 AH1 AH
H(72) U(85) $(36)
F V
](93) O(79)
AW2 AW1 AW
Ø(48) S(83) =(61)
K G
Y(89) \(92)
O2 O1 O
4(52) 5(53) &(38)
H
[(91)
IU W U1 U
6(54) -(45) 7(55) ((40)
NASAL CONSONANTS
M N NG
L(76) M(77) T(84)
001 00
V(86) W(87)
UH3 UH2 UH1 UH
#(35) 1(49) 2(50) 3(51)
STOP CODE
STOP
?(63)
R L ER
+(43) X(88) :(58)
PAØ PA1 (PAUSES)
C(67) >(62)
R.HILL 82 APR 4

**Figure D:** Sample Program using the HP-IL/Sweet Talker Interface of Fig. B. Setting Flag 01 will cause a name whose phoneme characters are stored in registers 01-03 to be substituted for "everybody".

```
LBL"HELLO
END
159 BYTES

 01*LBL "HEL
LO"
 02 SF 17          Set Flag 17 to avoid speech gaps.
 03 "c[A#bX&          Hello   (falling pitch)
_"
 04 OUTA
 05 FC? 01
 06 "CB0+"N2          everybody;
c↑)"                              (rising pitch)
 07 FC? 01
 08 GTO 14
 09 CLA           Get name from R01-R03 if Flag 01 set.
 10 ARCL 01       Example of
 11 ARCL 02        name.....{R01= "+Jc*P:
 12 ARCL 03         Richard *  "
 13*LBL 14         (rising pitch){R02= "↑C"
 14 OUTA                        R03= ""
 15 ">c"           Pause and return to pitch c (if not
 16 OUTA                                 already there).
 17 "8'__JR"          this is
 18 OUTA
 19 "+U↑Z:['          Roger Hill's
XRR"
 20 OUTA
 21 "CF"*P%,          HP-
!"
 22 OUTA
 23 "]4+*)-1          41C
MM_,""
 24 OUTA
 25 "%UYB*C"          pocket
 26 OUTA
 27 "YC/#XbY          calculator (falling pitch)
"6XF!*:"
 28 OUTA
 29 "_%,"Y<T          speaking.
>"
 30 OUTA
 31 ">c[$-U+          How are you?  (Pause and start
"d6<-"                 with pitch c; rise to d on last
 32 CF 17               word.)   Restore Flag 17 for
 33 OUTA                         later convenience.
 34 END
                  *NOTE:  A final "D" phoneme (char. ↑)
                          comes out more clearly when
                          followed by a pause PA0 or PA1
                          (chars. C or >) rather than
                          STOP.
```

As I mentioned at the beginning, this is only the beginning of what has been a new experience for me in both hardware design and the software aspects of speech synthesis. I would be interested in hearing of anyone else's experience with either this design or some other circuit. Until the next report on this subject,

"Happy Speech Synthesizing!"



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| **Phone:** | 618-650-2472 (Physics Office) |
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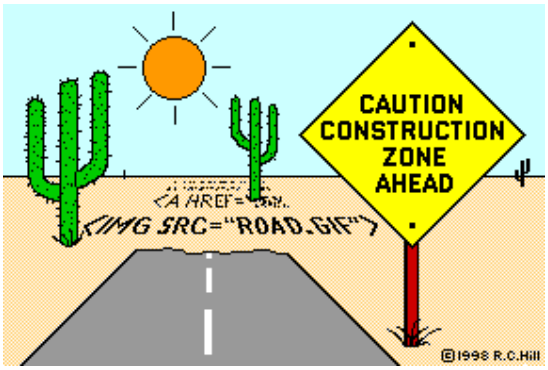

**Background**

- Born and raised in Pasadena, California.
- B.S. in Physics, California Institute of Technology, 1963.
- Ph.D. in Physics, California Institute of Technology, 1969.

Thesis: "Relativistic Quark Models and the Current Algebra".

- Research Associate and Lecturer, Northwestern University, 1968 - 1970.
- Assistant Professor, Associate Professor, and Professor, Southern Illinois University at Edwardsville, 1970 - 2010.
- Emeritus Professor, Southern Illinois University at Edwardsville, 2010 - present.

## Interests and Activities




- **Professional Activities**
  - Currently writing a textbook on senior-level quantum mechanics.
- **Recreational Mathematics, Computers, and Programming**
  - **Programmable Calculators** (particularly Hewlett-Packard)
    - **The Museum of HP Calculators** (by David Hicks) - A comprehensive source of information, particularly on the older models. Also information on earlier calculating machines and slide rules.
    - **Hewlett Packard and Handheld/Palmtop Links** (by Jake Schwartz) - References to calculator information and user groups.
    - **Joe Horn's Sundry Diversions** (by Joseph Horn) - Information on HP calculators; interesting problems in math, science, and other topics.
    - **HHC** (Hewlett-Packard Handheld Conference) - An annual meeting of users of Hewlett-Packard handheld calculators/computers, sometimes hosted by Hewlett-Packard dedicated to getting the most from Hewlett-Packard calculators, exploring new directions in calculator technology, and documenting the history of calculator technology and the user community.
    - **HPCC** (Handheld And Portable Computer Club) - Based in England; again devoted to getting the most from Hewlett-Packard handheld and portable computers.
  - **TeX Users Group** - Dedicated to getting the most out of the *TeX* typesetting system which was designed by Donald Knuth in the late 1970's and still the ultimate in high-quality mathematical and other typesetting.
  - **Web Site Writing**

    - Current webmaster of the **SIUE Department of Physics**
    - Current webmaster of the **International Folk Dance Association of University City**
    - Former webmaster (1999-2009) of the **Saint Louis Chamber Chorus**
- **Astronomy** and **Photography**
    - **Astronomical Applications** (U.S. Naval Observatory) - Astronomical data; references; FAQ's about astronomical phenomena, calendars, calculation of Easter, etc.
    - **Sky & Telescope** - A long-standing popular magazine for amateur astronomers. Astronomical news and other resources.
    - **Cometography** and **Meteor Showers Online** (by SIUE alumnus Gary W. Kronk) - Current events, basic information, and references.
    - **National Space Science Data Center** - NASA's archive for space science mission data.
    - **Star Gazer** - Originally by Jack Horkheimer (1938-2010); a weekly 5-minute program on naked-eye astronomy seen on many PBS television stations.
- **Science Fiction and Fantasy**
    - **Los Angeles Science Fantasy Society** - Founded in 1934; the world's oldest continuously-meeting science fiction club.
    - **Star Trek** (Paramount Pictures) - Includes episode listings and synopses of all of the Star Trek television series and movies.
    - **Red Dwarf** - The British television series that parodied just about every aspect of science fiction.
        - **The Official Red Dwarf Fan Club** (by Jupiter Mining Company)
- **Folk Dancing and Folk Music**
    - **International Folk Dance Association of University City** - Activities; schedules; maps; references to other sites of ethnic and folk interest. Currently Secretary of the Board of Directors.
    - **Friends of Tuva** - Dedicated to spreading interest in Tuva and its culture, with particular interest in *khoomei* (throat singing). Interest in this small central-Asian republic (formerly Tannu Tuva) was stimulated by the renowned theoretical physicist and Nobel laureate **Richard Feynman**.
- **Medieval and Renaissance Music and Instruments**
    - **Medieval Music & Arts Foundation** - A very comprehensive source of information designed to bring early music to the general public. FAQ's on the nature of Medieval and Renaissance music, recordings, concerts, etc. Also information on traditional world music.
    - **Musica Antiqua** - An early-music performing group at Iowa State University. Includes a guide to Medieval and Renaissance instruments, and links to other early-music resourses.
- **Not-So-Early Music**
    - **Harry Partch** - American composer (1901-1974) who turned away from conventional musical traditions, devised a scale with 43 tones to the "octave", built his own instruments, and produced many compositions often based on folk elements. Among the many web sites are:

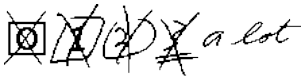
      **Harry Partch Information Center** (Montclair State University, New Jersey) - Information on Partch, the Harry Partch Ensemble, instruments, events, links.

        - **Corporeal Meadows** (by Jonathan Szanto, who worked with Partch) - Historical notes; information on recordings and performances; details on some of Partch's compositions.

- **Railroads and Model Railroading,** especially **Trolleys and Interurbans**
    - **National Model Railroad Association** - Founded in 1935; devoted to the development, promotion, and enjoyment of the hobby of model railroading. Organization information; model railroad standards; directory of World-Wide Rail Sites.
    - **The Model Train Magazine Index** - An index to model railroad magazines from 1933 to the present. Allows searches by magazine, category, title, author, etc.
    - **Trains.com** - Product news and other items from Kalmbach Publishing Co., publisher of *Model Railroader*, *Trains*, and other magazines.
    - **Electric Railway Historical Association of Southern California** (Los Angeles, CA) - History of streetcars and interurbans in the Los Angeles area; on-line bookstore; meeting information; links to other sites on railroads and southern-California history.
    - **Orange Empire Railway Museum** (Perris, CA) - One of the largest operating railroad museums; has the largest collection of streetcars and interurbans from the Los Angeles area as well as other steam, Diesel, and electric equipment. Site includes a "virtual trip" on one of the museum's operating trolleys.
    - **Illinois Railway Museum** (Union, IL) - Another of the largest operating railroad museums; has an extensive collection of midwest streetcars and interurbans as well as steam and Diesel equipment. History, equipment rosters, newsletters, projects in progress, schedules of operation, etc.
    - **Illinois Traction Society** - Devoted to study and recollections of the now-gone Illinois Traction / Illinois Terminal interurban system. Produces a magazine, newsletter, and calendar, and holds a meeting every spring in cities and towns where the railroad operated.
    - **South Shore Line** (Chicago South Shore and South Bend Railroad) - Generally considered the last surviving interurban line in the United States, now owned and operated by the Northern Indiana Commuter Transportation District. History, map, schedules, fares, and other information.
    - **MetroLink** - St. Louis' light rail system which opened in 1993 and doubled in length in 2001. See also . . .
    - **Citizens for Modern Transit** (St. Louis, MO) - A transit support group which has been instrumental in promoting the planning, building, and extending of MetroLink in the St. Louis area.
- **Miscellaneous**
    - **Frogs and Toads** - Here is some sites that treat the subject quite extensively:
        - **Michele's Frog Page** (Michele Maki) - Pictures, postcards, jokes, translations into many languages, etc.
        - **Welcome to Frogland!** (Dorota) - Just about every aspect of frogs and toads, again including translations into other languages.

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**Photo at top of page** shows the author playing a Bulgarian ***gaida*** (bagpipe) at the International Folk Dance Association of University City (thanks to fellow folk dancer Gene Woodford for the photo).




**Number of times this page has been visited:**
*This page: http://www.siue.edu/~rhill*
*Written by Roger Hill (rhill@siue.edu), revised 2012 Aug 17*
***Disclaimer:*** *Views and opinions expressed on this page are strictly those of the author. The contents of this page have not been reviewed or approved by Southern Illinois University at Edwardsville.*

Hello Roger,

I hope all is well.

I have a rounding question. How would you round the number 3.550001?

If you are rounding to three significant digits the "5" is "in the middle" and you would apply some statistical guideline to spread the rounding either up or down. The so-called Bankers Rule would round UP if "exactly 5" if the rounded number becomes even. In the example the number isn't quite "exactly 5" so it should it not be rounded up?

Most descriptions of rounding say to ONLY consider the digit to the right of the digit being rounded except if it is all zeros. Clearly the number is greater than 3.55.

What are your thoughts?

X < > Y,
Richard

-----Original Message-----
From: Roger Hill [mailto:rhill@siue.edu]
Sent: Monday, June 4, 2018 1:04 PM
To: Richard
Subject: Re: Rounding Question

Hi Richard,

I'm not sure where the ambiguity is in your example. I would say that 3.550001 unambiguously rounds off to 3.55 to 3 significant figures (because 0.000001 is less than 0.005), and 3.6 to 2 significant figures (because 0.050001 is greater than or equal to 0.05).

The rule that *I* go by is equivalent (for positive numbers) to adding 5 to the digit just past the point that you want to round to (carrying the result when necessary), and then dropping all digits past that point.

For example, 3.550001 + 0.005000 = 3.555001 which becomes 3.55 when the last 4 digits are dropped. This is not the same as the even/odd rule which is I guess the "Banker's Rule".

-- Roger

**From:** Richard [mailto:rjnelsoncf@cox.net]
**Sent:** Monday, June 4, 2018 6:16 PM
**To:** 'Roger Hill'

**Cc:** joseph.k.horn@gmail.com
**Subject:** RE: Rounding Question

Hello Roger,

Thanks for the comments and your "rule." **Is there a name for it?**

When I was a teenager in high school I learned what was then called the Astronomers Rule which is also the Bankers Rule.

The "Bankers Rule" for the exactly "5" case is to truncate and add a 1 **IF** adding it makes the rounded number even (or odd, just be consistent). If it is even you don't add the 1. This statistically "balances" the exactly "5" cases. Many rounding schemes do not account for the remaining digits past the digit *following the digit being rounded*. If you ignored the least significant digit (1) in my 3.550001 example its value is exactly "5" and you would round 3.550000 to 3 significant digits to 3.56 because the six is even. The "1" on the end clearly breaks the tie and you **must** add "1" to make the second 5 a six if rounding to three significant digits. Your rounding method doesn't get the same answer. I wonder how disparate the many users are in this rounding situation.

The Ambiguity is that the rules often do not look beyond the digit *following that being rounded* and by some rules are considered "all zeros." What I am trying to do is to better describe a/the rounding process.

Isn't the idea of rounding to find the shorter number that is **closest** to the number being rounded? Using only positive numbers in these examples.

The rounding process only does one of two things. (1) Truncates all digits past the digit being rounded, or (2) Truncates all digits past the digit being rounded **and** add 1 to the digit being rounded. In the special case event of a "tie" some additional statistical rule is followed (e.g. the Bankers Rule") to equalize the adding or dropping the "1" in the exactly "5" case.

Of course, whatever set of rules or process you use the same result must be obtained every time you process a set of data. The idea of **randomly** adding or not adding the "1" in the "tie" case may be statistically appropriate, but is not suitable for normal data processing.

**Do you think that the rounding rules (5/4 and ignoring the "5" tie case) our calculators follow are suitable for serious work? Have you seen any analysis on this, and the quantified impact this mathematical nit-picking might have?**

We have all heard of the repetitive computer processing of a small fraction of a cent (Millicent, etc.) can have in thousands of banking transactions that individually are insignificant, but does add up (computer wise) in some account to someone's advantage. An old friend, Doug Mecham, worked on a large bankers software package with all kinds of neat features. They could not sell it because they dropped the cents in the end. Bankers software must calculate to the nearest cent. That was back in the "olden" days of computers. Accurate multi-decimal calculations are easily doable these days – more bits.

X < > Y,
Richard
##########################################################################
-----Original Message-----
From: Roger Hill [mailto:rhill@siue.edu]
Sent: Wednesday, June 22, 2011 2:06 PM
To: Richard J. Nelson
Subject: RE: Math problem

# Cosmic Cube Dynamic Range Problem Thoughts

Hi Richard,

Whenever the occasion arose, I used to tell classes that it is very hard to find a physically reasonable problem whose answer is as big as a googol (1E100), unless you start calculating some large volumes using very small units. If you take your "cosmic cube" 1 million light-years and find the volume in cubic nanometers, you get about 9E92. Eddington was famous for a theory which predicted the total number of electrons in the universe (or something like that; you can look him up on the internet), and got a number around 1E80, I believe.

Although his theory is not considered to hold water by most scientists, this could be considered a "ballpark" number for estimating the number of atoms in the observable universe, though there are probably better estimates gotten by counting galaxies, etc.

You can exceed a google by getting sufficiently ridiculous, such as finding the number of nuclei packed together that would fill the observable universe. For a VERY rough answer I approximated a nucleus as a cube 1E-15 m on a side) and the universe as a sphere of radius 1E10 LY, and got for the answer about 4E123. (A typical neutron star, basically a sphere packed with neutrons, might have around 1E57 neutrons packed together.)

Factorials, and some combinatorial problems that use them, can also easily exceed a google. As I remember, 69! is the highest integer factorial that is less than 1E100) and would fit on the classic HP calculators (35, 41, etc.). You could exceed this by asking, for example, how many different piano pieces you could compose using each key once and only once (answer: 88! = 1.85E134, since a piano has 88 keys).

I don't know if these would be considered "real world practical problems"...
7P <> S,
-- Roger

RJN Note. This seems to be a combinations problem: ${}_{88}C_{88} = 1.85482642257 \times 10^{134}$.
${}_{88}C_{55} = 2.13608036006 \times 10^{97}$.
${}_{88}C_{56} = 7.04906518821 \times 10^{98}$.
${}_{88}C_{57} = 2.25570086023 \times 10^{100}$.
$69! = 1.71122452428 \times 10^{99}$. These values are for just the HP35s ! key (meaningless?)
$69.8 = 5.11552018734 \times 10^{99}$.
$69.9 = 7.82738282497 \times 10^{99}$.
$69.95 = 9.6828476730 \times 10^{99}$.

## Email Notes

Hi Bob and Joe and all,

I used to have a Model 100 (great computer) and even wrote a little for it in machine (8085) language. I'd be interested in seeing how you implement a 41C emulator on it, particularly the graphical interface. I'm curious as to how AI would help in doing this, as opposed to just implementing each command one at a time in BASIC or machine language using plain old HI (Human Intelligence).

— Roger

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## HHC List 01

My first clue that something may be wrong was when Roger did not attend our December 2025 meeting. Our community was not aware of Roger's passing until long after the event. The only information that Bob and I was aware of was the result of a Google search that found an announcement of his passing provided by his university. I am still not aware of the reason for his passing. I talked to Roger sometime in November and he had found an apartment to live in – his home and all of his possessions burned to the ground in the LA wild fires. He had decided NOT to rebuild his parent's home in Pasadena. I sent him a copy of the PPC ROM manual – because it was dedicated to him. All he had was his car and its continents when he was denied entrance to the area coming from having lunch with a couple of friends.

I have known Roger for well over 45 years.

X < > Y,
Richard

**From:** hhc-conf@googlegroups.com <hhc-conf@googlegroups.com> **On Behalf Of** David Hayden
**Sent:** Tuesday, February 17, 2026 8:44 AM
**To:** hhc-conf@googlegroups.com
**Subject:** Re: [HHC-Conf] Passing of Roger Hill

I found this Photo of Roger from the 2022 HHC.
Dave

Note: I used this photo for the cover page (1).

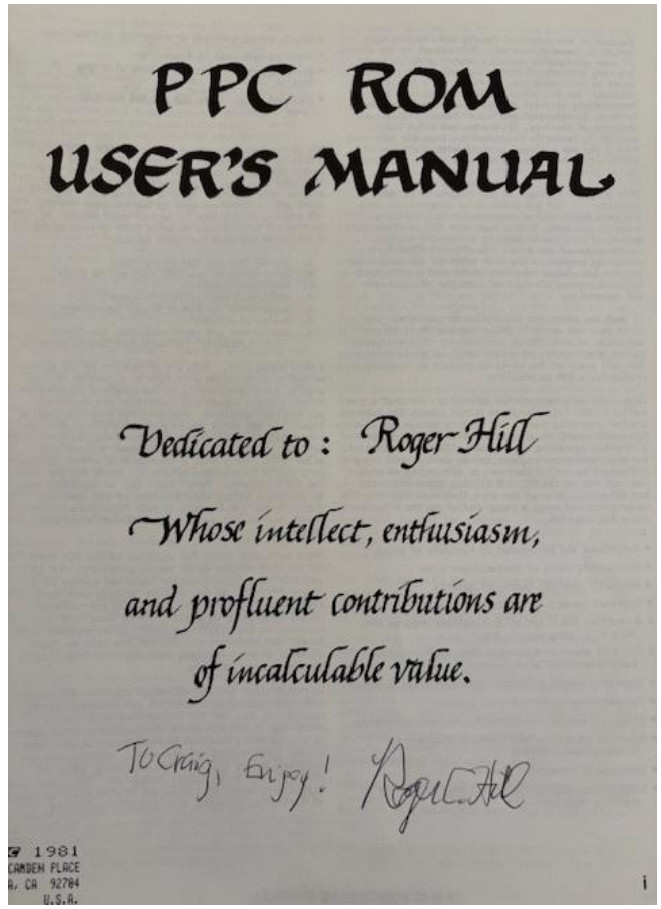


On 1/13/2026 6:40 AM, 'Jim Johnson' via HHC-conf wrote:
Did I somehow miss this sad news about Roger?

Sad news: **Roger C. Hill**, Died Nov. 5-2025
https://www.siue.edu/news/obituaries/2025/RogerCHill.shtml

**HHC List 02**

I'll miss Roger, he always had a kind word for everyone and was very humble. When I asked him to sign my PPC ROM User's Manual at HHC 2025 he questioned why anyone would want his autograph.




On Monday, January 19, 2026 at 7:06:46 AM UTC-7 Brad Barton wrote:
Thank you for posting this. So sorry to hear that Roger is gone. He was always so friendly and animated, and loved to share our passion, even with a part timer like me. I'll miss him.

###########################

**HHC List 03**

From: **hhc-conf@googlegroups.com** <**hhc-conf@googlegroups.com**> On Behalf of Jim Wild
I had the pleasure of going to Kennedy Space Center with Roger on our last HHC in September 2025.

Here he is sitting in the replica cockpit of the Space Shuttle Atlantis exhibit. On his calculator is an emulated HP-41C.

##########################################################

Here he is calculating burn duration and timing to keep us all on target trajectory. Roger wrote programs that solved problems, taught students, and won contests - often using fewer bytes than anyone thought possible.

I remember the participants of every programming contest wondering "how did Roger do this with so little memory?"

He was an inspiration and a very kind man. He will be missed.

Jim

See the photo on the next page.



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**Google AI information**

Professor Roger C. Hill passed away in his sleep on November 4, 2025. [1, 2]

**Key Details**

- **Name:** Roger C. Hill, PhD
- **Role:** Professor Emeritus of Physics at Southern Illinois University Edwardsville (SIUE)
- **Date of Death:** November 4, 2025 (announced/noted around November 5)
- **Location:** Altadena, California
- **Cause of Death:** Passed away peacefully in his sleep. [1, 2]

If you would like more information, I can help you with:

- **Academic career details** (his physics research and publications)
- **Life history** (his background and hobbies like model railroading or folk dancing)
- **Obituary links** and memorial notices
-

Roger C. Hill, PhD, was Emeritus Professor of Physics
Biographical Data: Roger C. Hill, PhD (died Nov. 4, 2025, age 84, Altadena, Calif.); born Pasadena, Calif. Education & Career: BS ...



-

File 770

Roger Hill (1941-2025) - File 770
Posted on November 10, 2025 by Mike Glyer By John Hertz: Long-time fan Roger Hill died in his sleep on November 4. Roger Hill play...

Professor Roger Hill's sister, **Catherine S. Hill**, lives in **Glendale, California**. [1]
Would you like to know more about **Professor Hill's parents** (such as his father, H. Stanton Hill, who was a notable geologist), or any other aspects of his **family's roots in the Pasadena area**? [1]

Professor Roger C. Hill's family has a deep-rooted history in the Pasadena and Altadena areas of California, closely tied to local education and the geological sciences. [1, 2]

**The Father: H. Stanton Hill (1911–2004)**

His father, **Hamilton Stanton Hill**, was a highly influential and beloved figure in the Southern California academic community. [1, 2]

- **The Pasadena Connection:** Though born in Massachusetts, he moved to the Pasadena area as a teenager and lived there for **77 years**. He completed graduate work at Caltech, which is notably the same institution where his son Roger would later earn his PhD in physics. [1, 2]
- **Academic Legacy:** He was a **Professor Emeritus of Geology and Mineralogy** at Pasadena City College (PCC), where he taught for 37 years (1935–1972). [1]
- **Impact:** He inspired hundreds of future professional geologists. In 1970, he was honored with the national **Neil Miner Award** for exceptional contributions to earth science education. He was also an active researcher of local California geology, co-authoring papers on formations like the central Sierra Pelona. [1, 2]

**The Mother: Marie Hill**

Professor Hill's mother, **Marie Hill**, raised her family alongside Stanton in the Pasadena/Altadena area, where they watched their children grow up to pursue successful endeavors of their own. [1, 2]

**A Multi-Generational Legacy**

Because of his parents' deep roots, Professor Roger Hill grew up completely immersed in the Pasadena community. He attended local schools before staying local for college at Caltech. Even after spending 40 years teaching physics in Illinois at SIUE, he eventually returned to his childhood roots, retiring to **Altadena** where he spent his final years. [1, 2]

# END