Ty’s contributions to anesthesia were numerous. In addition to his organizing role in STA and founding of the Journal of Clinical Monitoring, Ty made major contributions in the fields of closed loop control of anesthesia, modeling, simulation, narcotic-induced rigidity — all at the same time.

Those of us who worked with Ty knew to bring something to read while waiting for him, but he would take the time to steer you in the right direction. Ty foresaw the use of immersive simulation in anesthesia, brought the first computer into an OR, and championed improvements in intraoperative monitoring.

An avid photographer, he would come back from trips with 10 rolls of Kodachrome. Long before PowerPoint, Ty could give a 50 minute talk with two carousels on two screens and keep everything in sync. Ty also found time for opera, orchids, and family.

We are all saddened by the passing of this great visionary, but rededicate our efforts to keep his memory alive through the Society.
Mr. N. Ty Smith M.D., Ph.D. is a Professor of Anaesthesiology at UCSD, San Diego, CA, USA. Mr. Smith served for two years in the Navy and spent nine years on the faculty of Stanford University and twenty-four at the University of California, San Diego.

During the 45 years of his professional life, he spent much of his time with a computer.

His work has included cardiovascular physiology and pharmacology, EEG analysis and display, closed-loop control, drug interactions, physiologic and pharmacologic mathematical modeling, simulation, noninvasive monitoring, the human pharmacology of inhaled anesthetic agents, and automated record keeping, including voice recognition.

Mr. Smith was a Founding Editor of the Journal of Clinical Monitoring, the Founding President of the Society for Technology in Anesthesia, and has served on and helped put together many meetings. Mr. Smith serves as a Member of the Scientific Board of BMEYE B.V. He serves as Member of Corporate Advisory Board at Virtual Heroes, Inc. As founding Chair of the American Society of Anesthesiologists Committee on Electronic Media and Information Technology, he helped hold the ASA into the electronic world.

His current work includes mathematical modeling and simulation of physiology and pharmacology. During his prolific career, he has authored over 400 publications.

*Dental disease as a fundamental problem.*

Smith NT
Dental disease as a fundamental problem.

Smith NT

Temperatures were recorded continually in 39 patients. Preinduction temperatures were, in decreasing order, (P < .01) 1) rectum and esophagus, 2) intercostal muscle, 3) gastrocnemius muscle and intercostal subcutaneous, 4) tibialis anticus muscle, and 5) tibialis anticus and gastrocnemius subcutaneous.

Subcutaneous, muscle, and body temperatures in anesthetized man

N. Ty Smith
Anesthesia Laboratories, Massachusetts General Hospital, Boston, Massachusetts

Temperatures were recorded continually in 39 patients. Preinduction temperatures were, in decreasing order, (P < .01) 1) rectum and esophagus, 2) intercostal muscle, 3) gastrocnemius muscle and intercostal subcutaneous, 4) tibialis anticus muscle, and 5) tibialis anticus and gastrocnemius subcutaneous.
Studies on 100 fasting infants and children anesthetized for elective surgery showed that there was often considerable gas and liquid in the stomach. The total volume of the gastric contents was sufficient to exert mechanical effects on respiratory movements... It is suggested that a gastric tube be passed in pediatric patients as soon as possible after induction of anesthesia, and the gastric contents removed.

Changes in Ventilation in Pediatric Patients After Removal of Gastric Contents

N. Ty Smith, MD, and Edwin J. Lilly, MD, Portsmouth, Va
Changes in Ventilation in Pediatric Patients After Removal of Gastric Contents

N. Ty Smith, MD, and Edwin J. Lilly, MD, Portsmouth, Va

<table>
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<tr>
<th>Age</th>
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<tr>
<td>Total</td>
<td>10.8</td>
<td>10.9</td>
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The Hemodynamic Effects of Potassium Infusion in Dogs

N. Ty Smith, M.D., and Aldo N. Corbascio, M.D.

The hemodynamic effects of K infusion were studied in 8 normal and 5 reserpine-treated dogs. Arterial blood K levels were correlated with changes in hemodynamic parameters.

Normal animals were more resistant to deleterious changes in cardiac output, total peripheral resistance, mean transit time, heart rate, mean arterial pressure, stroke volume, and left ventricular work, although the difference was statistically significant only with the first three parameters.
The Hemodynamic Effects of Potassium Infusion in Dogs

N. Ty Smith, M.D., and Aldo N. Corbascio, M.D.

Left Ventricular Work

Mean Transthoracic Time

Total Peripheral Resistance

Left Ventricular Work

BOTH ANESTHETIC agents and decreased calcium ion depress the myocardium. A similarity of action between the two factors suggests that they may significantly interact with each other on the myocardium. This interaction may influence the circulatory depression noted during massive transfusions in anesthetized patients. As an initial approach to the problem, the interaction of pentobarbital and decreased calcium ion was studied on the isolated guinea pig atrium.

INTERACTION BETWEEN PENTOBARBITAL AND DECREASED CALCIUM ION ON GUINEA PIG ATRIA

N. Ty Smith, M.D., and Aldo N. Corbascio, M.D.

about the authors

N. Ty Smith, M.D., is Assistant Professor of Anesthesiology at Harvard Medical School, Boston, Massachusetts. He received his M.D. degree from the University of California, Los Angeles, in 1958. He served on the surgical staff of the Massachusetts General Hospital in Boston, 1958-1963.

Aldo N. Corbascio, M.D., is Associate Research Pharmacologist at the University of California, Pacific Medical Center, Los Angeles, California. He received his M.D. degree from the University of California, Los Angeles, in 1958. He served on the staff of the Massachusetts General Hospital in Boston, 1958-1961, and on the staff of the Washington University School of Medicine, St. Louis, Missouri, 1963-1966.
INTERACTION BETWEEN PENTOBARBITAL AND DECREASED CALCIUM ION ON GUINEA PIG ATRIA

N. Ty Smith, M.D., and Aldo N. Corbascio, M.D.

The professional man has no right to be other than a continuous student. - G. V. Black

There never was a good war or a bad peace. - Benjamin Franklin

We may be personally defeated, but our principles, never! - William Lloyd Garrison

Greatness is only one of the sensations of littleness. - John Taylor
The Cardiovascular Effects of Nitrous Oxide During Halothane Anesthesia in the Dog

N. Ty Smith, M.D., and Aldo N. Corbascio, M.D.

Nitrous oxide-oxygen, halothane-oxygen, and nitrous oxide-oxygen-halothane were administered in random order to each of 12 dogs. Thirteen cardiovascular parameters—cardiac output, stroke volume, heart rate, mean arterial pressure, systolic arterial pressure, total peripheral resistance, mean transit time, left ventricular pressure, right ventricular pressure, the time derivatives of the pressures, and the left ventricular ejection time were plotted against concentrations of nitrous oxide and halothane.
The Cardiovascular Effects of Nitrous Oxide During Halothane Anesthesia in the Dog

N. Ty Smith, M.D., and Aldo N. Corbascio, M.D.

Since considerably greater analgesia was achieved when nitrous oxide was added to a given concentration of halothane, nitrous oxide used with halothane spares the cardiovascular system, in a relative way.

Hemodynamic Effects of Experimental Hypercitremia

Aldo N. Corbascio, M.D. and N. Ty Smith, M.D.
Hemodynamic Effects of Experimental Hypercitremia

Aldo N. Corbascio, M.D. and N. Ty Smith, M.D.

With this issue of the JOURNAL a new section heading appears: Clinical Workshop. The Editors have, for some time, felt that the former designations—Current Comment and Gadgets—did not do justice to the high caliber and importance of the material published under these headings.

LEROY D. VANDAM, M.D.
Editor-in-Chief

Hemodynamic Effects of Gallamine and Tubocurarine Administered During Halothane Anesthesia

N. Ty Smith, MD and Charles E. Whitcher, MD

Acute Hemodynamic Effects of Methoxamine in Man

N. Ty Smith, MD and Charles E. Whitcher, MD
Hemodynamic Effects of Gallamine and Tubocurarine Administered During Halothane Anesthesia
N. Ty Smith, MD and Charles E. Whitcher, MD

Acute Hemodynamic Effects of Methoxamine in Man
N. Ty Smith, MD and Charles E. Whitcher, MD

The Effects of Interaction Between Lidocaine and Pentobarbital on Toxicity in Mice and Guinea Pig Atria
N. Ty Smith, MD and Charles E. Whitcher, MD

Effect of propranolol on alpha-adrenergic blockade in the dog and isolated rabbit aortic strip
Olivares GJ, Smith NT, Aronow L

Mode of action of hydralazine on guinea pig atria
Gershwin ME, Smith NT

Hemodynamic effects of ouabain on the surgically denervated, autotransplanted dog heart
Smith NT, Gershwin ME, Hurley EJ

Cirrre infusion in dogs following cardiac autotransplantation. Studies on cardiovascular effects
Smith NT, Hurley EJ

Whole-body autoradiography of histamine-14-C in rats
Gershwin ME, Smith NT, Hood N

Rapid computation of myocardial contractility in intact animals
Smith NT, Schrader HO
Cardiovascular Effects of Halothane in Man

N. Ty Smith, MD; Edmond I. Eger II, MD; Robert K. Stoelting, MD; and Charles E. Whitcher, MD

The cardiovascular response to induction of anesthesia with halothane-oxygen, as well as to changes in alveolar concentration from one steady-state level to another, was studied in eight subjects. Heart rate, arterial and right atrial pressures, stroke volume, cardiac output, left ventricular minute work, and total peripheral resistance were recorded beat-to-beat.

The last four variables were calculated by a ballistocardiograph-analogue computer system.
1967 Monitoring of hemodynamic parameters by the BCG in conscious man.

1968 The BCG in cardiac homotransplantation.

1969 The relation between the ultra-low frequency ballistocardiogram, the acceleration pneumocardiogram, and ascending aortic flow acceleration in the baboon.

1973 ULF ballistocardiography in human cardiac transplantation.

1974 The acceleration ballistocardiogram in relation to left ventricular flow in the baboon.

1975 The ultra-low-frequency ballistocardiogram in a young California gray whale.

1976 Opening address by the president of the American Ballistocardiographic Research Society.

1976 The BCG for measuring cardiac output in a California Gray Whale.
The pneumocardiogram: a potential monitor for the operating room.

N. Ty Smith, M.D., and John A. Reitan, M.D.

The pneumocardiogram is familiar to all anesthesiologists as pulsations in the breathing bag, most readily apparent during apnea.

We tested the physiologic validity of the PNCG by comparing it with a standard index of cardiac function - peak ascending aortic blood acceleration (dQ/dtmax).
The pneumocardiogram: a potential monitor for the operating room.

A non-invasive correlate of ascending aortic blood flow acceleration

John A. Reitan, N. Ty Smith And Leslie B. Kados

The purpose of this study is to examine the relationship between blood flow acceleration and data useful for routine patient monitoring which is procured in a non-invasive and comfortable manner.

The variable investigated is the cardiac pre-ejection period (PEP), the interval during which energy is developed for ventricular ejection.

Mongrel dogs with chronically implanted pulsed ultrasonic flow probes and arterial and venous catheters. Additional monitoring equipment included ECG leads and precordial and oesophageal microphones.

The pre-ejection period was calculated indirectly from the tracings of the ECG, phonocardiogram, and pulse wave form.

The calculation of the PEP and its squared reciprocal is readily performed with a small computer.
The cardiac pre-ejection period: a correlate of peak ascending aortic blood-flow acceleration

John A. Reitan, M.D., N. Ty Smith, M.D., V. Scott Borison, MS., Leslie B. Kadis, M.D.

The purpose of this study was to investigate the relationship between peak ascending aortic blood-flow acceleration and the cardiac pre-ejection period, on interval that can be obtained indirectly by noninvasive means.
Cardiovascular Effects of Halothane in Man

N. Ty Smith, MD; Edmond I. Eger II, MD; Robert K. Stoelting, MD; and Charles E. Whitcher, MD

The cardiovascular response to induction of anesthesia with halothane-oxygen, as well as to changes in alveolar concentration from one steady-state level to another, was studied in eight subjects. Heart rate, arterial and right atrial pressures, stroke volume, cardiac output, left ventricular minute work, and total peripheral resistance were recorded beat-to-beat. The last four variables were calculated by a ballistocardiograph-analogue computer system.
Cardiovascular Effects of Halothane in Man

N. Ty Smith, MD; Edmond I. Eger II, MD; Robert K. Stoelting, MD; and Charles E. Whitcher, MD

The ballistocardiographic analogue computer technique used in this study allows us to examine induction of and rapid changes in anesthesia in a manner never before possible in humans. The advantages of this technique are many. We can study several parameters in a beat-to-beat fashion. Previously, the only possible way to do this was to perform a thoracotomy or to insert a rather long, large intra-arterial catheter. The Beg method is the only nondestructive method suitable for and proved in human subjects.

A comparison of the cardiovascular effects of halothane, fluroxene, ether and cyclopropane in man

Edmond I. Eger, II, M.D., N. Ty Smith, M.D., David J. Callen, M.D., Bruce P. Callen, M.D., George S. Gregory, M.D.
A comparison of the cardiovascular effects of halothane, fluroxene, ether, and cyclopropane in man

Cardiovascular Effects of Fluroxene in Man
Bruce F. Cullen, M.D., Edward J. Eger, II, M.D., N. Ty Smith, M.D., Donald C. Sawyer, D.V.M., Ph.D., George A. Gregory, M.D., Thomas A. Jones, M.D.

Cardiovascular Effects of Halothane in Man
Edward J. Eger, II, M.D., Norman Ty Smith, M.D., Robert K. Stoelting, M.D., David S. Cullen, M.D., Leslie B. Kadis, M.D., Charles E. Whitcher, M.D.

The Cardiovascular and Sympathomimetic Responses to the Addition of Nitrous Oxide to Halothane in Man
Norman Ty Smith, M.D., Edward J. Eger, II, M.D., Robert K. Stoelting, M.D., Thomas F. Whayne, M.D., David Cullen, M.D., Leslie B. Kadis, M.D.

The Cardiovascular Effects of Diethyl Ether in Man
George A. Gregory, M.D., Edward J. Eger, II, M.D., N. Ty Smith, M.D., Bruce F. Cullen, M.D., David J. Cullen, M.D.

The effects of halothane anesthesia on reflex cardiovascular responses to simulated diving and the Valsalva maneuver
Thomas F. Whayne, A. H., M.D., N. Ty Smith, M.D., Edward J. Eger, II, M.D., Robert K. Stoelting, M.D., Charles E. Whitcher, M.D.

The Effects of Ether, Halothane, and Forane on Apneic Thresholds in Man
Robert F. Whaley, M.D., Henry E. Faust, M.D., Edward J. Eger, II, M.D., C. Philip Larson, Jr., M.D., Steven D. Robison, M.D., H. Wendell Stevens, M.D., George A. Gregory, M.D., Norman Ty Smith, M.D.
Anesthesiology 1971;35:274-85
The cardiovascular effects of nitrous oxide-halothane anesthesia in man

Anesthesiology 1971;34:415-20
The circulatory response to hypercapnia during fluroxene anesthesia in man
Bruce F. Cullen, M.D.; Edmond I. Eger, II, M.D., N. Ty Smith, M.D., Donald C. Sawyer, Ph.D., M.J. Halsey, Ph.D., T.H. Cromwell, M.D.

Anesthesiology 1972;36:494-502
The cardiovascular effects of halothane in man during spontaneous ventilation.

The cardiovascular responses to the addition of nitrous oxide to diethyl ether in man
N. Ty Smith, M.D., Edward I. Eger, II, M.D., George A. Gregory, M.D., Bruce F. Cullen, M.D., David J. Cullen, M.D.

Anesth Analg. 1972;51:956-63
Cardiovascular effects of 40 percent nitrous oxide in man
John H Eisele, M.D.; N. N Ty Smith, M.D.

The cardiovascular effects of carbon dioxide in man awake and during diethyl ether anesthesia
George A. Gregory, M.D., Edward I. Eger, II, M.D., N. Ty Smith, M.D., Bruce F. Cullen, M.D.

1974
Multiple model approach to uptake and distribution of halothane: the use of an analog computer

Aart Zwart, N. Tj Smith, Ann E. W. Beneken
Institute of Medical Physics, TNO: Department of Cardiovascular Physics, Utrecht, The Netherlands

This paper describes a multiple analog computer model of the uptake and distribution of the anesthetic agent halothane. The model consists of two interdependent loops, one representing the blood circulation and another representing the halothane transport. Cardiac output and regional conductances are influenced in relation to the concentration of halothane in some relevant compartment of the model.
Multiple model approach to uptake and distribution of halothane: the use of an analog computer

Interaction between the circulatory effects and the uptake and distribution of halothane: use of a multiple model

12 compartment analog computer model
This study was performed to extract parameters from the EEG which would give quantitative information about brain function during halothane anaesthesia.

The EEG was analysed by a hybrid spectral analyser, consisting of a bank of 20 electronic bandpass filters covering the frequency range 2-32 c/secs.

As a check on the analogue frequency analysis, a spectral analysis of some epochs was performed off-line on a digital computer (PDP-9) using the Fast Fourier Transform procedure.
An equation system and programs for obtaining base excess using a programmable calculator

Gershwin R, Smith NT, Suwa KS

A computer module for the continuous monitoring of cardiac output in the operating theatre and the ICU

Wesseling KH, Purschke R, Smith NT, Rust M, de Wit B, Weber HA

An inexpensive device for analyzing and monitoring the electroencephalogram

Robert A. Fleming, MS, and N. Ty Smith, MD
Interactions among ventilation, the circulation, and the uptake and distribution of halothane
Use of a hybrid computer multiple model: I. The basic model

Interactions among ventilation, the circulation, and the uptake and distribution of halothane
Use of a hybrid computer multiple model: I. The basic model

Digital and sampled-data control of arterial blood pressure during halothane anesthesia

Digital and sampled-data control of arterial blood pressure during halothane anesthesia
Digital and sampled-data control of arterial blood pressure during halothane anesthesia

Phentolamine infusion

Nitroglycerin infusion

EEGs during high-dose fentanyl-, sufentanil-, or morphine-oxygen anesthesia

N. Ty Smith, MD, Holly Dec-Silver, RN, Ted J. Sanford Jr, MD, Charles J. Weather Jr, MD, Michael L. Quinn, PhD, Fritz Klein, PhD, and D. A. Davis, MD

Automatic control in anesthesia: a comparison in performance between the anesthetist and the machine

N. Ty Smith, MD, Michael L. Quinn, PhD, James D. Ris, MS, Ronald J. Chase, PhD, Robert Fleming, and John R. Civic, PhD

The scores for machine and anesthetist by system are shown in Tables 1-3. The scores combined from the three systems are shown in Table 4. In general, the machine's scores were considerably better than the anesthetists' scores. In addition, the machine's performance tended to be more consistent from experiment to experiment, as indicated by the larger coefficients of variation of the anesthetists' scores (not shown).

The machine scored better than the anesthetist in 38/42 possible scores, the differences in 19 scores being statistically significant. In no case was the anesthetists' score significantly better than the machine.
Multiple-model adaptive control of blood pressure
using sodium nitroprusside

James F. Martin, Alan M. Schneider, N. Ty Smith

Supervisory adaptive control of arterial pressure during cardiac surgery

James F. Martin, N. T. Smith, Michael L. Quinn and Alan M. Schneider

Patient in pain: SNP is replaces BP as vital sign
Ketanserin pretreatment reverses alfentanil-induced muscle rigidity

Matthew B. Weinger, M.D., Elizabeth J. Cline, B.S., N. Ty Smith, M.D., George F. Koob, Ph.D.

A measure of association for assessing prediction accuracy that is a generalization of non-parametric ROC area.

Warren D. Smith, Ph.D., Robert C. Dutton, M.D., N. Ty Smith, M.D.

\[ P_K = \sum_{R-1}^{R} \sum_{i=1}^{R-1} p_i p_j p_{i,j} \]

Measuring the performance of anesthetic depth indicators

Warren D. Smith, Ph.D., Robert C. Dutton, M.D., N. Ty Smith, M.D.
A multicenter study of bispectral electroencephalogram analysis for monitoring anesthetic effect

Sebel PS, Lang E, Rampil IJ, White PF, Cork R, Jopling M, Smith NT, Glass PS, Manberg P

Performance of the ARX-derived Auditory Evoked Potential Index as an Indicator of Anesthetic Depth

Virtual medical trainer: Patient assessment and trauma simulator
Kizakevich PN, McCartney ML, Newman DR, Starko K, Smith NT

The Virtual Medical Trainer (VMET) combines multimedia sound and graphics with physiological engines, medical-procedures databases, and 3-D patients to produce an interactive environment that can mimic the cognitive pre-hospital assessment and care demands of a real emergency.

VMET uses a reconfigurable component software and training framework that allows a uniform user interface, ease of increasing training complexity, and expansion of the software components.

VMET provides an opportunity to experience a range of trauma scenarios prior to the challenge of an actual trauma situation.

Simulation in anesthesia: the merits of large simulators versus small simulators
N. Ty Smith

I define ‘large’ as the so-called realistic simulators, and ‘small’ as everything else. Several words or phrases have been used to describe the large anesthesia simulators. These include high fidelity, realistic, theater and full scale.

I emphasize the merits of small simulators at the expense of large simulators.

The Physiology and Pharmacology of Growing Old, as Shown in Body Simulation
N. Ty Smith, Kenton R. Starko

We present a detailed model and simulation of the aging process.

To implement the aging process, we changed over 50 existing parameters that are part of a physiologic, pharmacologic multiple transport model of the human body.

To evaluate the new patients, we imposed three stresses: anesthesia induction, hemorrhage and apnea.

The elderly patients fared worse with anesthetic induction and with hemorrhage, but better with apnea.

Some independent data support our results.
The history of medical simulation

Kathleen R. Rosen MD
Department of Anesthesiology, East Carolina University School of Medicine, Greenville, NC 27834, USA

1928 Edwin Link builds first flight trainer in basement of father’s piano and organ factory.

1931 Link becomes full-time flight instructor. His school offers a flight training program.

1934 US Army buys 6 Link trainers.

1938 US Military purchases 1000 Link trainers. First plastic skeleton made by founders of Medical Plastics Laboratory.

1941 Rocket flight simulator completed.

1957 First successful external defibrillation with Johns Hopkins’ equipment.

1958 Laerdal begins R&D for mouth-to-mouth mannequin. NASA develops biotelemetry.


1961 First primitive computer-assisted learning in medicine.


1968 AT&T designates 911 as national emergency telephone number. Cardiology Patient Simulator—“Harvey”—debuts from University of Miami.

1970 Massachusetts General Hospital produces computerized clinical encounter simulations.

1972 NLM provides sponsorship and access to medical simulations from Ohio State University, Massachusetts General Hospital, and University of Illinois.

1973 CPR introduced with instruction by the AHA and Red Cross. University of Wisconsin develops patient encounter simulation prototypes for future NBME computerized examinations.

1974 First AHA guidelines published with support from Laerdal.

1975 First description of Objective Structured Clinical Examination.

1978 Singer-Link pioneers computer imaging with introduction of DIG digital image generator.

1979 First report of VFib resuscitation out of the hospital.

1980 Anesthesia Simulator Consultant program released (pre-Anesoft anesthesia simulator).

1981 ECNS launches SP examination.

1982 Rhythm and Pulse released (pre-Anesoft ACLS simulator).


1986 CASE develops an standard precursor to CAELink simulator.

1988 CAE purchases Link simulation business from Singer. CAE-Link patient simulator born in Palo Alto, Precursor to CAELink.

1989 CAE-Link patient simulator born in Palo Alto, Precursor to CAELink simulator.

1990 Anesthesia Simulator Consultant program released (pre-Anesoft anesthesia simulator).

1991 Anesthesiology Patient Simulator—“Anesoft” simulator.

1992 Rhythm and Pulse released (pre-Anesoft ACLS simulator).

1993 First Medicine Meets Virtual Reality Conference. Rhythm and Pulse 2.0 update released.

1994 Anesthesia Simulator Consultant program released (pre-Anesoft anesthesia simulator).

1995 Anesthesiology Patient Simulator—“Anesoft” simulator.

1996 Anesthesiology Patient Simulator—“Anesoft” simulator.

1997 Anesthesiology Patient Simulator—“Anesoft” simulator.

1998 Anesthesiology Patient Simulator—“Anesoft” simulator.

1999 Anesthesia Simulator Consultant program released (pre-Anesoft anesthesia simulator).

2000 Anesthesiology Patient Simulator—“Anesoft” simulator.

2001 Anesthesiology Patient Simulator—“Anesoft” simulator.

2002 Anesthesiology Patient Simulator—“Anesoft” simulator.

2003 Anesthesiology Patient Simulator—“Anesoft” simulator.
2.4. Software-based simulation

N Ty Smith and colleagues at the University of California—San Diego used their experience in cardiovascular physiology and anesthesia to develop Sleeper. It is based on sophisticated multicompartment modeling of physiology and pharmacology. It was the precursor of the current BodySim software. A fellow at the University of California—San Diego laboratory, Howard Schwid, simplified the models to run on a laptop and added critical event management. The Anesthesia Simulator Recorder became a commercial product in 1989. Later in the 1990s, a learning framework with objectives and feedback was added, and the software was renamed the Anesthesia Simulator Consultant (ASC). Further improvements in the ASC became the Anesthesia Simulator. The Sedation Simulator was created later (1998). Gas Man was also introduced in the 1990s. Its software displayed classic computer-based tutorials on anesthetic gas uptake and distribution.

From James Martin:

What I can tell you is that Ty Smith is responsible for my success.

I was starting my second year in Graduate school at UCSD pursuing a PhD in Orbital Mechanics (yes, I was heading down the path of being a rocket scientist). Ty came to my advisor looking for a control engineering expertise to a closed-loop drug delivery project he was working on. It was supposed to be a 3 month gig. Within those 3 months I was hooked on medicine / biomedical science.

I was in awe of Ty.

From James Martin:

I ended up switching my dissertation work from orbital mechanics to physiologic modeling and automated drug delivery. I spent 4 years working with Ty and got exposed to automated anesthesia record systems and simulation training. Both are now standard practice in anesthesia now, but in the early 80’s they were new.

I learned all about the cardiovascular system and pharmacokinetics from Ty, and the anesthesia fellows he brought through (Matt Weinger, Jeff Mandel to name a couple). I got exposure to the conduct of animal studies, and even clinical studies while working for Ty. Everything I do today on Sedasys is rooted in what I learned working for Ty for those 4 years.
From James Martin:
Not once have I regretted my decision to leave orbital mechanics to become part of Ty’s research program at UCSD.

From Howard Schwid:
Ty had an impact on my career years before I even met him. As a biomedical engineering student at the University of Wisconsin I studied the Smith-Fukui model of cardiovascular physiology and transport of halothane, developed during Ty’s sabbatical in Madison, Wisconsin.

That model was years ahead of its time, built on the supercomputer of its day which combined analog and digital computing. The Smith-Fukui model included enough physiology and pharmacology to convince me that it should be possible build a computer model with sufficient fidelity to serve as the predictive engine for an anesthesia simulator with many drugs, a variety of patient conditions, and critical incidents.

From Howard Schwid:
Ty supported my fellowship position in 1985 and arranged for me to work with a flight simulator company interested in expanding into medical simulation. Together we built the first screen-based anesthesia simulator.

Looking back now it was amazing that Ty was able to make these connections and build the financial support for this project at a time when Apple was just releasing the first personal computer with a graphical user interface, before Microsoft Windows even existed. My year with Ty enabled me to start my career in academic anesthesiology with an emphasis on medical simulation. His support of my fellowship is just one example of his vision and leadership.
From Matt Weinger:

I have lots of impressions since I was one of his Fellows (1986–7) and then on faculty and a collaborator residing in an office nearby for 15 years. He was kind, gentle, and encouraging. He smiled a lot and seemed generally happy the vast majority of the time.

He was very supportive and I don’t ever remember him losing his temper and saying anything negative to a menthe or colleague. He was brilliant and innovative. While Ty’s focus was on computers and technology, he also was able to envision (or recognize) and then pursue interesting cross-disciplinary collaborations.

From Matt Weinger:

Shortly before I arrived for my fellowship, Ty had initiated a collaboration with George Koob at The Scripps Research Institute up the street from UCSD to study the mechanisms of opioid-induced muscle rigidity. Ty had observed muscle rigidity when doing clinical research with alfentanil for cardiac surgery and wondered why a neuronal depressant would cause an excitatory phenomenon. Further, some had reported that high dose opioids produced seizures but Ty thought it was just muscle rigidity.

When I arrived in San Diego (from UCSF), Howard Schwid was already in Ty’s lab doing computer modeling of physiological processes (to create a simulator), which is what I had intended to do.

From Matt Weinger:

Ty suggested I work on opioid-induced rigidity. Since I had a Masters degree in neurobiology it turned out to be a good fit. Further, as I finished my fellowship and considered joining the faculty at UCSD, Ty convinced the VA to give me some lab space and then Janssen Pharmaceuticals into ponying up $40,000 as an unrestricted grant, equipping and staffing of my new lab.

Ty mentored me in the next couple of years to obtain a VA ‘starter grant’ and a Parker B Francis (ASA) Young Investigator Award to study the mechanisms of opioid-induced muscle rigidity with the rat model.
From Matt Weinger:

I had expressed an interest in human factors and how it applied to anesthesia equipment. Early in my fellowship, Ty asked me to review a paper in *Journal of Clinical Monitoring on vigilance*.

After reading my review Ty suggested that I write an editorial with Nik Gravenstein, fostering that connection and giving me my first publication. Later that year, Ty helped me to find Dr. Carl Englund (at the Naval Medical Research Center in San Diego) with whom I wrote my first review article in *Anesthesiology on this topic*.

From Ted Eger:

Ty was a pleasant (to me at least), easy to work with researcher, careful and meticulous, who taught me what little I know about the ballistocardiogram, a device he protected with all his powers.

My association with him caused me to wear sandals in my life from our association forward. We had finished an experiment and I was dragging one of the H cylinders used to supply the pressurized air needed to power the BCG. I had not screwed the cap on carefully and when it separated from the cylinder I stupidly put out my foot to break the fall of the tank. I remember thinking this is going to hurt in two seconds, and it did. The swelling lasted several weeks and the only comfortable footwear was sandals which I soon learned to appreciate for other reasons.

I've loved music ever since I can remember, from "conducting" the kindergarten band to singing boy soprano in some very small performances, to being allowed to march and play the snare drum with the junior high band while still in elementary school. Music had to wait, however, while I engaged in sports and academics in high school.

Things started to change in college. The college radio station would broadcast "Music 1," and I listened intermittently with considerable fascination, but little understanding. The medical school dormitory had a library with LP records of classical music. I used to wake up in the middle of the night listening to the scratch of the needle at the end of the record.
During college and university, music was the one luxury. Being self-taught meant that years were required to learn about music. After a year or so of listening, one of my proudest moments came when I heard a new piece and recognized the composer (Beethoven's Seventh).

With PACEM, we want to ensure that children of all ages can learn about, enjoy and love music, with nothing but the finest as teachers and examples.

*Start early; learn a lot.*

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The Measures of a Man

Ty Smith

Temperature in many tissues, stomach contents, ventilation, cardiac output, total peripheral resistance, mean transit time, stroke volume, left ventricular work, atrial contraction, pentobarbital, potassium, lidocaine, calcium, citrate, halothane, enflurane, isoflurane, oxygen, carbon dioxide, nitrous oxide, propranolol, hydralazine, histamine, rigidity, ballistocardiogram, pneumocardiogram, analog EEG, digital processed EEG, analog computer analyses, digital computer analyses, accuracy of simple and complex physiologic models, accuracy of open loop drug administration, accuracy of closed loop drug administration, muscle rigidity, measures of predictive performance, evoked potentials, human performance in medical simulators,