KOPF CARRIER

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In Memoriam

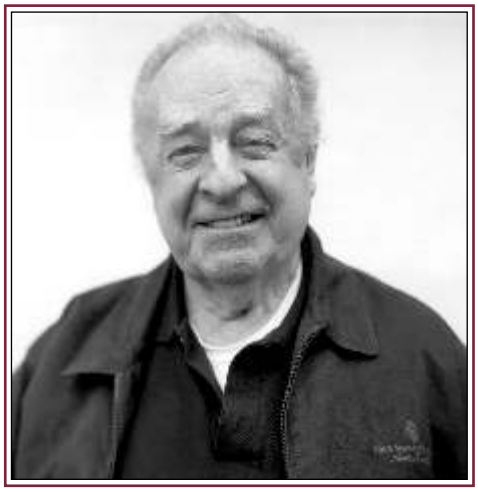
J. David Kopf

August 9, 1927 - May 18, 2004

J. David Kopf, founder of David Kopf Instruments passed away at his home in Tujunga, California on May 18, 2004. He was interred on May 26, 2004 at Plainsburg Cemetery in Le Grand, California. A Memorial Service in his honor was held on June 27, 2004 in Tujunga, California.

This issue of the *Carrier* is devoted to the life and accomplishments of J. David Kopf, a master machinist, inventor, collector, sportsman and entrepreneur.

"Science moves ahead on the skills of its Instrument Makers"



J. David Kopf

David's Early Life

David was born J. David Turner on August 9, 1927 in Merced, California, the son of Wade H. and Leona A. Turner. When he was three, his parents divorced. With his older sister, Norma, he lived with his grandfather, owner of a mercantile store, in Le Grand, California and spent time with his father in Mt. Bullion, California and in Yosemite where his father was a park ranger. His mother later married Paul Kopf, giving David his last name. When he was four, his great grandfather gave David a pocket knife, and soon David was discovering his passion for making things, carving small wooden animals as keepsakes and for sale. David belonged to Cub, Boy and Sea Scouts and the DeMolay. He worked in his stepfather's grocery store (The Green Frog Grocery "A Leap Ahead of Them All"), delivered newspapers and worked in a fruit dry yard.

In High School, David was an outstanding track athlete in the 440 and 880 meter races. In 1944 and 1945, he won the Merced High School blanket for both, becoming the only 2 year blanket winner in the school's history. In 1945 he set the fastest time in the 1320 meter race and was offered a scholarship to USC by Dean Cromwell. However, he decided to join the Navy and served two years on a minesweeper on the inland sea of Japan. He spent time at the Modesto Junior College then moved to Los Angeles where he worked at the Los Angeles County Hospital while studying pre-med at

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Editor's Column

It is a sad time for the David Kopf Instruments family. J. David Kopf passed away at his home on May 18, 2004. The Carrier that is now on line commemorates David and his many accomplishments. The David Kopf Instrument Company is now headed by Carol Kopf with the full support and talents of all company employees. The operations of the company have continued seamlessly, as David planned. While his death was not expected, he had made plans for just such a contingency so that the company would continue its tradition of excellence and innovation in his absence. The world standard for stereotaxic instruments and related equipment will continue and innovations brought to neuroscientists around the globe.

While the past four months have been difficult for all of David's family, company employees and his many friends, the knowledge that his legacy will continue through the products and services of David Kopf Instruments is a wonderful support for all of us.

We invite each of you to stop by the new David Kopf Instruments booth (3908) at the Society for Neuroscience meetings in San Diego October 24 - 27 to say hello and look at the expanding line of the world's best stereotaxic and related instruments. It will be a pleasure to see you there.

On a personal note, we weathered Hurricane Francis in good shape, although farther north there was significant damage. We just had some trees down and were without power for a couple of days. Ivan should go south of us, so we hope that we do not have a repeat.

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Pasadena Junior College. He needed to earn money so dropped out of school to work in a machine shop and became a master machinist. He worked at several companies as a machinist and at Menasco Manufacturing in Burbank for five years where he became the youngest Foreman of R&D and learned to run the first numerical controlled machines.

In 1953, David married Patricia Clary. They had four children, Jeff, Jeannine, Doug and Randy and moved to Tujunga. In 1963, they divorced and David married Carol Dahl, who became his life-long partner and business associate.

Background to Stereotaxis

All scientific disciplines have experienced technological breakthroughs that opened doors to revolutionary advances. The microscope in microbiology, the telescope in astronomy and the computer in mathematics are examples. In the neurosciences, two such technologies stand out, the development of neural staining techniques and the stereotaxic instrument. These two technologies have allowed the tremendous advances in understanding brain and spinal cord function evident in the 20th Century.

During the first part of the twentieth century, the area of brain science began to come of age. The use of staining techniques began to show the incredible complexity of the neural networks of the brain and spinal cord as psychologists were providing greater understanding of behavior control. However, the need for reproducible and accurate placement of electrodes into the brain of living humans and animals was acute. Stereotaxic machines originated in Russia in the late 1800's and Trendelenburg, a German physician-surgeon had developed the "myelotome" to position a knife in the brain for lesion making before 1900. These devices were devoted to human surgery.

The development of the animal stereotaxic began with Robert Clarke and Victor Horsley in England in 1906. Their machine allowed relatively accurate and reproducible placement of cannula and electrodes into the brain. Several versions of the Horsley - Clarke instrument were built and in 1909, Ernst Sachs, after studying with Horsley, purchased a stereotaxic from Palmer and Company and brought it to the states in 1911. He used it at Washington University Medical School in St. Louis. Later Clarke sold a third version of his machine to A.T. Mussen at Johns Hopkins University for studies of the cerebellum. Sachs donated his machine to H.W. Magoun at the UCLA Brain Research Institute, where it is on display in the John Douglas French Conference Room (see Picture 1). The size of the machine can be seen in the second

picture where it is flanked by Magoun and C.W. Sawyer in 1984. David Kopf Instruments refurbished the machine in 1989.

The first American stereotaxic was built by Rex Ingram in Ranson's Institute at Northwest University in about 1930. By 1947, there were about 50 instruments in use, most made by Mr. Kittle at the University of Chicago, where Ralph Gerard used one in his early studies. Shortly after, a few commercial machines appeared, notable the Labtronics machines, used by several brain scientists by the early 1950's. By then, at least four companies made versions of a stereotaxic, including Labtronics, Trent Wells, Stoelting and Baltimore Instruments.

The Horsley / Clarke Stereotaxic Instrument donated by Sachs to the UCLA Brain Research Institute

H.W. Magoun and C.W. Sawyer with the Horsley / Clarke Instrument in 1985

The Beginning of David Kopf Instruments

In 1956, David was informed by his brother-in-law that the scientists at the White Memorial Hospital in Los Angeles needed a stereotaxic device for their work. David decided that he could build such a device in his garage shop and adapted a Labtronics machine, building the parts for three machines. He sold the first to White Memorial, the second to C.G. Gunn and in 1957, finished the third machine for Nat Buchwald, Ph.D. at the Veterans Administration Hospital in Los Angeles. Buchwald was impressed with the quality of the work, but encouraged Kopf to rethink the design and operational characteristics of the machine. Over several months, Buchwald schooled Kopf on the principles of stereotaxis and the practical aspects of the work. David then designed the first Kopf Stereotaxic machine with major design and functional element changes. This design became the basis for the line of Kopf Stereotaxic Instruments that have become the standard for brain research. The first new machine was delivered to Buchwald in a cat food box and wrapped in tin foil in 1958. During the visit, he took orders for five more machines and soon had three more. David Kopf Instruments was underway.

Soon an instrument was delivered to Ross Adey at UCLA and soon thereafter, the UCLA Brain Research Institute was founded, where scientists became prime users of the Kopf line of stereotaxic instruments. Many of these were graduate students who went on to direct their own laboratories and use Kopf instruments, thereby spreading the instruments across the country and around the world.

The first machines were very similar to the 1200 series unit seen in the next picture (Picture 3).

A very early 1200 Series Kopf Stereotaxic

The next design was a smaller unit that could easily be used with rats, mice and other small animals, yet was compatible with the adaptors and electrode carriers used in the first units. In about 1960, Kopf introduced the now famous "900 series" units.

A very early 900 Series Kopf Stereotaxic

With the introduction of this unit, a single piece design anchored to a base plate, the basic designs of the Kopf Stereotaxic instruments were set.

Evolutionary Improvements in the Machines

Once the basic designs for the two models were determined in the early 1960's, the gross appearance and function of the Kopf Stereotaxic machines have remained remarkably constant (compare Picture 3 with Picture 5 and Picture 4 with Picture 6). However the functional details along with the material specifications have undergone dramatic evolutionary change.

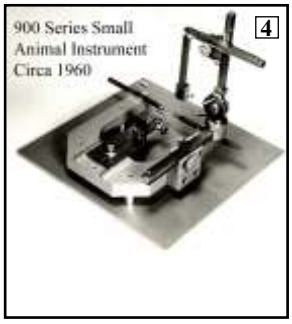
This evolutionary change can be best seen in the 900 series pictures (Picture 4 and 6). The first model (Picture 4) featured a rack and pinion electrode carrier, while by 1965 that had been replaced by a screw mechanism with sliding posts for movement control stability. By 1968 the A-P movement control had been modified to a tongue and groove mechanism that provided even greater stability. Picture 6 shows the contemporary 900 Series machine.

Close inspection of the 1200 series design (Picture 3) and the current 1500 series (Picture 6) shows improvements in the overall electrode carrier and frame designs. Other improvements include upgraded materials as the metallurgy improved and the use of laser engraving of calibration marks and figures for greater accuracy.

Thus, while the basic designs of the two major lines have remained constant, the functional details and stability of the machines have been enhanced over the past 35 years. This has allowed the practicing neuroscientist to use the line without major relearning for over 45 years.

Model 1200 Series Stereotaxic Circa 1965

Current Model 1500 Series Kopf Stereotaxic

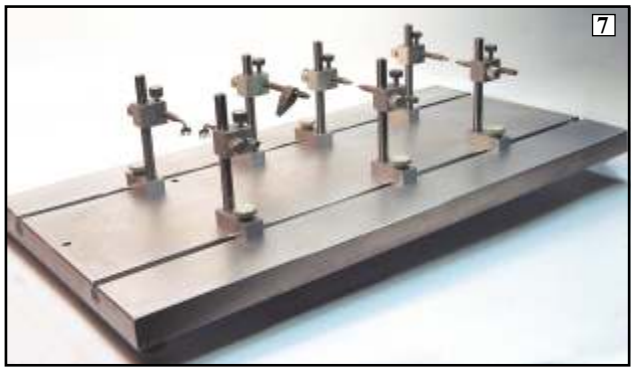


A very early 900 Series Kopf Stereotaxic

The current 900 Series Kopf Stereotaxic

Other Instruments

In 1966, with the advice of Edward Perl, Ph.D., Kopf added the spinal unit to the basic instrument line. Perl had developed a series of equipment parts to hold a small animal steady for spinal cord investigation. Kopf adapted these into the spinal investigation unit (see Picture 7). This unit allowed the animal's spinal column to be held rigidly while probes were inserted into the exposed spinal cord. This led to a greatly increased investigation of spinal cord function in the 1970's.



The Kopf Spinal Unit Model 980

As the use of stereotaxic instruments grew during the 1970's, additional lines were added, including microdrives, electrode pullers, and others. The increasing use of intracellular recording prompted the

production of the ultra stable intracellular unit (1700 series, Picture 8) to the large animal line, and a similar 900 series device (not shown). These units, along with similarly upgraded electrode carriers, added the necessary weight and frame strength to give sufficient stability for intracellular recording.

Model 1730 Intracellular Frame Assembly

Expansion of Animal Adaptors

Over the years since the founding of the instrument line, the range of animals that can be used in the stereotaxic machines developed by Kopf has expanded tremendously. In the early days of stereotaxis, the machines were built to handle cats, rabbits and some monkeys. Each machine was designed for a small range of animals. The versatility of the Kopf design made it feasible to construct different adaptors for the frame. This has led to the construction of adaptors for at least 45 different animals and more can be designed and built with relative ease. The flexible design characteristics of the instrument allow for an animal adaptor to be made for almost any animal, supporting studies of a wide range of species, and an unprecedented freedom of choice for the neuroscientist.

Significance of the Kopf Stereotaxic Machines

With the original design changes of the late 1950's, the Kopf instruments were a radical departure from the previous stereotaxic designs. The flexibility of the head mounts, the stability and durability of the structure and the precision characteristics of the frame, scales and electrode holders made the instruments a life-time investment and provided a precision that was finer than the human error associated with using the equipment. Over the years, as shown by the pictures above, the two basic designs of the Kopf Instruments have changed little. The changes have been to detail, materials and precision as new construction methods and materials have become available.

The stability in design has meant that generations of scientists have been able to use these instruments with assurance of accurate results. The continual improvements in precision and stability have allowed the instruments to be used in increasingly demanding electrode placements, such as intracellular recording and iontophoresis. Kopf's development of mass produced, highly accurate and reliable stereotaxic instruments with wide applicability to various animals allowed rapid advances in all areas of brain research from staining techniques to intracellular recording. It is very possible that without such a machine, with its interchangeable adaptors and ease of use, the current state of the brain sciences would not be what it is today.

David Kopf Instruments

David Kopf Instruments, founded in 1956 in Kopf's garage, moved to its present location in Tujunga, California in 1960. Initially housed in a building that had been a garment manufacturing company, Kopf eventually bought surrounding buildings for the expanding company. David Kopf Instruments has sold stereotaxic units in over 100 countries around the world. At least seven Nobel Prize Laureates have used Kopf equipment in their work.

During its entire history, the company has been privately owned and operated by David and now by Carol Kopf. There are approximately 30 full-time employees; some have been with the company for over 35 years, and many for more than 20 years. The most advanced machining and design tools are used in manufacturing the stereotaxic instruments, thus ensuring exacting precision and reproducibility as well as essentially unlimited life. In fact, recent additions of computer controlled milling machines and multi-station pallet machines mean that to do the equivalent work output would require at least 75 machinists (see Picture 9). More importantly, the automation of many of the manufacturing steps has meant an increase in reproducibility of the precision parts along with a much finer dimensional tolerance. New laser engraving technologies insure tolerances in the laser engraved scales of the bars to better than .0002 inches in a 12 inch length.

(left to right) Dan Renwick and James Styer at the company's Multi Station Pallet Machine

The *Carrier* Newsletter

In 1973, Kopf Instruments published the first Kopf Carrier scientific newsletter. This newsletter, distributed to the neuroscience community (now by website), publishes articles of general scientific interest and is the oldest continuously published company newsletter of this type in the neurosciences. The *Carrier* was first produced by Dan Nichols from 1973 - 1983. In 1983, Michael M. Patterson, Ph.D. was named Editor and Scientific Consultant to the company. The Carrier has been published regularly since then, providing the scientific community with valuable articles on a wide variety of subjects. Other publications include a list of animal stereotaxic atlases that is also available on the company website free of charge.

David Kopf Instruments was one of the first Sustaining Associate Members of the newly formed Society for Neuroscience in 1970. In addition, the company was an initial supporter of the International Society for the History of Neuroscience, providing funds for organizational activities early in the Society's existence.

Other Businesses

Over the years, David and Carol Kopf formed other businesses. The first was David Kopf Systems, established in 1972 to manufacture dialysis equipment developed by Kopf. David Kopf Sensors (1974) manufactured transducers for the dialysis systems and manufactured a vitrophage for treating diabetic blindness. At their peak, Kopf's three companies employed 110 people. Kopf closed / sold the systems and sensors businesses in 1976 and 1981 respectively. In 1991, following David's entry into sportscar racing, the Precision Race Products Division of David Kopf Instruments was formed to produce parts for the high performance race cars (see page 7, Race Car Enthusiast).

David Kopf was granted patents for 10 instruments including various stereotaxic devices and several dialysis and ophthalmic instruments.

Traveler and Collector

As the company flourished, David and Carol began to travel extensively. Early trips in the 1960's included New Orleans, where they developed tastes for good food. In the 1970's they traveled extensively in Europe where David began some of his extensive collections. In 1976, he bought and shipped to the United States a grand fairground organ, the Mighty Ruth, built in the Black Forest of Germany in 1907. After an initial restoration, the Ruth was played at the Society for Neuroscience Meeting in Anaheim in 1977. Just prior to his death, David had finished with his son, Doug, a full restoration of this unique organ (Picture 10).

The Mighty Ruth fairground organ after its full restoration in 2003

He had amassed a large collection of organs and mechanical musical instruments over the years. David also collected original wood carousel animals and other carved pieces, including miniatures of ivory and bone. He loved to carve, having begun at the age of 4, and was an accomplished wood carver, having carved a full sized wooden carousel horse (Picture 11).

Full sized Carousel Horse "Rosie"

In addition, he carved miniatures from wood and ivory under a dissecting microscope. This art form, known as Netsuke in Japan, is very precise. David was recognized by the International Netsuke Society as a collectible contemporary carver. In later years, he took up metal engraving and produced beautiful engraved knives and other pieces. He collected many different things, including miniature cameras, canes, cannons, clocks, guns, radios, swords, watches, western boots and jewelry and wild boar replicas. Carol also has numerous collections, including postcards and items featuring poppies. One of the more recent collections was of harmonicas and banjos, and David had recently learned to play both, and had been asked, on a trip to New Orleans in 2000, to play the harmonica with the Preservation Hall Band. David appreciated quality in not only his stereotaxic instruments, but also in all his collections.

Race Car Enthusiast

Early in his life, David had an appreciation for high performance cars. He purchased a Ferrari shortly after the company was formed, much to the dismay of his wife. As the company prospered, he drove Ferraris and Porsches. In the 1980's he purchased a Ferrari owned by Steve McQueen and drove it for some time. In the 1970's he collected VW bugs, owning thirty at one time, plus a storehouse of parts. Over the years, he acquired many high performance cars, both stock and modified, and loved to drive and show them. In about 1985, he became involved in vintage sportscar racing. True to form, he immersed himself in the sport, taking professional lessons to become a licensed driver, and drove cars in many races. He drove the Italian Mille Miglia in 1986, 1987 and 1988 in a Porsche 550A. He won a 100 mile race at Nurburgring, Germany and a class race at Zolder, Belgium in 1989 in a 1960 Porsche RS60, one of only 12 built. In the 1990's, he moved to the high performance Chevron race cars (B16, B19 & B60) winning endurance races at Willow Springs, Road Atlanta, Road America and Watkins Glen. Overall, David raced in over 150 races in America and Europe. He was named Sportscar Vintage Racing Association Driver of the Year in 1991.

In the mid 1990's, David decided to build his own race cars for Division One racing. The result was the Keiler KII World Sports Car prototype that he entered in professional races. This LeMans sportscar, was designed on the computers at David Kopf Instruments by David, and built on the state of the art machines there. The first race for the new car was in 1998 at the Daytona 24 hour race where it finished 10th in its class (see Picture 12). By 1999, due to changes in the rules for race cars, David decided to leave professional racing. However, by this time he had founded Kopf Precision Race Products, to manufacture custom wrist pins, axles, uprights, top hats, CV joints, hubs and brake calipers for various NASCAR teams. In his usual style, David enjoyed the thrill of racing and owning many fine cars.

The Keiler KII Race Car in 1998 at Daytona

David the Man

David Kopf lived life large. He had both the intellect and the means to do so. Three traits characterized David and were the underpinnings of his life and achievements:

1. His drive for exceptional quality. His instruments, his many collections and his actions all manifest this drive. He loved and sought out both people and things of exceptional quality. This drive extended to his personality, providing sureness in his manner. Some, however, would say it was stubbornness and a few might even say bullheadedness. But underlying these was a drive for exceptional quality.
2. His loyalty to those around him who understood and shared his zeal for quality. He was intensely loyal to his wife, Carol, to his employees and to his friends. On the other hand, he had little patience for those who did not share his pursuit of quality.
3. His unabashed delight in life; David had fun! Whether starting a new business, learning to drive a race car, collecting miniature cameras or savoring good food and drink, David had fun.

This is the man who founded David Kopf Instruments. He was a master machinist, inventor, collector, sportsman and entrepreneur. His love of life is seen in the next picture, taken at a gathering of some of his employees, his wife, Carol and guests at the Society for Neuroscience Meeting in 2003. He will be missed.

Society for Neuroscience 2003, from left to right: Teresa Batter, Jan Patterson, Chuck Wright, Dawn Gelsinger, Victor Olszewski, Dan Renwick, Windee Fleming, Joe Saracione, Carol & David Kopf

The Future of David Kopf Instruments

In recent years, David and Carol had begun positioning the core business of the company, David Kopf Instruments, to become increasingly autonomous. While David had designed most of the instruments himself, he increasingly turned more of this task over to exceptionally qualified designers who had become familiar with the concepts and quality that have been the hallmarks of the company. Many of the machinists now in the company had come into the business as apprentices and had been schooled by David or sent to school by the company to become master machinists. These employees have become thoroughly acquainted with the necessity for quality and precision in all instruments they design and produce. The company has converted its equipment to the most advanced computer controlled machines available, and has some of the most sophisticated computer aided design (CAD / CAM) equipment in existence.

The operations of the company, under Dawn Gelsinger, Vice President - Sales / Operations, Dan Renwick, Director of Engineering and Quality Assurance, with their team of dedicated and talented employees and of course, company President, Carol Kopf, will continue seamlessly. David Kopf Instruments is committed to continue supplying the instruments that for almost 50 years have been the world standard.

David's Legacy

David Kopf left a legacy of accomplishments that have had a tremendous effect on the world knowledge of brain and spinal cord function. Without his genius, the fields of neuroscience and brain science would not have advanced as far as it has in the past 50 years. As David planned, his legacy will continue in David Kopf Instruments.

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Acknowledgments

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Picture of the Horsley - Clarke instrument (Picture 1) and that of Magoun and Sawyer (Picture 2) were graciously supplied by the UCLA Neuroscience History Archives. All other pictures of stereotaxic instruments and the Kopf building were supplied by David Kopf Instruments or taken by the author.

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