

History of the Electron Microscopy Service

Most of the early history was included in Bob Loizzi's RRC history articles in the RRC reporter

The **Research Resources Center** at UIC grew out of the Aeromedical Laboratory, which was constructed in 1948 in a purpose built building, now housing the magnetic Resonance Imaging Center. Jointly set up by the College of Medicine in Chicago and Mechanical Engineering in Urbana it was to investigate the effects of physiologically unfriendly environments on humans as part of the increase in commercial airline flights and growing interest in space research. The laboratory was set up with two rules for access: -

1. Users would perform their own work rather than lab personnel doing it for them and,
2. Users from all colleges would be treated equally.

The director of the laboratory (John Marbarger) reported directly to the vice-president of the University.

An early RCA EMU similar to the first EMF microscope (EMU-2A) >

In November 1952 Dr Reed, a faculty member in Physiology, asked the Aeromedical Lab to take responsibility for an **RCA EMU-2A** Transmission Electron Microscope (new in 1948). After determining there was a need for this technology the director accepted the instrument, transferred it to the Aeromedical Lab, set it up as a new unit, the **Electron Microscopy Facility**, and hired the first EM Technologist (Ms E.T.Bush). As Marbarger wrote in 1952 *"With this acquisition the Aeromed lab... was launched on a program with the same philosophy as originally followed but with the acquisition of large, expensive scientific equipment centrally located, maintained in excellent operating conditions and available to any investigator who truly needs to use it."* In 1955 Ms Irena Kairys was hired to supervise and build up the EMF.



During the 1960s two more RCA TEMs were added to the facility (**EMU-3G** in 1963 and **EMU-3H** in 1966) and a second EM Technologist, Ms Lucia Vedeygys, joined the facility in 1962. In 1964 the Aeromedical Lab equipment was installed in the basement of the new Medical Sciences Addition (now MSB) and the electron microscopes were relocated to the space in MSB that they occupy today. In 1967 the addition of other techniques led to the renaming of the Aeromedical Laboratory as the Research Resources Center. By the end of the decade three more TEMs had been acquired **Hitachi HU11A** (1964) and **Hitachi HS-7S** (1964) which replaced the EMU-2A and a **Philips EM300** (1969) which replaced the EMU-3G. The EMU-3G was donated to the Museum of Science and Industry where it was one of three sectioned to reveal the insides of the TEM (one was for practice, one is still in reserve at MSI and the third went to the Smithsonian). During the period 1965 to 1978 the EMF

also looked after a **Zeiss EM9-S-2** TEM for the Obstetrics department which was installed in the EMF.



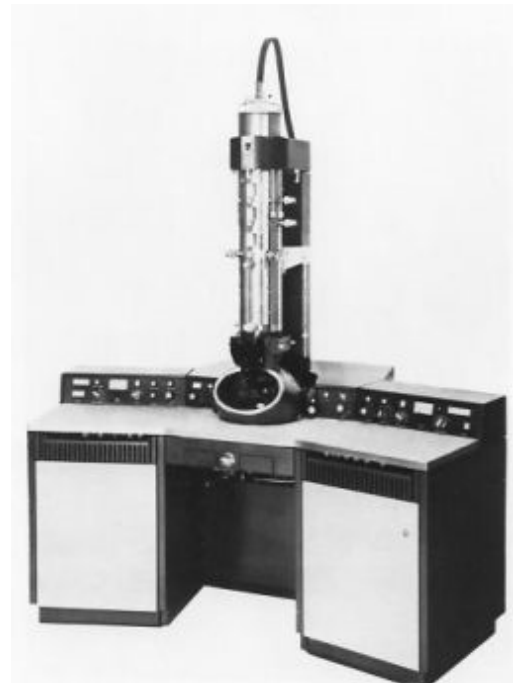
A RCA advert for the RCA EMU-3A which is similar to the EMF EMU-3G and EMU-3H.



A Hitachi HS-7S similar to the EMF microscope



A Zeiss EM9-S similar to the EMF microscope owned by Obstetrics



A Philips EM300 similar to the EMF microscope

By the early 1970s several changes were taking place in the RRC which resulted from a decrease in the government funding for space research and also a decrease in the RRCs role as a research catalyst for the campus. New faculty with proven grant funding records were being recruited who

were able to get both RO1 and equipment grants which led to TEMs being installed in their own laboratories. The shift from State to Federal funding of research also led to a stagnation of support for central facilities. In electron microscopy, while the number of instruments increased, the novelty of EM for purely structural studies among life scientists was waning and use of the instruments reached low levels. Some of this drop was offset by an increasing use of the electron microscopy facility by materials scientists and engineers.

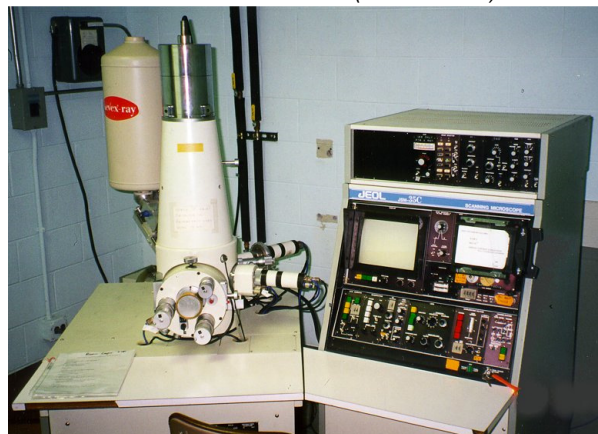
By the end of the decade the instrumentation in EMF was becoming dated and the older microscopes were replaced by a **Hitachi H-300** TEM which was delivered to the Eye & Ear institute in 1977, **JEOL JEM-100CX** TEM in 1978 and a **JEOL JEM-100S** TEM in 1981. These replaced the EMU-3H, EM9S-2 and HS-7S. In 1978 the EMF received its first Scanning Electron Microscope, the **JEOL JSM-35CX**.



A Hitachi H-300 similar to the EMF microscope purchased by the Eye & Ear Institute



The JEOL JEM-100S (1981-1999)



The first SEM; a JEOL JSM-35CX (1978-2000)

< The JEOL JEM-100CX (1978-2001)

In 1980 Marbarger retired and Sam Marotta became the RRC's second director.

During the 1970s and 1980s the operation of the EMF followed the rules set up on the formation of the Aeromed Laboratory. The staff, which grew to three in 1973, was there to maintain the instrumentation and to train investigators how to use the facility, but not to carry out the work for them. A description of his first impressions of the EMF, in 1966, by Bob Loizzi appeared in the RRC Reporter (Vol 1, No. 3): -

“The EM facility I visited (at UIC), however, was a dedicated, multi-user core facility. That is, its main function was to maintain and provide access to instruments by investigators from the entire campus for their research and the expertise of scientists and technologists to train and assist them in their work rather than that of a single P.I. or single group of collaborators. It was totally subsidized by the University and thus neither the instruments nor the personnel were dependent on one individual's grant. This meant independence for the investigator as well as continuity of function unrelated to external funding. Its equal treatment for all users was ensured by the fact that the RRC reported to the Graduate College (later, the OVCR) and not to a particular departmental or college unit. In 1966 there were no user fees, the facility staff was knowledgeable, enthusiastic, and generous with their time for training and assistance although services such as sample preparation and data acquisition were not available. There was a distinct teaching commitment, primarily to graduate education. Eventually, however, problems developed in this and similarly organized "no fees" facilities nationwide. Obsolescence of equipment and lack of funds for replacement or upgrades marked the end of this utopian arrangement.”

Up until the early 1990s the RRC was still committed to the philosophy of its earlier, Aeromedical Lab days of charging no fees and providing access and training, but not services. The reasons for this were, first, a deep sense of responsibility in the RRC to support research and graduate education and, second, since granting agencies frowned on charging internal users differential rates (resulting in funded users subsidizing non-funded users) there was a reluctance to charge uniform fees which would cut off critical services from some active researchers who were temporarily without support. But in an era of proliferating grants, this policy was increasingly viewed by the University management, not as stimulating research productivity and excellence, but as subsidizing all research indiscriminately, without regard to quality or probability of funding or publication. Further, the changing research picture and economics gave observers the impression that the RRC catered primarily to non-funded investigators and, in fact, enabled them to continue in this state. Thus, the RRC was caught between the University management growing increasingly cool toward this free "perk" for researchers and the demands by some investigators that the no-fee policy continue and that the RRC supply newer instruments and in greater numbers. Added to was an increasingly obsolete inventory of instrumentation, which the RRC, lacking user fee income, was unable to pay for upgrades or leverage matching funds for new equipment.

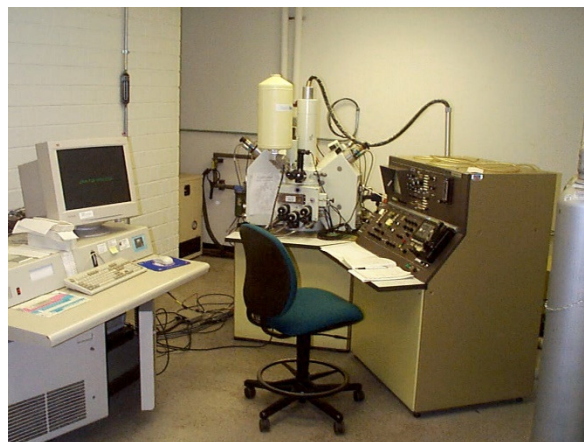
The second director, Sam Marotta, retired in April 1994 and was replaced by Charles Brown who joined UIC from industry. The University saw the retirement of Marotta as an opportunity to revitalize the RRC including new, state-of-the-art instrumentation, recruitment of scientific personnel with special skills to match that instrumentation and to open a new 12,000 sq. ft. facility on the east side of the campus. Charles Brown had soon realized that with all of the RRC facilities being on the west campus, the RRC was not adequately supporting the Physical Sciences. When he found that some of the cafeteria space in SES was available he did not give up until RRC-E successfully opened in June 1998, taking over all of the cafeteria space on the first floor of SES. The turning point was getting the full support of Vice Chancellor for Research, Van Rocek, who got the plans for the new center through the University. Administrative reorganization including creation of a new oversight position,

Assoc. V.C. of Research Resources and its first appointment, Dr. B. Taylor Bennett. User Fees were introduced from October 1st, 1995 in line with NSF, NIH and State rules for Special Instrument Centers aimed to cover 50% of the operating costs from users with the other 50% a subsidy from the University. This has allowed budgetary changes that permit rational updating and replacement of existing instruments and introducing new technology. There has also been increased opportunity for input from faculty and administration, and a new focus of the campus on the role of core facilities, faculty research needs, and how to maximize the effectiveness of such support units. Besides introducing user fees, EMF also started offering services. This change in RRC policy recognized the need for specialized data by investigators unable to spend the time mastering a technique but who were willing to hire this work out, at a premium rate, to experts who did it routinely.

The Electron Microscopy Facility was one of the early beneficiaries of the revitalization as the newest existing instrumentation was approaching 15 years old. The HU11A fell out of use in the early 1990s and it was clear that the EM300, already over 20 years old, was also in need of replacement. An EM Selection Committee was set up involving Ralph Albrecht (UW Madison was to become Dean of Dentistry), John Botsis and Mike McNallan (Engineering), Nigel Browning and Steve Guggenheim (LAS), Jim Drummond (Dentistry), George Papas, Rochelle Cohen and Dean Shraufnagel (Medicine). The equipment search resulted in the delivery of the **JEOL JEM-1220** TEM for life sciences (which replaced the EM300 and H-300), **JEOL JEM-3010** TEM for materials science and the **JEOL JSM-6320F** field emission SEM to extend the EMF SEM capabilities. Nigel Browning was also awarded an NSF MRI grant to purchase the **JEOL JEM-2010F** Field emission TEM. The 1220 and 6320F were installed on the west side in



< The JEOL JEM-2010F 200kV Shotkky field emission TEM/STEM (1998-2011)



The JEOL JXA-733 electron microprobe (new 1984, in EMS 1998-2007)

1997 and the 2010F and 3010 in the new RRC-E lab in SES on the east campus in 1998. At the same time a committee was set up to purchase the RRCs first confocal microscope (Zeiss LSM-510) which was installed in the Microscopy Facility in 1998. During 1998 three new members of staff were hired by the RRC to bring expertise in materials, life science and confocal microscopy. Secondhand acquisitions in 1998 & 1999 included:-

- **JEOL JEM-100CX II** (new 1986 to Civil & Materials Engineering),
- an electron microprobe acquired new to Northwestern University in 1984 (**JEOL JXA-733**) to support Earth & Environmental Sciences

- two VG dedicated STEMs - a VG Microscopes HB501A (new 1985) which was used for parts, and a **VG Microscopes HB601UX** (new 1992) which was subsequently fitted with a Nion aberration corrector.

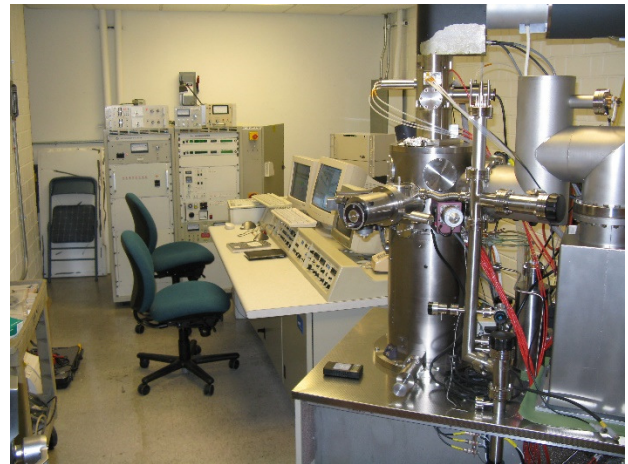
With the continued decrease in use of life science TEM the JEM-100S was retired in 1999, following a major failure, and in 2001 the JEM-100CX was also retired following damage caused by a ComEd power cut. Early in 1999 the Confocal Microscope was made part of a new Confocal Microscopy Facility still sharing space with EMF. A **Renishaw Ramascope 2000** was also added to EMS instrumentation in 1998.



The JEOL JEM-100CX II 100kV TEM acquired from Civil & Materials Engineering (new 1986, EMS 1998-2015)



The Renishaw Ramascope 2000 (1998-2016)



The VG Microscopes HB601UX 100kV STEM (new 1992, EMS 1999-2012)

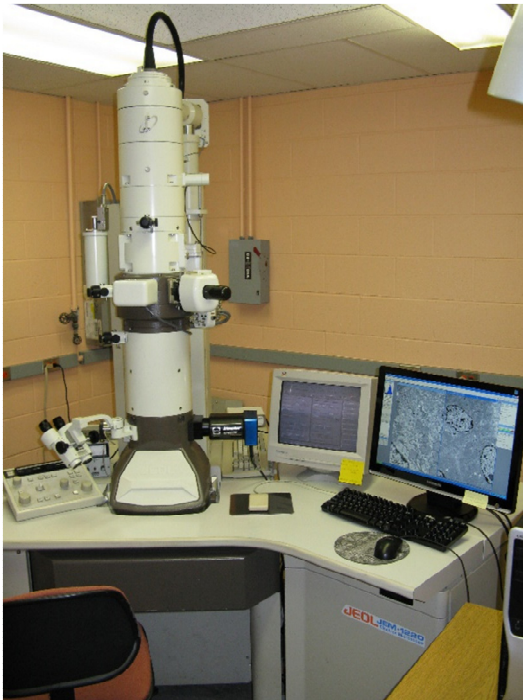
As the emphasis changed from access only to instrumentation to service and access the name of the facility was changed to **Electron Microscopy Service (EMS)** in 2000. The same year the RRC was able to replace the 22-year-old JEOL JSM-35C with a new **Hitachi S-3000N** variable pressure SEM that opened up opportunities to look at non-conducting specimens without a conductive coating. In November 2004 EMS extended into the surface analysis field with the acquisition of a **Kratos AXIS-165** X-ray Photon Spectroscopy (XPS) system purchased with an NSF MRI award to John Regalbutto, Christos Takoudis and Ken Brezinsky (Engineering), Mike Trenary (LAS) and Jim Drummond (Dentistry). At the same time EMS extended into the thin film growth area with the acquisition of a secondhand VEECO Gen2 Molecular Beam Epitaxy (MBE) system purchased and operated by Sid Gosh's group (Engineering). The JXA-733 electron microprobe was retired in 2007 as its use had decreased and the room was needed for the aberration corrected HB601UX which had

to be moved from its original location due to magnetic fields. Also in 2007 Mike Trener acquired an Omicron VT-SPM which was installed in EMS space. The XPS, MBE and SPM were installed in RRC-E.

With Robert Klie joining the Physics department in early 2007 thoughts turned to upgrading the JEOL JEM-2010F with a probe aberration corrector. However, in the event, an opportunity arose to replace the JEM-2010F with a new probe aberration corrected, cold field emission **JEOL JEM-ARM200CF** TEM/STEM purchased with an NSF MRI-R2 equipment awarded to Robert Klie (LAS) with co-PIs Luke Hanley and Neil Sturchio (LAS) with Constantine Megaridis and Randall Meyer (Engineering). The new microscope was delivered in July 2011 and installed and accepted by December 2011. The success of the ARM200CF resulted in the VG HB601UX being stored from January 2012. The last working JEM-100CX on campus succumbed to old age in 2015.

In 2016 the Renishaw Ramascope 200 was replaced by a new more user friendly **Renishaw inVia Reflex** Raman system. During summer 2017 the Gatan Enfina EELS spectrometer on the JEOL JEM-ARM200CF was replaced by the latest design Gatan Quantum GIF which allows much faster acquisition of EELS data.

CURRENT EMS INSTRUMENTATION



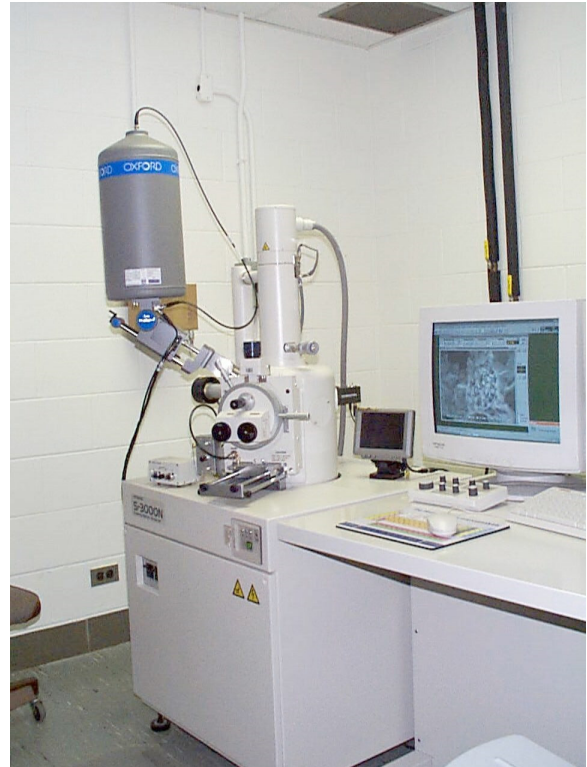
The JEOL JEM-1220 Life Science TEM (1997-to date)



The JEOL JEM-3010 300kV Materials Science TEM (1998-to date)

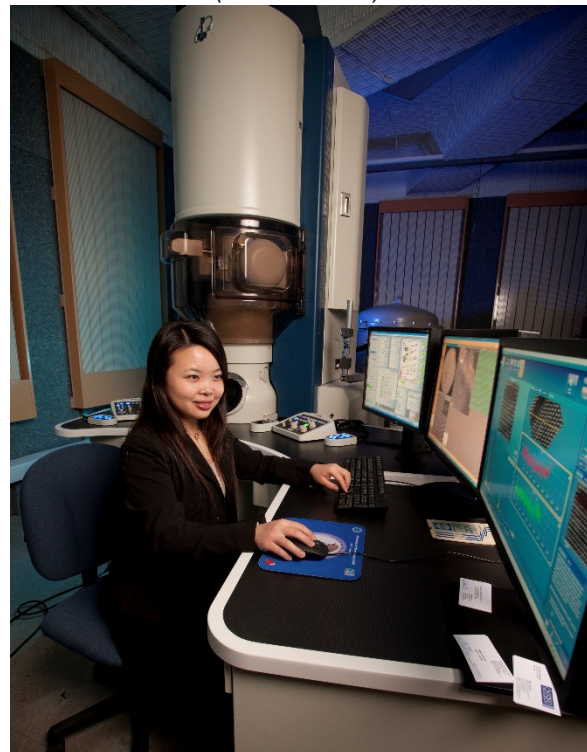


*The JEOL JSM-6320F Field Emission SEM
(1997-to date)*



*The Hitachi S-3000N Variable Pressure SEM
(2001-to date)*

The Kratos AXIS-165 XPS (2004-to date)



*The JEOL JEM-ARM200CF 200kV aberration
corrected, cold field emission STEM/TEM (2011-
to date)*



The Renishaw inVia Reflex Raman (2016 to date)