The year 2020 will not be remembered fondly by history, but especially so for friends and colleagues of Doug Craig, who passed away from complications with cancer in early January (Figure 1). Doug was a multitalented fixture of the Canadian entomological community for more than half a century, publishing more than 100 papers that spanned the realms of insect morphology, palaeontology, embryology, microscopy, hydrodynamics, systematics and biogeography. He was, however, best known for his contributions to the study of black flies (Diptera: Simuliidae) — a little loved but fascinating group of bloodsucking insects. Doug enjoyed a long and distinguished career at the University of Alberta, where he was a key member their legendary Entomology Department (Ball, 1985). He taught a wide variety of undergraduate courses and sponsored 18 graduate students and 4 postdoctoral fellows during his 31-year tenure as professor. Doug took early retirement in 1997 at age 58, but remained active until his death. Remarkably, nearly half (52) of his 113 publications were produced during his time as Professor Emeritus.


M.Craig

Douglas A. Craig (1939 – 2020)

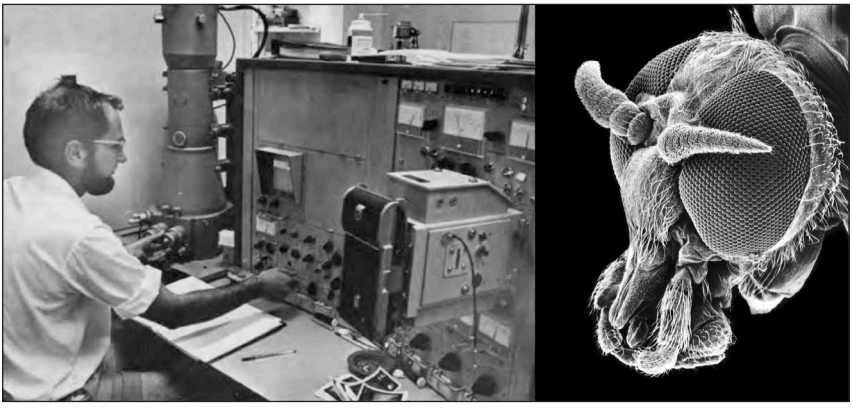
Douglas Abercrombie McBeath Craig was born on 24 October 1939 in Nelson, New Zealand — the son of Andrew and Violet Craig. Doug's mother died when he was only 6 years old, and he spent the next 4 years in a series of foster homes until his father remarried in 1949. Doug attended Nelson College from 1953-1957, moving to Christchurch in 1958 to attend Canterbury University. It was there that he met his future wife, Ruth Heath, in a Botany class. They married in 1962 while still enrolled in their undergraduate programs, with Doug attaining his B.Sc. (Honours) degree the following year. As was typical in New Zealand at the time, Doug commenced a direct-entry PhD program at Canterbury University, where he studied the biology of New Zealand net-winged midges (Diptera: Blephariceridae). After defending his thesis in late September 1966, Doug and Ruth departed the very next day for what was supposed to be a temporary gig at the University of Alberta in Edmonton. Janet Sharplin — the Department of Entomology's insect morphologist – was going on sabbatical, and Doug's role was to cover her courses for the year. As fate would have it, the sabbatical evolved into maternity leave, with Janet opting not to return to her former role. Doug was at the right place at the right time, transitioning seamlessly from Sessional Instructor to Assistant Professor in 1968. Once settled in the security of a tenure-track position, Doug and Ruth set about expanding their family. Daughter Jaqueline was born in May 1968 followed by son Michael in June 1970. They lived in a succession of residences before settling into their 'forever' home in 1974. Situated in the Belgravia District immediately south of campus, the Craigs' beautifully appointed bungalow became a social hub for generations of University of Alberta entomologists.


R.E.G.Craig

Doug and Ruth Craig in New Zealand

Doug's career-long focus on black flies started soon after his arrival in Alberta. The Head of the Entomology Department at that time, Brian Hocking, was an internationally renowned authority on

the ecology, physiology, medical importance and control of biting flies. It just so happened that one of Hocking's students, Osman Abdelnur, was in the midst of preparing a manuscript from his PhD thesis on the biology of some Alberta black flies. The journal was prepared to accept the manuscript if Abdelnur provided illustrations for some of the characters in his dichotomous keys — a challenge for anyone lacking artistic skills. Doug volunteered to step in, producing the drawings needed for the paper to be accepted. The high quality of Doug's illustrations was evident in his first published (though uncredited!) renderings of black fly bits and parts (Abdelnur, 1968). Nonetheless, the exercise proved sufficient to spark Doug's interest in black flies, with his own publications on the group soon to follow (Craig, 1968a, 1968b).



G.Graybrook D.Craig

Left: Doug Craig operating the first SEM in the Department of Entomology. Right: The head of *Helodon susanae* — Doug's most reproduced SEM image.

In the early part of his career, Doug's black fly research concerned various aspects of embryology, histology, morphology and methodology — a transdisciplinary approach that served him well throughout his career. But Doug's early embrace of scanning electron microscopy (SEM) proved to be a game changer (Craig and Braybrook, 1972). He first used the SEM to reveal the ontology of larval black fly heads (Craig, 1972), later launching a long and productive line of research on the morphology and function of labral fans — the filter-feeding apparatus of larval black flies. The technology proved equally effective for exploring other character systems and taxa, providing endless grist for Doug's lab and the broader university community. Doug took his first sabbatical around the same time (1972/1973), traveling to Tahiti and New Caledonia to launch another new research program on the diversity, evolution and biogeography of southern Pacific black flies. Subsequent sabbaticals to the South Pacific in 1980/1981 and 1988 provided enough material to produce a series of important revisionary works for the region, along with a pair of biogeographical studies that rank among Doug's most cited publications.

The 1980s heralded a new chapter in Doug's career with his burgeoning lab and development of an entirely new research focus. Long fascinated by the complexities of the labral fans of larval black flies, Doug became curious about how they worked. He was greatly influenced by Rubenstein and Koehl's (1977) paper that applied theoretical considerations to the mechanisms of filter feeding organisms. Another major influence was stream hydrologist Bob Newbury, who at the time was a research scientist at the Freshwater Institute in Winnipeg. In 1983 Doug attended a field course offered by Newbury at the Wilson Creek Experimental Watershed in Manitoba, thus spawning the field of "Behavioural Hydrodynamics". Over the next decade or so, Doug and

his collaborators published dozens of papers that applied hydrodynamic principles to the study of morphological adaptations to life in flow. This period represented the highwater mark of his academic career at the University of Alberta, though circumstances were soon to change. In 1994 the university folded the tightly-knit Department of Entomology into the much larger Department of Biological Sciences. The new dynamics exacted a toll, especially with regard to Doug's teaching assignments, which were adjusted to suit the needs of the new, supersized, department. Doug happily took early retirement when the opportunity arose in 1997.

Far from settling into quiet retirement, Doug's emancipation from teaching and graduate student supervision proved a boon for his research productivity. He continued going to the lab on a daily basis, focussing on his revisionary studies of South Pacific black flies and other simuliids of interest. It was during that period that he dove deeply into the geological literature, publishing his highly cited research on the geographical history of southern Pacific islands. I suspect few other biologists have the skill and background to comprehend (let alone synthesize!) the arcane geological literature on that subject. Doug and Ruth relished the opportunity to return to their natal land to study the black flies (sand flies or te namu, as they're known locally) of New Zealand. The result was a massive 336-page tome on the taxonomy, bionomics and evolution of the 19 species of *Austrosimulium* known from that country (Craig et al., 2012). Remarkably, the last 3 years of Doug's life were among his most productive, with at least 10 papers published during that time. Among them was a series of six major revisions of the Gondwanan black flies of Australia — a monumental collaboration that came to fruition only through Doug's leadership and perseverance. At least one other such contribution was in the works, though Doug sadly died before it was completed.

It's difficult to encapsulate one's life and accomplishments in a short note, and there was certainly more to Doug than just his academic achievements. Although exceptionally attentive to the needs of his graduate students, Doug didn't require that his name appear on all their papers — despite the fact most were supported both intellectually and financially. Imagine Doug's CV had he adopted a more conventional approach to graduate-student supervision. He was also a key figure in the social life of the Department, hosting countless extracurricular events at the Craig family home. In fact, Doug and Ruth's home was the temporary first place of residence for many students and postdocs when they first arrived in Edmonton. That's just the kind of folks the Craigs were. In 2012 Doug organized the "1922: Then and Now Symposium", a celebration of past and present entomologists at the University of Alberta. It attracted an international gathering of about 100 former department members and accompanying guests. The timing was right, as many key members of the former department have since passed, including George Ball, Bruce Heming, Ron Gooding, Andy Nimmo, Mac McIntyre and Robin Leech.

Doug's passion for research was matched only by his zest for the finer things in life, whether it be travel, classical music, engaging in conversation (he was a gifted raconteur!) or enjoying a fine scotch or wine ("the red stuff", as he liked to call it). He especially enjoyed concocting witty subject lines for email messages, using cringe-inducing puns that related to the contents of his messages. I, for one, very much miss seeing his missives in my inbox. In Doug's typical humble fashion, he requested that no funeral be held upon his death. Nonetheless, there was considerable interest on the part of Doug's many friends and colleagues to hold an event in his honour. The family agreed, offering to hold a Celebration of Life at the Craig family home in June of this year. Unfortunately, the COVID-19 pandemic intervened and the event was cancelled. I can't help but wonder whether Doug is smiling at our scuttled efforts to skirt his wishes. You see, Doug was never one to say good bye, so we'll have to settle for his favoured signoff "Toodles for the nonce".

Doug Craig's publications and other research contributions are posted on ResearchGate: https://www.researchgate.net/profile/Douglas_Craig/research

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Douglas C. Currie
Royal Ontario Museum, Toronto