shared through trusted social connections on Facebook, YouTube, Twitter and other platforms, exploiting the "two-step flow" of propagation, in which interpersonal relationships increase the traction of a message.

That flow also helped to set an agenda in the mainstream media. Jamieson shows how much news reportage was triggered by uncritical tracking of Twitter and Facebook memes. Finally, the contagion effect did much to ensure that even attempts to dismiss the more ludicrous conspiracy theories meant that negative associations still clung to Clinton. Facebook became a "contagion machine", Jamieson writes. Its algorithms quickly learnt that the best way to retain users was to keep them angry and afraid — responses that troll messages were designed to elicit.

As Jamieson writes, the trolls aimed strategically to direct attention to hot-button issues such as illegal immigration or police brutality. Exploiting the two-step flow, the trolls gained traction in niche groups by pretending to be extremists in both left-wing and right-wing camps and sending out messages ranging from exaggerations to complete fictions. As Senator Mark Warner (Democrat, Virginia) of the Senate Intelligence Committee recounts, these efforts were largely directed at demobilizing possible Clinton voters. Meanwhile, trolls tried repeatedly to incite violence, attempting to organize at least 129 rallies on both left and right — some at the same time and place, with the clear intent that they should clash.

The media's frames of choice prevented the full implications from sinking in — for instance, casting e-mails hacked from the Democratic National Committee and published in 2016 as 'leaked correspondence'. And the media inadvertently aided counter-messaging that protected Trump from bad press (such as recordings of him speaking lewdly while filming for the *Access Hollywood* programme) through the timing of reports, even distracting from US government announcements that a Russian disinformation campaign was under way.

"Trolls aimed strategically to direct attention to hot-button issues such as illegal immigration."

Cyberwar is all the more powerful for what it is not. It is not a book of international politics or warfare. Its title is likely to displease those who think it might inadvertently support those actors (such as Russia) who wish to cast information warfare as 'war'. It does not attempt to portray the full landscape of this new, cyber-enabled cold war. It describes only part of the new conflict paradigm, which also includes Russia's preparations for 'real', critical-infrastructure-crashing cyberwar, along with the slow and steady erosion of the Western alliance, democracies and international law writ large — all in an attempt to fulfil a zero-sum world view in which Russian greatness can be (re)achieved only by vanquishing the country's implacable foes.

Indeed, Jamieson plays little heed to accusations that the actual electoral system — voting machines and voter registries — might have been tampered with. She concludes (rightfully, in my view) that if they had been, the manipulation would probably represent only a fraction of the votes 'stolen' through troll activity. In the end, Jamieson's final analysis is clear, if not explicit: Russian trolls must have swung many more votes than the 78,000 in 3 crucial states that constituted Trump's winning Electoral College margin. Indeed, the reader is left with the distinct impression that the number of affected votes was probably orders of magnitude higher.

Cyberwar provides a convincing model of how the old Soviet 'active measures' of propaganda, honed throughout the twentieth century, can be enacted with great effect under the new media order. Most importantly, Jamieson specifies the roles of complicit citizens and an unwitting media. By showing that modern Western democracy has a significant existential challenge, she has set us on the path to help patch it — if only we are able to move fast enough. ■

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SCIENCE FICTION

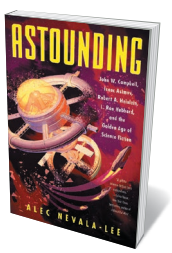
How science fiction grew up

Rob Latham savours the convoluted tale of four men who reshaped the genre.

Alec Nevala-Lee's *Astounding* is a fascinating collective portrait of four men who, together and apart, helped to shape modern science fiction. They were the legendary, irascible John W. Campbell Jr, long-time editor of the magazine *Astounding Science Fiction* (later *Analog*), and three of his key writers. Isaac Asimov and Robert A. Heinlein became giants of the genre. L. Ron Hubbard, by contrast, was a prolific purveyor of pulp fiction (and future founder of the Church of Scientology).

Under Campbell's editorship, *Astounding* was transformed during the late 1930s and 1940s from a showcase for space-opera schlock into a serious venue for futuristic extrapolation, often written by professional scientists such as Asimov, a biochemist, and electronics engineer George O. Smith. That era has become known as science fiction's golden age. Nevala-Lee — himself a science-fiction writer — delivers a compelling account of its hopeful rise and ignominious fall.

Pivotal in this trajectory was the massive, lingering impact of the Second World War on the magazine and its stable of authors, several of whom were drawn into military research. Asimov, Heinlein and fellow *Astounding* regular L. Sprague de Camp tested war materials at the Philadelphia Navy Yards in Pennsylvania from 1942. Campbell, under the aegis of the University of California's Division of War Research, led a team of authors revising technical manuals for military use. He also joined Heinlein and de Camp in brainstorming unconventional responses to kamikaze attacks, such as detecting approaching aeroplanes using sound.



Astounding: John W. Campbell, Isaac Asimov, Robert A. Heinlein, L. Ron Hubbard, and the Golden Age of Science Fiction
ALEC NEVALA-LEE
Dey Street (2018)

Despite knowing that publishing stories treating potential new forms of military technology would run afoul of the wartime censors, the ever-obstinate Campbell did just that in March 1944. Cleve Cartmill's 'Deadline' depicted the invention of a nuclear bomb using isotopes of uranium. Campbell, a trained physicist who strongly suspected the government was working on such a weapon, fed technical details to Cartmill, who set the tale on another planet. (Cartmill slyly called the warring aliens Sixa and Seilla, Axis and Allies spelt backwards.)

Unsurprisingly, the story drew the ▶

attention of the national Counter-intelligence Corps, which suspected a leak from the Manhattan Project; swathes of the personnel at the project's site in Los Alamos, New Mexico, were science-fiction fans. Campbell was aggressively interviewed by an intelligence agent, Cartmill's personal correspondence was put under surveillance, and *Astounding* came close to having its mailing privileges revoked. After the war, Campbell often cited the incident to demonstrate the genre's prophetic nature — its capacity to project a convincing fictional future from known scientific facts.

Indeed, the unprecedented technological advances of the war fuelled the public taste for science and technology, in turn raising the cultural status of science fiction. The late 1940s and 1950s were a boom time for the genre. That boosted the stock of *Astounding*, which came to specialize in stories of nuclear conflict and crisis. It also led to the rise of competing titles such as *Galaxy* and *The Magazine of Fantasy & Science Fiction*, as well as an expansion of the science-fiction book market. Campbell's talent began to be poached.

Nevala-Lee carefully traces the rifts that developed in the core group, largely prompted by Campbell's increasing fondness for pseudo-scientific ideas such as the Dean drive (proposed by inventor Norman Dean, who claimed it could produce thrust without a reaction — in violation of the laws of motion).

More generally, Campbell had always been obsessed by the possibility of a truly scientific psychology, which he believed would have predictive power along the lines of the fictional science of psychohistory in Asimov's Foundation series. So when Hubbard, in the late 1940s, shared ideas that later became his 'self-help system' Dianetics, Campbell took the bait. Hubbard's vision of superpowers purportedly lurking in everyone — once they had gone through an 'auditing' process and emerged as 'clears' — gripped Campbell, and he helped Hubbard to market his 1950 book *Dianetics*. Nevala-Lee argues that a lingering messianism at the heart of science fiction — its "persistent dream of an exclusive society of geniuses" — helped to propel Hubbard's movement, which became Scientology. Numerous sci-fi authors embraced Dianetics, submitting to auditing or even becoming trained auditors; A. E. van Vogt briefly abandoned his writing career to run a chapter in Los Angeles, California.

***Astounding Science Fiction*'s cover for May 1947.**

GRANGER HISTORICAL PICTURE ARCHIVE/ALAMY

Hubbard's gift for the hard sell was pivotal, and Nevala-Lee's portrait of him as a paranoid narcissist and skilled manipulator is scathing. However, Campbell is also sharply scrutinized for his role in midwifing and unleashing *Dianetics*. Heinlein and Asimov were repelled by what they saw as an uncritical embrace of quackery, and took refuge in newer, often more lucrative markets. The book's final chapters detail the steady decline of the magazine into a second-rank publication, and Campbell (who died in 1971) into a reactionary crackpot with racist views.

Although much of the story outlined in *Astounding* has been told before, in genre histories and biographies of and memoirs by the principals, Nevala-Lee does an excellent job of drawing the strands together, and braiding them with extensive archival research, such as the correspondence of Campbell and Heinlein. The result is multifaceted and superbly detailed. The author can be derailed by trivia — witness a grisly account of Heinlein's haemorrhoids — and by his fascination for clandestine love affairs and fractured marriages. He also gives rather short shrift to van Vogt, one of Campbell's most prominent discoveries and a fan favourite during *Astounding*'s acme, whose work has never since received the attention it deserves.

These quibbles aside, the book is a rich, gripping cultural and historical study of how a small cadre of talents in a minor commercial genre became some of the most influential figures of the second half of the twentieth century. ■

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NATURAL HISTORY

Scientific artistry of the Lister sisters

Beth Fowkes Tobin applauds a book on a gifted family of early-modern naturalists.

Between 1685 and 1692, Martin Lister — a noted British physician and naturalist — published *Historiae Conchyliorum*, a significant study of molluscs filled with hundreds of beautiful illustrations of all known shells. The illustrators were Lister's daughters Anna and Susanna. How these drawings and etchings came into being in an era that excluded women from formal scholarship is meticulously shown in *Martin Lister and his Remarkable Daughters*.

Historian Anna Marie Roos marshals her considerable talents as a researcher to recover the story of how Lister's daughters learnt to draw and etch scientifically accurate natural-history illustrations. Records of women's scientific work from this time are scant; naturalist and illustrator Maria Sibylla Merian's spectacular drawings of Surinam's insects are among the rare surviving examples.