From bombs to bubbles: the extraordinary career of Cyril Stanley Smith

Denis Weaire, Physics Department, Trinity College,
University of Dublin, Ireland

Smith meets Oppenheimer

The excellent movie "Oppenheimer", recently released, understandably places nuclear physicists front-and-centre in its story. But at one stage Oppie explains to his colleagues that the Manhattan Project depends on much more than their theories. Engineering, metallurgy and chemistry were to play essential roles. Of these the last was particularly challenging. A primary task was to determine the properties of Plutonium, of which practically nothing was known. Furthermore, adequate samples for lab work would be some time in coming...

The man entrusted with leadership of the crucial metallurgy programme was Cyril Stanley Smith. In time of war, talent trumps all else, so that his non-American origins (in Birmingham) did not matter. (One is reminded of Klaus Fuchs, recommended to the Americans by Nevill Mott, a less fortunate recruitment!). Smith had established a fine record as a research metallurgist in industry, before joining the war effort in administration. Sitting with Oppie on a park bench he was persuaded to go to Los Alamos.

Plutonium is radioactive and highly reactive chemically: it required extraordinary dedication for Smith's team to succeed in good time. It seems they had no qualms about the eventual purpose of their work, being carried along by magnitude of the challenge to their abilities.

The rest is history, but not very well recorded. Despite its substantial length "The Making of the Atomic Bomb" [1] barely mentions Smith and his team, yet he was the very last person to lay hands on the Plutonium bomb (making an improvised last-minute repair.)

Chicago

After the war, his career his career took another turn, as he became an academic, founding and directing the Institute for the Study of Metals at the University of Chicago. It looked out on Moore's impressive piece, commemorating Fermi's achievement of a chain reaction in the tennis courts. He saw his new institute as a counterweight to the neglect of his subject by the universities, and the "aloofness of physicists".

I had the privilege and pleasure of being at the Institute for a year in the mid-Sixties, when it comprised many leading solid state physicists. I enjoyed its inclusive

collegiate atmosphere: Smith had drawn inspiration from the mutual support and teamwork that characterised the work of his Los Alamos metallurgists.

Personally I regret that the Institute was listed as such only until 1967, when it was renamed as the James Franck Institute - not dissimilar in spirit but with a much wider remit. Did the aloofness of physicists win out?

A final move

By then Smith had undergone his last migration/transformation, to MIT. His interests steadily grew wider, taking in history, philosophy and art, all drawing inspiration from his metallurgical insights. Eventually he summed all this up in his book "A Search for Structure" [2], consisting of his relevant published papers, with detailed notes. A recurrent theme was the disordered nature of many materials, and their history-dependence. He chided the solid state physicists for their obsession with very pure and perfect materials. No doubt this fell on deaf ears, as crystalline silicon played its central role in the emergence of semiconductor technology, as it does today.

Most materials, he insisted, are funeous, a word that he introduced. A character called Funes in a Borges short story sadly lost the ability to forget! Material objects are the products of their individual history, not just of their composition, and do not forget the past.

Perhaps some of his grander ideas were tenuous or tentative, but one elementary paper was transparent and intriguing, at least to me.

The 2D soap froth

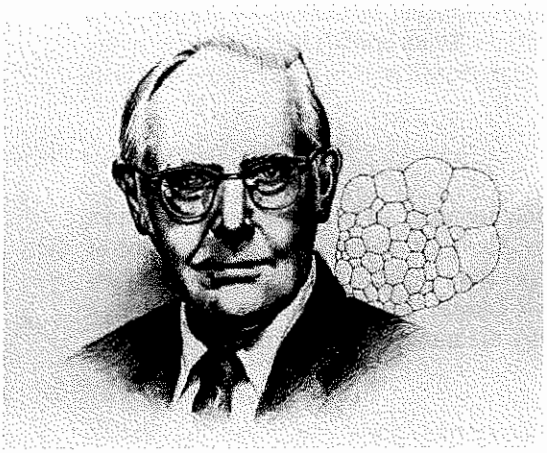

Fig 1 Cyril Stanley Smith and his 2D soap froth.

In the book's first paper, Smith gives pride of place to a very simple system that could be used to illustrate some of his principles. His 2d soap froth is not the bubble raft of Bragg - rather it is a bubble sandwich between two glass plates. It was taken up by E N da C Andrade, of the Royal Institution.

In a somewhat tangled tale of misleading error, I was drawn into study of foam coarsening (the growth of average bubble size with time, involving sudden local topological changes). Paul Kermode and I developed a computer simulation for this phenomenon, closely analogous to grain growth in metals. Smith did have a weak spot: like many of his generation. He could not see the coming impact of large computers in simulating the kind of systems that interested him. He urged me to concentrate more on experiments, which turned out to be good advice, anyway. For me this was the inception of several decades of research in a field that has expanded to the present day, in a group now led by Stefan Hutzler.

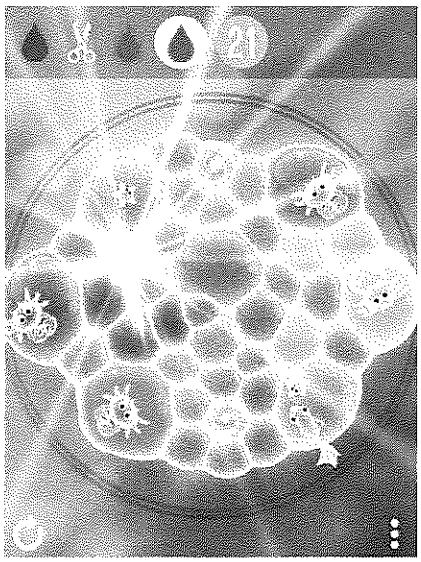

Fig 2 Denman's computer game based around Smith's soap froth.

Smith died at the age of 88. Eventually his grandson, Stuart Denman, has become interested in his work, and he is busy exploring odd corners of it. Being a software expert, he developed a computer game based on the 2d soap froth, which was successfully commercialised (Fig 2).

Perhaps the title that Smith would have most appreciated was philomorph (lover of form) – he was indeed a member of the Society of Philomorphs in Cambridge, Mass. No doubt he is well remembered there: Birmingham should be proud of him too.

References

1 Richard Rhodes, The making of the Atomic Bomb, Simon and Schuster, New York, 1986
2 C S Smith, A Search for Structure, MIT Press, 1983

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DISCORSI
E
DIMOSTRAZIONI
MATEMATICHE,
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Attenenti alla
MECANICA & i MOVIMENTI LOCALI;
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GALILEO GALILEI LINCEO,
Filoſofo e Matematico primario del Sereniſſimo
Grand Duca di Toſcana.
Con vna Appendice del centro di grauità d'alcuni Solidi.

IN LEIDA,
Appreſſo gli Elſeuirii. M. D. C. XXXVIII.

The title page of Galileo's Mathematical Discourses and Demonstrations concerning Two New Sciences (Leiden 1638).

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