CAMBRIDGE

Cambridge University Press
0521382319 - Boojums All the Way Through: Communicating Science in a Prosaic Age
N. David Mermin
Excerpt
More information

I.

Reflections on the pursuit of physics

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
0521382319 - Boojums All the Way Through: Communicating Science in a Prosaic Age
N. David Mermin
Excerpt
More information

1

E pluribus boojum: the physicist as neologist

I know the exact moment when I decided to make the word "boojum" an internationally accepted scientific term. I was just back from a symposium at the University of Sussex near Brighton, honoring the discovery of the superfluid[1] phases of liquid helium-3, by my Cornell colleagues Doug Osheroff, Bob Richardson, and Dave Lee. The Sussex Symposium took place during the drought of 1976. The Sussex downs looked like brown Southern California hills. For five of the hottest days England has endured, physicists from all over the world met in Sussex to talk about what happens at the very lowest temperatures ever attained.

Superfluid helium-3 is an anisotropic[2] liquid. The anisotropy is particularly pronounced in the phase known as ^{3}He-A. A family of lines weaves through the liquid ^{3}He-A which can be twisted, bent or splayed, but never obliterated by stirring or otherwise disturbing the liquid.

Several of us at the Sussex Symposium had been thinking about how the lines in ^{3}He-A would arrange themselves in a spherical drop of the liquid. The most symmetrical pattern might appear to have lines radiating outward from the center of the drop, like the quills of a (spherical) hedgehog (Fig. 1). There is an elegant topological argument, however, that such a pattern cannot be produced without at the same time producing a pair of vortex lines[3] connecting the point of convergence of the anisotropy lines to points on the surface of the drop (Fig. 2).

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
0521382319 - Boojums All the Way Through: Communicating Science in a Prosaic Age
N. David Mermin
Excerpt
More information

It appeared that if one did try to establish the symmetric pattern of radiating lines then the accompanying vortices would draw the point of convergence of the lines to the surface of the drop (Fig. 3), resulting in a final pattern that looked like Fig. 4.

When I returned to Ithaca I began to prepare for the proceedings the final text of the talk I had given which examined, among other things, the question of the spherical drop. Although no remarks about the drop were made after my talk, I decided to use the format of the discussion remark to describe the opinion that developed during the week that the symmetric pattern would collapse to one in which the lines radiated from a point on the surface. I found myself describing this as the pattern that remained after the symmetric one had "softly and suddenly vanished away." Having said that, I could hardly avoid proposing that the new pattern should be called a boojum.

The term "boojum" is from Lewis Carroll's "Hunting of the Snark" and it came to me at my typewriter rather as it had first come to Carroll as he walked in the country. The last line of a poem just popped into his head: "For the Snark was a Boojum, you see." A little distance along it was joined by the next to last line, "He had softly and suddenly vanished away." The hundreds of lines leading to this denouement followed in due course.

Goodness knows why "boojum" suggested softly and suddenly vanishing away to Carroll, but the connection having been made,

Fig. 1.

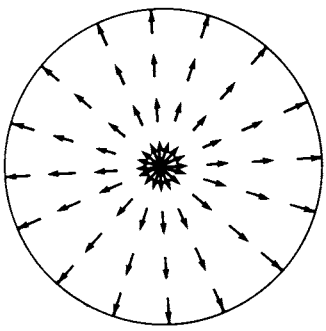
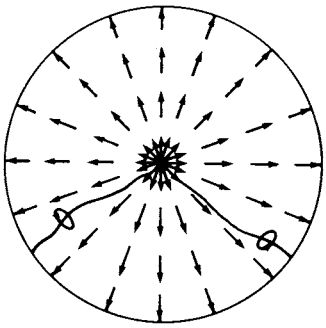


Fig. 2.



© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
0521382319 - Boojums All the Way Through: Communicating Science in a Prosaic Age
N. David Mermin
Excerpt
More information

it was inevitable that softly and suddenly vanishing away should suggest "boojum" to me. I was not unaware of how editors of scientific journals might view the attempt of boojums to enter their pages; I was not unmindful of the probable reactions of international commissions on nomenclature; nevertheless I resolved then and there to get the word into the literature.

There would be competition. Other people at the symposium had proposed calling my boojum a flower or a bouquet. Philip W. Anderson, who was to win his Nobel Prize the next year, and who appears at several critical moments in my tale, was not at the Sussex Symposium, but he was also thinking about spherical ^{3}He-A, and wanted to call the stable pattern a fountain. It is possible that Anderson's colleague at the Bell Telephone Laboratories, William F. Brinkman, was thinking about boojums at least a year before any of us. But he didn't know it was boojums he was thinking about and didn't bother to call them anything else either. Although he may not know it to this day, Brinkman was to play a role of pivotal importance in boojum's progress.

The first step toward assuring the adoption of "boojum" was easily accomplished. The discussion remarks, including my nomenclatural proposal in the guise of a discussion remark, received the usual minimal editorial attention. Shortly thereafter the word "boojum" – albeit encumbered by quotation marks – made its maiden appearance in the literature of modern physics.

Fig. 3.

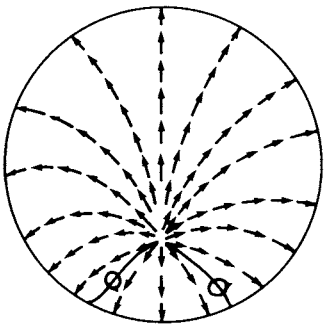
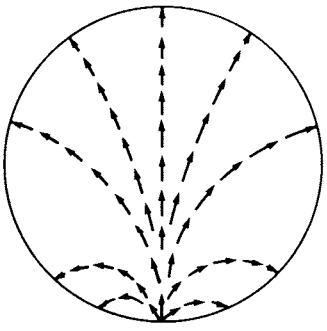


Fig. 4.



© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
0521382319 - Boojums All the Way Through: Communicating Science in a Prosaic Age
N. David Mermin
Excerpt
More information

> Maki and Hall (see also their prepared talks) both felt that the yozh would be unstable. They disagreed on the fashion in which it would disappear, but it was my impression that both favored the texture of fig. 3c as that prevailing after the yozh had softly and suddenly vanished away. Hall proposed calling it the "flower texture," but I personally think that "boojum" is more to the point.

Note my use of the word "yozh" to describe the symmetric pattern. "Yozh" is Russian for "hedgehog." I have never forgotten the word since studying Russian for the PhD language requirement, because it is only two letters long in Cyrillic. Since a Russian physicist, writing in Russian, had introduced the term, I used "yozh" instead of the increasingly popular "hedgehog" in the text of my paper. This effort to make an English word out of "yozh" failed utterly. Little did I then suspect that I would one day succeed in making a Russian word out of "boojum."

Published boojums

My next step was clearly to publish something which put my nomenclatural proposal to use, calling a boojum a boojum without fanfare or quotation marks. I wasn't ready to fight with editors of journals, but I was to deliver a paper on superfluid helium-3 at a conference to be held on Sanibel Island in January 1977, and the conference proceedings were to be published as a book. The form of my contribution to the Sanibel proceedings as well as the intensity of my interest in the boojum was considerably influenced by a series of letters I exchanged with Phil Anderson that fall.

Our correspondence was somewhat constrained by the fact that although I knew I was writing to Anderson, he – at least for a while – did not know he was writing to me. I had been sent the text of a paper by Anderson and Gerard Toulouse to referee for *Physical Review Letters*. Anderson and Toulouse argued that ^{3}He-A might not be as good a superfluid as people had expected, producing an ingenious reason why what might appear to be a conventional permanent supercurrent could in fact lose its flow.

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
0521382319 - Boojums All the Way Through: Communicating Science in a Prosaic Age
N. David Mermin
Excerpt
More information

I saw a possible flaw in their argument. The surface of a container has a rather peculiar effect on the anisotropy lines of ^{3}He-A: they are forced to line up perpendicular to the surface at the boundaries of the liquid (as they are in the pictures of the spherical drops shown above). Although this seemed to be of no relevance to the argument of Anderson and Toulouse, I worried that it might, in fact, invalidate the mechanism they proposed for the disappearance of the supercurrent. I suggested that such questions should be cleared up before the paper was published. In the only mildly acrimonious correspondence that ensued, the authors and I both started to realize that the ability of the surface to stabilize the supercurrent was indeed relevant, but that this stabilizing power could be lost if there was even a single boojum (none of us called it that) on the surface.

This was interesting enough for their paper to appear (though without the word boojum), and I found myself more committed than ever to establishing the term. It was now evident that boojums were more than an inert feature of the structure of ^{3}He-A drops; they had a vital role to play in the most fundamental property of the liquid, its superfluid flow. Furthermore it was no longer a bad idea about the pattern in spherical drops that was softly and suddenly vanishing away, but the supercurrent itself, whose soft and sudden vanishing could be triggered by a well placed boojum. My nomenclatural impulse had acquired the character of a prophetic vision.

In "The Hunting of the Snark," a boojum is a singular variety of snark with the alarming ability to bring about the soft and sudden vanishing away of anyone encountering it. The boojum in ^{3}He-A, being a point at which lines in different directions all meet, is a mathematical singularity. A singularity in ^{3}He-A responsible for the vanishing of a supercurrent *had* to be called a boojum.

Accordingly, at the appropriate point in my paper for the Sanibel Symposium, I let loose a flock of boojums:

> This twisted boojum is shown at the bottom of the torus in the cross section in which it resembles the hyperbolic

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
0521382319 - Boojums All the Way Through: Communicating Science in a Prosaic Age
N. David Mermin
Excerpt
More information

> twistless boojum of Fig. 10 (but note that the cross section perpendicular to the page will resemble the circular boojum). If either of the booja encircles its part of the torus (see inset) then two quanta are subtracted from the circulation about the entire torus.

Inspection of this specimen reveals that I had adopted "booja" as the plural form. As we shall see this turned out to be a serious error. I believe it was the one false step I made in an otherwise impeccable campaign, though publishing this article may turn out to have been the second.

The editor of the proceedings approved "boojum"; indeed, he allowed it to appear in the index, where it can be seen in the company of better established but, I would have said far less poetic technical terms in **B**:

> BCS theory, 112, 379
> BW state, 130, 186–188, 190
> Boojum, 17, 21, 29
> Borders, 5, 7, 12
> Bose–Einstein condensation, 287, 293, 303, 307, 405
> Breathers, 59, 74

The Sanibel Symposium took place during the remarkably cold winter of 1976–77. Many of the people who suffered through the heat of the Sussex Symposium found themselves together again, six months later, experiencing the coldest Florida January on record. They were rewarded by the first public lecture (mine) in which the word "boojum" was used in its new scientific context. (Anderson also spoke at Sanibel but he called the boojum a fountain.)

A boojum in Erice

Returning from cool Florida to frigid Ithaca, I set to work preparing a set of lecture notes that I delivered that June at a summer school in Erice, a mountain-top Sicilian town three thousand feet straight above the sea, whose streets and alleys are paved in geometrical patterns of massive stones, polished smooth

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
0521382319 - Boojums All the Way Through: Communicating Science in a Prosaic Age
N. David Mermin
Excerpt
More information

by feet and wheels. The views in all directions were spectacular and the weather was neither too hot nor too cold. Occasionally a cloud would settle over the mountain top for a day or two sending cool mists swirling through the steep alleyways. The perfect place to meet a boojum, though nobody ever did.

The boojum, however, did make a casual but prolonged appearance in one of my lectures. The index entry in the published volume was worthy of a fully mature technical term:

BCS gap, 175, 242, 244, 258
Bogoliubov–Zubarev method, 274
Boltzmann equation, 129
Boojum, 214
  circular, 223
  hyperbolic, 223
  and sound attenuation, 224
  and superflow, 224
Bose–Einstein condensation, 198
Bose liquid, 36

A month later I talked about boojums at a conference in New Hampshire. No proceedings were published, but several Russians attended the meeting and it seemed important to get them thinking boojum too. I had hoped that the first person plural future form of the Russian verb to be ("budyem", more or less pronounced "BOODyum") would make them receptive to the term, but I was never then or thereafter able to convince any Russian that the two words resembled each other in any way. No matter. The Russians took to boojums at once, and one even said a boojum or two in his own talk. The weather was once more decidedly boojumish. I believe Concord recorded several of the hottest July days in its history. The temperature was 102 or 104, and Lake Winnipesaukee, in which many of us swam before, after, and sometimes during lectures, was as warm as a bath.

I returned from New Hampshire convinced that the boojum was ready to make its debut in an established scientific journal, but before I could consider how to bring this about there were two alarming developments.

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
0521382319 - Boojums All the Way Through: Communicating Science in a Prosaic Age
N. David Mermin
Excerpt
More information

Chia-Ren Hu, whom I had met at Sanibel, became interested in boojums, and wrote a paper, "Exact solution of a 'boojum' texture in ^{3}He-A." He sent it to the *Journal of Low Temperature Physics* and in due course received a letter from the editor, which read in part

> I have just received the comments of our referee on your paper and I enclose a copy of them. As you will see, he considers that the paper should be published provided the word "Boojum" be replaced with a suitable scientific word or phrase in the title, abstract, and text (p. 4, lines 8 & 17; p. 6, line 6). I too as General Editor concur unreservedly in this requirement. If you are willing to make such changes, we shall be happy to publish the paper.

Dr. Hu sent this communication on to me, together with a copy of the report of the referee who actually recommended only the removal of the boojum from the title. Dr. Hu informed me that it was his plan to substitute for the word "boojum" the acronym "SOSO" (for "singular on surface only"). Appalled at the imminent possibility of my boojum turning into a SOSO, I wrote immediately to the General Editor, dissenting unreservedly from his conclusions:

> Professor John G. Daunt
> Editor, Journal of Low Temperature Physics
>
> Dear Professor Daunt:
>
> I have received from C.-R. Hu a copy of a referee's report on his article on surface point singularities in superfluid ^{3}He-A, recommending that the word "boojum" be removed from the title, accompanied by a copy of a letter from you stipulating that the word be removed from the abstract and text as well. I agree that the term has not gained the currency to warrant its use in a title, but there is no reason for it to be excised from the text provided proper citations are given.
>
> The term "boojum" is now in wide use in the field of superfluid helium-3. It first appeared at the Sussex Symposium (August 1976) and can be found in print in *Physica*, **90B + C**, 1 (1977). The term appears again in the proceedings of the Sanibel Symposium (January 1977) to be published by Plenum within a month or two. There its literary origins are

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
0521382319 - Boojums All the Way Through: Communicating Science in a Prosaic Age
N. David Mermin
Excerpt
More information

explained and its use justified. Briefly, a boojum is a singular beast, the appearance of which causes the observer to "softly and suddenly vanish away." This is precisely the role played by the boojum in ^{3}He-A. If a boojum is in the container it can catalyze the decay of the supercurrent. Such a process is unique to ^{3}He-A and it requires a new nomenclature. The word "boojum" is sanctified by Webster's unabridged (2nd edn) where it is defined essentially as I have done above. It is therefore as respectable a term as the currently fashionable "hedgehog" (and rather more respectable than "quark").

In addition to the two citations mentioned above, the term "boojum" will appear in print in the proceedings of the June 1977 Erice Summer School on Quantum Liquids, to be published by North Holland this fall; it appears in a recent preprint of a *review* article by Brinkman and Cross; it appears in a recent preprint from the Landau Institute; and it was widely used and understood in discussions at last month's Gordon Conference on non-equilibrium phenomena in quantum liquids, attended by most of the world's experts on superflow in ^{3}He-A.

In short, "boojum" has now been used in the field for a year as a technical term meaning, quite precisely, "any surface point singularity the motion of which can catalyze the decay of a supercurrent." The term is specific, apt, and recognized by Webster. It has the virtue of being easily pronounced in Russian (since it is a homonym for the first person plural of the Russian verb to be). It is already in print in one reputable journal and will appear in print in at least five other places within half a year.

To ask that Dr. Hu resort to circumlocutions in the text of his article serves no linguistic or esthetic purpose, and obscures the physical significance of the point he wishes to make. Now that I have told you a little more about the meaning and widespread use of the term, may I urge you to let him reintroduce it in his text.

Sincerely yours,
N. David Mermin
Professor of Physics

The reference to the dictionary is important. If Hu's paper had mentioned a "flower texture" or a "fountain texture" chances are

© Cambridge University Press www.cambridge.org