

A Google search for the combination “big bang” and “universe” gives 28.6 million returns, a rough indication of the popularity of the term that since the late 1960s has been almost synonymous with the standard model of modern cosmology. Ironically, the term was coined by Fred Hoyle (figure 1) in 1949 to characterize the kind of theory he much disliked and fought until the end of his life. Although it is widely agreed that Big Bang is a misnomer because it inevitably conveys the image of an explosion, the term has long ago become a staple part of cosmologists’ vocabulary. More than a thousand scientific articles have been written with “big bang” in their title. As Hoyle said in an interview in 1995: “Words are like harpoons. Once they go in, they are very hard to pull out” (Horgan 1995).

It is worth looking at the etymology of scientific names and phrases that catch on, because they influence how scientists and the public at large think about Nature. “Relativity theory” – a name for which Einstein was not responsible – may allude to relativism (“everything is relative”) in the same way that “big bang” alludes metaphorically to an explosive and noisy event at the beginning of time. Both convey unfortunate pictures, but it is difficult to find substitutes that are both apt and more appropriate.

A detailed study of the history of the name Big Bang reveals misunderstandings in the popular and scholarly histories of modern cosmology. For example, the epic cosmological debate in the period 1948–1965 is usually described as a fight between two rival world systems, the Big Bang theory and the Steady State alternative. This is to a large extent a misrepresentation in both a terminological and factual sense. It is “well known” that Hoyle coined the term “big bang” in a pejorative sense, to make fun of the idea of an exploding universe, but what is well known is not necessarily correct. It is also generally assumed that the name was adopted by the cosmologists at an early stage and widely used in the controversy. This was not the case. It took more than two decades until Hoyle’s phrase became common in the scientific literature.

Early explosion theories

The Belgian physicist and cosmologist Georges Lemaître is often mentioned as the father of the physical big bang, a concept he introduced in 1931. Incidentally, the origin of his finite-age model is often misdated to 1927, the year in which he developed a pioneering theory of the expanding (but non-big bang) universe. Even the authoritative *Oxford English Dictionary* states Lemaître’s Big Bang theory to date from 1927. To describe in words the initial state of the universe he had recourse to metaphorical terminology, his favourite names being “primeval atom” and “fireworks theory”. One name he did *not* use was the “cosmic egg”, to which there are

Big Bang: the etymology of a name

Fred Hoyle famously coined the term “big bang” in 1949, but it took a long time to catch on. Helge Kragh shows how the story of the name is also the story of how modern cosmology emerged.



**1 (left): Fred Hoyle (1915–2001).
2 (right): George Gamow (1904–1968).**

nevertheless several references in the literature, none of them with a source reference. With the benefit of hindsight we can today recognize in Lemaître’s primeval atom hypothesis the germ of the later Big Bang theory, but in the 1930s it was scarcely taken seriously. Most astronomers either ignored it or dismissed it as “clever *jeu d’esprit*”, as one critic called it.

It was only in the late 1940s that George Gamow (figure 2) and his collaborators Ralph Alpher and Robert Herman independently transformed Lemaître’s spirited hypothesis into a sophisticated model of the early universe. They assumed the initial state to consist of a very hot, compressed mixture of nucleons and photons, thereby introducing the hot Big Bang model. On this basis they succeeded in calculating the amount of helium in the universe (about 30%), but unfortunately there were no reliable observations with which their calculations could be compared. Although Gamow did not associate the early exploding universe with a particular name or phrase, he did coin a name for the collapsing universe he imagined might have preceded the present expansion (Gamow 1951). He sometimes referred to the “big squeeze” in terms that were almost indistinguishable from the Big Bang, a name he resented. As he said in an interview shortly before his death in 1968, it was a cliché (Gamow 1968).

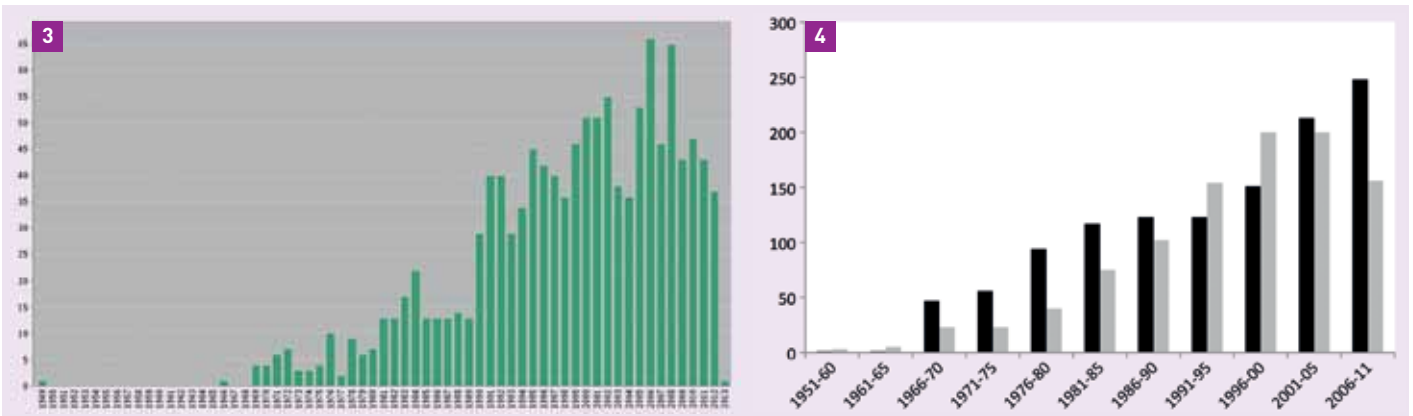
Hoyle coins a phrase

As one of the founders of the Steady State theory of the universe, together with Hermann Bondi and Thomas Gold, Hoyle was strongly opposed to cosmologies with a beginning in

time. On 28 March 1949 he gave a talk on his favoured “continual creation” theory to BBC’s Third Programme which shortly thereafter was reproduced in *The Listener*, the widely circulated BBC magazine. He emphasized the contrast between the Steady State theory and “the hypothesis that all matter of the universe was created in one big bang at a particular time in the remote past”, which he found to be “irrational” and outside science. Less than a year later he gave a series of five broadcasts on the BBC which again were printed in *The Listener* and also in the form of the best-selling book *The Nature of the Universe*. With Hoyle’s radio lectures of 1949–1950 the term “big bang” made its entry in the cosmological vocabulary.

There are in the literature some misconceptions about Hoyle’s BBC addresses and the effect of his neologism. One of them is that Gamow was directly involved in Hoyle’s BBC talks, such as stated by Alpher and Herman in several of their recollections: “Toward the end of 1949 Gamow engaged in a transatlantic debate with Hoyle on the BBC. It was during this debate that Hoyle first used the designation ‘Big Bang’, and in a pejorative sense” (Alpher and Herman 1997). There never was such a radio debate between the two cosmologists, and Hoyle did not mention Gamow in his talks or in his book. Nor is it true, as one can read in some sources, that Gamow promoted the term Big Bang or – even worse – that he invented it. In fact, the cosmological controversy was not really between the Steady State theory and the Big Bang theory in either Lemaître’s or Gamow’s sense, and it was even less a fight between Hoyle and Gamow.

In the American popular press the controversy over the universe was usually put in the context of Hoyle versus Gamow, which is a misrepresentation if perhaps an understandable one from a journalistic point of view. Gamow’s theory of the early universe played very little role in the predominantly British debate and Hoyle rarely referred to it. Characteristically, when the BBC arranged a radio symposium on modern cosmology in 1959, focusing on the controversy between the Steady State theory and the relativistic evolution theories, no speakers referred to Gamow’s Big Bang theory or Lemaître’s prime-



3: Web of Knowledge data showing the number of science papers with “big bang” in their title (as of December 2012). Total number 1205.
4: Number of articles or notes 1951–2011 in *Nature* (black) and *Science* (grey) with references to big bang. Not all the references are to cosmology, but the vast majority are.

val atom hypothesis (Bondi *et al.* 1959). Was Hoyle’s use of “big bang” intended to be pejorative, as stated by Alpher and Herman and numerous other authors? This is possible, of course, but the evidence for the claim is unconvincing. In the British edition of *The Nature of the Universe* Hoyle twice referred to “big bang”, and in neither of the cases in ways that were clearly derisive. Neither Gamow, Lemaître nor other protagonists of explosion cosmologies felt at the time offended by the term or paid any attention to it. Moreover, in the many reviews of the book and critical comments on the BBC broadcasts, the name for the exploding universe that Hoyle had so casually invented played no role. As a broadcaster Hoyle needed word pictures to get over technical and conceptual points, and “big bang” was just one of them. As to Hoyle himself, he considered the name an apt but innocent phrase for a theory he was opposed to. In an interview of 1989, he insisted that he had not thought of it in a derogatory sense. “I was constantly striving over the radio – where I had no visual aids, nothing except the spoken word – for visual images,” he said. “And that seemed to be one way of distinguishing between the steady-state and the explosive big bang. And so that was the language I used,” (Lightman and Brawer 1990). The non-pejorative interpretation is further strengthened by the uses of “big bang” in the cosmological debate. If Hoyle had coined the name to ridicule or disparage theories with a definite origin of the universe, he would presumably have used it frequently during the heated controversy, which he did not. After 1950, he only returned to it in 1965 (Hoyle 1965). In the same period his steady-state allies Bondi and Gold also refrained from referring to the term. Finally, the supposedly derogatory part of the name Big Bang must be “bang”, a term that Eddington had used for finite-age cosmological models as early as 1928. “As a scientist I simply do not believe that the universe began with a bang,” he said, inventing half of

the later term (Eddington 1928). No-one felt Eddington’s designation to be pejorative.

Catchy but unpopular

Hoyle’s term came to be seen as compelling and catchy, and sometimes controversial, but originally this was far from the case. It simply did not catch on in either of the cosmological camps and appeared only insignificantly in the scientific literature until the 1970s. Although no scientific paper in the early period included “big bang” in its title, the term appeared a few times in both the scientific and popular literature, and especially in American popular magazines such as *Science News Letter* and *Popular Science*. I have located 34 sources that mention the cosmological big bang before 1965. Of these, 23 are of a popular or general nature, 7 are scientific contributions and 4 are cited in the philosophical literature. The authors include 16 Americans, 7 Britons, 1 Australian and 1 German.

With the exception of one paper, all of the early references to “big bang” were brief and uncommitted. The exception was an essay of 1961 in which the eminent British–American astronomer George McVittie reviewed the Steady State theory and the Big Bang theory in equally critical terms. As he pointed out, the idea of a physical big bang was not legitimated by the solutions to the Friedmann equations corresponding to $R=0$ for $t=0$. “General relativity predicts no nuclear explosion, big bang, or instantaneous creation, for that matter, as the cause of the start of the expansion at that moment,” he said, adding that such notions were due to “imaginative writers” (McVittie 1961). He probably thought of Gamow and Lemaître. In a later paper (McVittie 1974), written after the hot Big Bang had become the standard model of cosmology, McVittie deplored the popularity of the term “big bang”, which he found inappropriate because of its association to an exploding cosmic bomb.

Only three scientists referred to “big bang” in research publications before 1965, and none

of them used the term pejoratively. Otto Heckmann, a distinguished German astronomer and cosmologist, agreed in a paper of 1961 with McVittie’s point that a big bang does not follow from either the Hubble law or the Friedmann equations. The American nuclear physicist William Fowler, a later Nobel Prize winner, worked closely with Hoyle on the celebrated theory of stellar nucleosynthesis known as the B^2HF theory (the two other contributors were Margaret and Geoffrey Burbidge). Although “big bang” did not appear in the B^2HF paper, Fowler used it in another publication of 1957. He may have been familiar with the name from his discussions with Hoyle. Also, 28-year-old Steven Weinberg, who introduced “big bang” in the pages of *Physical Review* while examining the role of neutrinos in cosmological models (Weinberg 1962), was in contact with Hoyle.

Astronomers and physicists were not the only ones to make sporadic use of the name Big Bang before 1965. Norwood Russell Hanson, a philosopher of science at Yale University, apparently liked the term which he used repeatedly in an analysis of the concept of creation in the two competing world systems. Moreover, he coined his own word for supporters of what he called the “Disneyoid picture” of the exploding early universe, namely “big bangers”. According to Hanson (1963), the difference between the big bangers and the continual creators was basically semantic, rooted in different meanings given to words such as creation and universe. However, he seriously misunderstood the Steady State theory, stating that it shared with the Big Bang theory the view that in the far past the universe was quite different from what it is now.

Revival of the Big Bang

On 21 May 1965 the *New York Times* included on its front page an article entitled “Signals Imply a ‘Big Bang’ Universe”. The occasion was the sensational discovery of a cosmic microwave background that changed the course of cosmology and effectively eliminated the already ailing

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Steady State theory. In a now classic paper of July 1965, written by Robert Dicke, Jim Peebles, Peter Roll and David Wilkinson, the discovery was interpreted as the fossil radiation from the early universe. The authors referred to the “primordial fireball”, a name suggested by John Wheeler, but not to the Big Bang. Only in 1966 did Peebles use the name, apparently identifying it with the phase of element formation in Gamow’s theory. The same year we meet the first research paper referring to “big bang” in its title, an investigation of Stephen Hawking and Roger Tayler concerning the synthesis of helium in anisotropic models of the early universe. Contrary to Peebles, they spoke of the Big Bang as the initial space–time singularity.

In the late 1960s the Big Bang bandwagon was rolling, although the name “big bang” lacked somewhat behind the bandwagon. The *Web of Knowledge* lists only 11 scientific papers in the period 1960–1970 with the name in their titles, followed by 23 papers in the period 1971–1975. On the other hand, Hoyle’s name appeared with increasing frequency in newspapers and the popular literature, in almost all cases employing the explosion metaphor that scientists find so misleading. In any case, a decade after the discovery of the cosmic background radiation the hot Big Bang theory had acquired a nearly paradigmatic status. While a poll among predominantly American astronomers in 1959 showed 33% to be in favour of the Big Bang picture, in a later poll of 1980 the figure had increased to 69% (Brush 1993). It would have been considerably higher had the poll been restricted to astronomers active in cosmological research.

The new paradigm was followed by new textbooks. In 1971 Peebles published *Physical Cosmology* and Dennis Sciama the more elementary *Modern Cosmology*, both of them solidly anchored in the now paradigmatic hot Big Bang theory and making use of the term “big bang”. Not all textbook authors felt the term attractive or appropriate. Although Weinberg had used it as early as 1962, in his advanced text *Gravitation and Cosmology* of 1972 it only appeared once. He preferred to speak of the “standard model”. Yet another important book from the early period, Yakov Zel’dovich and Igor Novikov’s encyclopedic *Relativistic Astrophysics*, avoided the term altogether. The two Russian authors based their exposition on what they called the Friedmann theory of a singular beginning of the universe, referring throughout to the “theory of the hot universe” as an alternative to the hot Big Bang theory.

Big bang outside cosmology

Astronomers and physicists naturally associate the term “big bang” with the origin of the universe. It may come as a surprise to learn that the first scientific paper with “big bang” in its title was received by the *Journal of Meteorology*

A Big Bang poem

The two Cambridge astronomers Fred Hoyle and Martin Ryle disagreed violently about the measurements of “radio stars” and their cosmological significance. The disagreement evolved into a major feud, which in the early 1960s inspired Barbara Gamow, the wife of George Gamow, to write a poem on an imagined discussion between Ryle and Hoyle (Gamow 1968). In two of the verses Hoyle speaks to Ryle:

*Said Hoyle, “You quote
Lemaître, I note,
And Gamow. Well, forget them!
That errant gang
And their Big Bang –
Why aid them and abet them?
You see, my friend,
It has no end
And there was no beginning
And Bondi, Gold,
And I will hold
Until our hair is thinning!”*

two months before Hoyle coined his memorable phrase (Cox *et al.* 1949). The subject of the paper was the meteorological effects of a large TNT explosion. Indeed, in so far that “bang” often refers to an explosion of some kind – and not necessarily a cosmic one – one should not be too surprised to read of big bangs in non-cosmological contexts. Such usage was fairly common during the Cold War period in the 1950s and 1960s, when “big bang” typically referred to nuclear weapons. What *The Economist* called the big bang in a note of 2 February 1957 was a reference to the British plan of testing a hydrogen bomb. The same connotation appears in John Osborne’s play *Look Back in Anger*, which was first performed in 1956. Jimmy Porter, a young disaffected man of working-class origin, says: “If the big bang does come, and we all get killed off, it won’t be in aid of the old-fashioned, grand design. It will just be ... as pointless and inglorious as stepping in front of a bus.”

With the paradigmatic status of hot Big Bang cosmology in the last quarter of the 20th century, Hoyle’s old name finally caught on. And yet the number of scientific papers referring to “big bang” remained low until about 1990, after which it increased drastically. The *Scopus* database includes 4077 papers from 1960–2012 with “big bang” in title, abstract or key words, of which 3673 are in the physical sciences. The corresponding figures for 1960–1989 are 422 and 404, respectively. Another way of illustrating the popularity of the “big bang” term is to search for it in the databases of journals such as *Nature* and *Science*. As a result of the popularity of the name in cosmology, and of cos-

mology’s wide appeal, since the 1980s the term began to appear in many other contexts as well.

About 10% of all academic articles relating to “big bang” appear in articles outside the astronomical and physical sciences, in particular in biological and economic studies. Thus, the Tunguska event in 1908 has been described as “Siberia’s big bang”, and biologists sometimes speak of the sudden appearance of life forms in the Cambrian era almost 600 million years ago as “biology’s big bang”. Likewise, the big bang metaphor has been used extensively in discussions of how to transform centrally planned economies into market-oriented ones, as in the cases of China and Eastern Europe. Today the big bang label is also used in a variety of commercial, cultural and artistic contexts that has only the name in common with the cosmological meaning of the term. Numerous music albums, television series, films, comics, sport events and commercial products of all sorts carry the name that Hoyle casually coined in 1949.

Many people feel that “big bang” is an unfortunate name, not only because of its association with a primordial explosion, but also because it is such an undignified label for the most momentous event ever in the history of the universe. When *Sky and Telescope* ran a competition in 1993 to find a more suitable name, the judges received no less than 13 099 responses. None of them were found worthy of supplanting Hoyle’s “inappropriately bellicose” name (Beatty and Fienberg 1994). It had stuck – like a harpoon. ●

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