S|S|S

Sound Studies:

New Technologies and Music

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Developments in sound technologies over the last 50 years have dramatically changed the way that music is produced and consumed. In the 19th century most music was experienced as live performance. Today most music is listened to individually through technologically mediated devices, such as a personal stereo or a personal computer that enables the downloading of MP3 files over the Internet, and in the past few decades music has been produced with new electronic instruments such as the Theremin, the Hammond Organ, the electric guitar, the synthesizer, and the digital sampler. Technologies such as the phonograph, tape-recorder, and compact disk have enabled 'sound' to be produced, controlled, and manipulated independently from musicians. In today's recording studios the sound engineers can be as important in the production of 'the sound' as are the musicians themselves. But how can such changes be understood and what do they mean for listeners and for science and technology studies (S&TS)?

The papers in this special issue address such issues. The papers were first presented at an international workshop, 'Sound Matters: New Technology in Music', held at the University of Maastricht, the Netherlands, in November 2002. The scholars at the workshop were drawn from such diverse fields as ethnomusicology, history, anthropology, cultural studies, sociology, and S&TS. All were working on some aspect of what we might call 'auditory culture'. For such scholars, sound matters.

The topic of the workshop was new technologies and music. The papers covered a range of technological innovations in the way in which music was produced and consumed. These included new instruments, such as new varieties of electric guitars and violas; new means of manipulating and controlling sound in the studio, such as microphones, reverberation units, mixing consoles, and new forms of networking software; new forms of technologically mediated listening, such as audiophilia,

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mobile listening in cars and via personal stereos; and the emergence of new genres such as sampling-based world music. There was agreement that none of the standard disciplinary approaches were alone adequate. In the spirit of interdisciplinary learning, scholars set aside their own perspectives to see what other approaches could bring to bear. This was sometimes frustrating, but often rewarding. At moments it seemed that the topic was impossibly large and complex with very little known. Whole areas of music technology and vast areas of listener experience remain completely uncharted. Occasionally we experienced that giddy feeling of seeing how the different parts might fit together – glimpses into the new vista that awaited us. There was agreement that we had stumbled upon a new and rich area, and this collection represents the first tentative advances into the territory.

This territory can be thought of as part of the wider field of what we shall call 'Sound Studies'. Sound Studies is an emerging interdisciplinary area that studies the material production and consumption of music, sound, noise, and silence, and how these have changed throughout history and within different societies, but does so from a much broader perspective than standard disciplines such as ethnomusicology, history of music, and sociology of music. Exemplary work in sound studies would include: Murray Schafer's pioneering notion of soundscape (see later); James Johnson's study of how audiences learned to listen to opera in a new way in Paris after the French Revolution and thereby produced the bourgeois listening audience (Johnson, 1995); and Christopher Small's notion of 'musicking' to capture how any form of music demands its own set of material performance and listening practices (Small, 1977).[1] What S&TS can contribute is a focus on the materiality of sound, its embeddedness not only in history, society, and culture, but also in science and technology and its machines and ways of knowing and interacting.[2] As Jonathan Sterne correctly claims in his recently published *The Audible Past*, there 'is a vast literature on the history and philosophy of sound; yet it remains conceptually fragmented' (Sterne, 2003: 4). But with this collection we hope to show that S&TS has a contribution to offer, over and above the more mainstream disciplines that investigate musical culture.

The papers in this special issue do not claim to provide a complete overview or to represent all of the current perspectives towards sound, music, and new technology. We believe the collection as a whole shows how this topic is relevant to S&TS, and we hope to encourage others to take advantage of the new research opportunities. Although there has been some previous interest in the area, there has been little sustained scholarship. For several of the participants at the workshop it was their first encounter with S&TS. In preparing the papers for this collection we have pushed scholars unfamiliar with relevant work on S&TS to read into the field and try and enter into a dialogue with S&TS approaches. Similarly those scholars working from within S&TS have tried to push their frameworks to learn from the other disciplines.

Sound Practices

S&TS's engagement with the auditory dimension can be thought of as an extension of the field's continued examination of the detailed material practices that constitute technoscience. Over the last two decades some of the most exciting work has focused on the minutiae of the visual practices and techniques of scientists (Lynch & Woolgar, 1990). Diagrams, drawings, graphs, photographs, and pictures are at the heart of the technoscience enterprise. The world of the scientist and the technologist and indeed the world of those who consume its ideas, products, and innovations can be treated as a visual world. Scientific instruments, for which Latour & Woolgar (1979) used the felicitous term, 'inscription devices', are often designed to render the world visually, to provide what Lynch (1990) has called the 'externalized retina' that guides scientific inquiry. What gets visually represented in what form and by what means, and how such visuals are read and transformed are key questions. What we might call the 'visual paradigm' has come to dominate S&TS and the humanities and social sciences in general.

But if the scientific laboratory is a visual world it is also a place where other senses play a role. Here we are concerned with sound. Scientists talk to each other and to other people in the laboratory (for example, technicians, administrators, and students); scientific instruments make noises (vacuum pumps and centrifuges whir); fax machines, computers, printers, and photocopiers hum and beep; solutions gurgle; tea and coffee bubbles; radios play in the background; and ambient noise is everywhere (Mody, 2001). If the visual dimension is part of material practice then so too is the world of sound. We who enter the laboratories to observe must also be prepared to listen.

In doing sound studies, however, it is nearly impossible to escape from the visual. Visual metaphors dominate our language – as we said earlier in this introduction we *see* the new *vista* of sound studies but don't hear it! The visual is the known – we have ways of dealing with it, talking about it and studying it. The auditory is the unknown, the unfamiliar, the new – it is the stranger knocking at the door threatening to disrupt the world. It is perhaps inevitable that, at least to begin with, we will *see* this new world rather than *listen* to it. More significantly, the world of scholarly publication is a world where visual technologies and modes of representation still predominate. Books and academic papers can easily reproduce visual images but not sounds. If the sounds themselves cannot be reproduced, then an even greater premium is placed upon the language used to describe and represent auditory phenomena. How does one describe the sound of a Steinway piano or a Moog synthesizer? Part of the difficulty that surfaced at the workshop was that different disciplines have evolved their own specialist languages for describing sound. Musicologists have evolved a highly technical language to describe music, working musicians use yet another language as do listeners and studio engineers. Then there are the social sciences parasitic upon this auditory culture: a conversational analyst

will transcribe a tape of the same auditory phenomenon in a different way from a socio-linguist – other analysts will focus upon yet other aspects.

There are many overlaps to be found with the auditory dimension in the history of science. There is a long and intimate connection between mathematics and music – it was Pythagoras who first realized that musical overtones occurred in ratios of rational numbers (Hankins & Silverman, 1995). Helmholtz, perhaps more than any other scientist, saw the deep insight that could be gained by studying sound and music as a means to understanding other physical phenomena (von Helmholtz, 1895). Musical instruments have been significant for the development of scientific instruments and scientists have made important contributions towards understanding and building better musical instruments and have contributed to projects such as the standardization of pitch (Jackson, 2003). But it is not just in the physical sciences – in fields as diverse as animal behavior and seismology, sound has been a key means to study the world. As we move into the 21st century the connections get ever more deep. Whole areas of instrumentation and parts of science depend on sound. For instance, sonar has revolutionized oceanography. Indeed sonification as a means of presenting results through sound rather than viewing results is a hot new topic in science. As Emily Thompson (2002) has powerfully shown, the development of acoustics in the 20th century took place hand-in-glove with architecture and new technologies, such as loudspeakers, which transformed the public spaces in which sound was experienced.

It is the study of technology that provides probably the most direct link between sound and music and the concerns of S&TS. Musical instruments can be thought of as technological artifacts. As Bob Moog the veteran synthesizer designer has commented, 'Musical instrument design is one of the most sophisticated and specialized technologies that we humans have developed' (Pinch & Trocco, 2002: v). The musicians who perform on such instruments are, in effect, the users of the technology. Many instrument-makers, such as Moog, see fine-tuning the interface between users and the technology as the key to an instrument's success. Musical interfaces indeed have been influential on the design of other human–machine interfaces. Both the typewriter and the computer mouse have been shaped by the musical keyboards that formed their earliest templates (Bardini, 2000).

Musical Instruments as Technological Artifacts

Thinking of musical instruments as technological artifacts with unique user communities brings sound studies within the domain of technology studies. In technology studies the call has been made to open up the black box of technology; to study how specific designs are shaped by amalgams of social, cultural, and economic factors, and how society, culture, and economics are in turn shaped by technology. There are now many studies that show the co-construction or co-production of technology and society. Users of technology have also gained increasing attention (Oudshoorn & Pinch, 2003). Woolgar (1991) has argued that users are 'configured' by

technologies and Akrich (1992) has suggested that technologies, like texts, have users' scripts embedded within them. Taking a cue from Wittgenstein, who famously argued that the way to understand language is from its use, Pinch and Trocco, in one of the most comprehensive studies from the perspective of S&TS of the evolution of a musical instrument (the synthesizer), have suggested that, 'the way to understand the meaning of an instrument is in its use by real musicians – in state of the art recording studios and home basements, on the stage and on the road' (Pinch & Trocco, 2002: 10). This means we must 'follow the instruments' in the same way that in the early days of S&TS we learnt to 'follow the actors'. It is the strategy adopted by Steve Waksman in his paper in the special issue, where he describes how tinkering with guitar designs can be tied to the special sound of two very different genres of music in the Los Angeles area – hard core punk and heavy metal (Waksman, 2004). The importance of tinkering by young men is a theme familiar from the story of radio and the synthesizer. Waksman shows the intimate links between use, design and manufacture as guitarist Eddie Van Halen moves from 'user as tinkerer' to become a guitar designer who eventually manufactures and sells his own customized instruments. Such guitars and their special sounds are marketed to still capture the mystique of the inveterate tinkerer and guitar virtuoso embodied in the persona of Eddie Van Halen.

Studying the evolution of musical instruments can tell us much about music as a form of culture. Musical instruments are used within highly developed and circumscribed social and cultural environments. Rock genres such as hardcore punk and heavy metal require performers, audiences, and listeners alike to partake in a highly ritualized form of cultural production and reproduction. Cultural conventions within a genre often hamper innovation, but on occasions the introduction of a new instrument or adaptation of an old instrument can be an opportunity to transform musical culture. One only has to think of Jimi Hendrix's use of feedback and how it transformed the genre of rock music by turning the guitar from an electrified acoustic instrument into a new source of pure electronic sound (Waksman, 1999; McSwain, 2002). What is often at stake in such cultural transformations is the very demarcation between noise, sound, and music (and indeed silence). The works of experimental composers like John Cage, the earlier introduction of the noise machines by the Futurists (Bijsterveld, 2002), and the introduction of new instruments such as the player piano and the synthesizer provided many such instances of such contestations (Pinch & Bijsterveld, 2003).

Perhaps the most circumscribed genre of all is the world of classical music that Karin Bijsterveld and Marten Schulp write about in their paper in this issue (Bijsterveld & Schulp, 2004). On the face of it the instruments of the classical orchestra have evolved hardly at all. The actors involved have well-defined roles whether as teachers, composers, players, instrument makers, or engineers. Moreover, institutions like orchestras, conductors, concerts, and the conservatories that train musicians have changed little over time. The classical repertoire also displays a remarkable

stability – certainly compared with anything in the rock genre studied by Waksman. How do innovations in instruments then come about in this conservative and stable world: are they accepted and for what sorts of uses? Bijsterveld and Schulp conduct interviews with instrument-makers to answer these questions. Their paper draws attention to how successful innovators rephrase or repackage tradition in a new way. They also draw upon an idea that is gaining some currency in S&TS – the importance of intermediaries or as they call it 'the go betweens'. It was people at the crossroads of their profession who most stimulated the instrument-makers to innovate. The world of musical instruments is full of such intermediaries or 'boundary shifters' (Pinch & Trocco, 2002: 313–14). In Pinch and Trocco's study of the synthesizer they found it was engineers' and musicians' abilities to morph between or 'shift' boundaries that enabled the worlds of design and use to be bridged.

As well as telling us something about musical innovation, these studies on the introduction of new instruments also contribute to the wider field of sound studies. The introduction of new technologies and instruments provides a way of probing and breaching the often taken for granted norms, values, and conventions of musical culture (Pinch & Bijsterveld, 2003). Issues such as virtuosity and creativity become contested: is it the performer or is it 'merely' the instrument that makes the innovation? The shifts back and forth between attributions of human and non-human agency and the debates they have garnered are familiar grist to the mill of S&TS scholars. The introduction of new instruments also makes visible the specific innovation strategies adopted and the roles of key actors like users and intermediaries.

The Studio: Tacit Knowledge and the Materiality of Sound

Sound technologies, of course, involve far more than musical instruments. Indeed the significance of any individual instrument has been dwarfed in the 20th century by the dramatic changes in the way that music is recorded, stored, and consumed. Detailed histories of the recording studio – including the many technologies involved, ranging from mixer consoles to reverb chambers and the role played by key personnel like recording engineers and record producers – are only just beginning to emerge (Day, 2000; Morton, 2000; Chanan, 1995). Susan Schmidt Horning has carried out one of the first such histories, and in her paper she documents how the studio effectively became a musical instrument in its own right as audio engineers managed to get ever better control of the ability to manipulate sound (Horning, 2004). Horning's paper focuses upon the neglected group of studio engineers and through her oral histories she describes what their skills and training were, how they worked with the new recording technologies, and how they emerged as a professional group. One science studies theme of her paper is tacit knowledge. The first studio engineers learnt on the job by trial and error, but soon they developed specific tacit skills like miking – the placement of microphone. Studio engineers have

always depended on their ears but with more and more technology at their disposal their listening skills became mediated via the vast array of new sound equipment. It provided them with as it were 'externalized ears', an aural field analogous to Lynch's externalized retina in the world of visualization.

Another relevant theme for S&TS is the role of space in the construction of specific sorts of sound in the studio and the evolution of standardized sound. Studio engineers, whether through miking, reverb, or mixing, are engaged in reconfiguring the sonic space of the studio. To do this effectively engineers build up not only tacit skills, but also a vocabulary to describe sound. As Tom Porcello shows in his paper in this issue on how neophytes acquire studio skills, the language of sound has become highly nuanced, often mixing up technical terms with local knowledge (Porcello, 2004). His transcriptions of live studio sessions show how the language of studio sound can reinforce hierarchies between 'insiders' and those who are still learning.

As studio engineers became more adept at manipulating sound, certain sounds started to become standardized. Sometimes these sounds were associated with one place or one studio, such as the famous Nashville sound; sometimes with a particular producer, such as Phil Spector's 'wall of sound', and sometimes with particular musicians, groups, or instruments. How sounds get recognized and reproduced and thereby standardized is a complex topic and depends not only on local configurations of technology and skills within studios (and in record cutting and pressing), but also upon a global recording industry which enables certain kinds of sound to travel and become the 'standards'. Both Porcello's and Horning's papers point to elements in this complex process of standardization.

The theme of reconfiguring sonic space is pursued in Paul Théberge's paper, as he follows the studio into its futuristic guise as the 'network studio' (Théberge, 2004). Théberge traces the history of the studio and shows how it becomes a particular sort of 'non-place'. The latest network technology promises to remove all aspects of local space from recording as musicians anywhere in the world in any time zone can in theory network together to record music. Théberge shows how this ideology of a non-space has emerged over time. He argues that the notion of a non-space actually arises from very specific configurations of technology and skill. He shows how studio devices like mixing consoles were important as means for reconfiguring the spatiality of sound. The introduction of the computer into the studio was another key moment as the process of recording became digitized. He follows software companies as they vie for control of the future direction of recording.

Listening

The remaining paper in this special issue, by Marc Perlman, deals with how new audio technologies have contributed to shifts in modes of listening (Perlman, 2004). Since his paper on the face of it seems far away

from the concerns of S&TS we need to delve a little more deeply into the field of sound studies to show how it relates to those concerns.

The notion of a 'soundscape' is a key concept in sound studies. The Canadian composer and environmentalist Raymond Murray Schafer coined the term in the 1970s (Murray Schafer, 1994 [1977]). It refers to our sonic environment and includes not only the 'natural' environment of sounds, such as waves breaking on a beach, but also compositions and sound sculptures which fill spaces such as gardens with sounds that invite people to listen. 'Soundscape' is perhaps an unfortunate term, because its resonance with visual landscapes suggests a static perspective rather than the moving and surrounding characteristic of most sounds (Rodaway, 1994: 86–87). Yet Jonathan Sterne is right in stressing that ephemerality is not 'a special quality of sound': both visual and auditory experiences are ephemeral (Sterne, 2003: 18).

Murray Schafer's goal was to 'map' historical and contemporary soundscapes. His famous World Soundscape Project had an environmental focus, drawing attention to new sounds as well as those that had vanished. Just as whole classes of animals and plants had become extinct, Murray Schafer and his colleagues claimed that 'man' had lost a pre-industrial 'hi-fi' sonic environment, in which signals had been clearly audible. In contrast, in today's industrial 'low-fi' soundscape individual sounds are masked and overcrowded. One of the problems of the modern soundscape is 'schizophonia': 'the split between an original sound and its electro-acoustic reproduction'. Echoing Walter Benjamin's famous argument that works of art in the age of mechnical reproduction become detached from their 'aura', Murray Schafer argued that: 'Original sounds are tied to the mechanisms that produce them. Electroacoustically reproduced sounds are copies and they may be restated at other times or places. I employ this "nervous" word in order to dramatize the aberrational effect of this twentieth-century development' (Murray Schafer, 1994 [1977]: 273).

Whereas Murray Schafer, true to the critical and gloomy atmosphere of the 1970s, underlined the alienating effect of the separation of original sounds from their reproduction, recent contributions to sound studies offer a more optimistic view in which there is the possibility of control over one's sonic accompaniment to daily life. In this historiography, the story starts at home. As Susan Douglas has stated in her influential book on the history of radio culture, *Listening In*, radio, because it made music available to people at all hours of the day or night, helped to make, 'music one of the most significant, meaningful, sought after, and defining elements of day-to-day life, of generational identity, and of personal and public memory . . .' (Douglas, 1999: 83).

In the 1920s, for instance, radio enabled the middle classes to escape the 'crowding and shoving, the unwanted advances, the noise, the often foul smells of small theater' and sustained their increasing desire for 'security, ease, and privacy of the home during leisure hours' (Douglas, 1999: 65). Over time, radio cultivated amongst Americans different repertoires of listening – distinguished from hearing by the activity involved. The

key to understanding the significance of radio was, according to Douglas (1999: 65), that most 'people listen to music to enhance, or travel to, a particular mood. . . . . This is one reason why the development of "formats" in radio became so successful – when people turn to the "country and western" or "modern rock" or "sports" station, they know exactly what moods and feelings will be evoked and stroked'. This suggests that unlike Murray Schafer's passive consumer of soundscapes, listeners are 'active' in seeking out particular sonic experiences.

The advent of home recording in the 1960s continued to encourage active listening. The open-reel recorder was first introduced in the late 1940s (Morton, 2000: 11). But this was a cumbersome and expensive device and it was not until the development of cheap transistorized tape-recorders (particularly the Philips compact cassette recorder introduced in 1962) that the culture of re-recording music albums and singles for personal use took off. The rise of rock-and-roll youth culture and 'patterns of mobile music listening' (Morton, 2000: 12), which had, in turn, been enabled by suburbs and the automobile, provided an added stimulus. The gramophone, the radio, the tape-recorder, the compact cassette recorder and the miniaturized personal stereos such as the Sony Walkman have all contributed, to quote Tia DeNora (echoing Foucault), to music 'as a technology of self'. According to her the 'ostensibly "private" sphere of music use is part and parcel of the cultural constitution of subjectivity, part of how individuals are involved in constituting themselves as social agents' (DeNora, 2000: 47). DeNora (1999, 2000) gives many examples of people using music as a resource to change or sustain their mood, to heighten energy levels, to keep themselves going, to relive past events, or to concentrate.

Michael Bull (2000) has carried out one of the first extensive ethnographies of listening practices with his studies of personal stereo use. He shows how people listening to music while on the move can aim to block out external sounds, pretend to be outside crowded urban space, choose their sound accompaniment, and create a 'filmic' experience, thus aestheticizing their environment. They may become absorbed with the flow of their memory, order their thoughts, have a sense of companionship, exercise control over their contact with others ('do not disturb'), make time pass more quickly, and make daily routines bearable. In all cases, they create 'their own personal soundscape placed directly between their ears' and 'reimpose control over the environment' (Bull, 2000: 186). Bull's contribution to the recently published anthology *The Auditory Culture Reader* (Bull & Back, 2003) deepens this line of research by studying the use of personal stereos *and* audio players while on the move (walking, biking, and driving, in streets, trains, subways, and cars). He shows the multifold way in which users actively reorganize public and private realms through these technologies. One overall message from his work is that music technologies are tools for choice and control in the management of daily life. This blends well with S&TS ideas as users as active consumers of technology.

Users of these mobile sound technologies can, in effect, reconfigure the social geography of cities.

The theme of listeners is developed in Marc Perlman's paper, which reports on an ethnography of audiophiles (Perlman, 2004). These are listeners (mainly white, middle-class men) who invest large sums of money in purchasing dedicated audio equipment for extreme hi-fi listening to recorded music. Often these audio 'set ups' have their own special spaces in homes – typically the basement. Perlman differentiates between two different groups of listeners: the 'golden ears' and the 'meter readers'. The former eschew science and audio engineering in favor of their ears and will often invest in equipment which they claim boosts fidelity, but which from the strict audio engineering viewpoint appears to work by black magic. The meter readers on the other hand are obsessed with scientific and technical criteria for measuring and understanding sound. Perlman describes the listening practices of audiophiles as carried out in the construction of what they call 'absolute sound'. He shows the different ways in which the two main groups of audiophiles legitimize their preferences for certain sorts of sounds. Intriguingly these listeners negotiate the boundary between what counts as legitimate science and pseudo science as part of their pursuit of different routes to absolute sound. Perhaps the larger point to be gained from Perlman's paper is that by embedding sound in a highly controlled sonic environment, listeners reassert their own control over sound.

Audio and recording technologies can be seen as adding a new chapter to the history of technology, thereby returning us to the long-standing S&TS tradition of studying 'cultures of control'. The history of technology can be presented as a struggle over control. Technology was initially used to control nature, and later this control was extended to machines and large technological systems. The post-1945 years were dominated by the idea that technology was 'out of control' – that is, until command, control, and information systems created a new culture of layered control (Hughes, 2000: 6). New audio and recording technologies, however, have enabled people to reestablish some control over their direct sonic environment (though not necessarily over the music made) and thereby other aspects of daily life, in a crowded, urban world dominated by technologies usually not within the control of the ordinary citizen.

At the very same time, we should like to stress that such a possibility of control over private auditory space with help of audio and recording technologies is far from self-evident. Jonathan Sterne, for instance, claims that the practice of listening in private auditory space was not so much the result of the capitalization and commodification of sound by sound-media industries, but of earlier audile techniques developed by doctors employing their stethoscopes and telegraphers using 'sounders'. Sound-reproduction technologies only 'disseminated and expanded these new technical notions of listening through their own institutionalization' (Sterne, 2003: 98). Moreover, the very idea that recording technologies produce a copy of the original sound had to be constructed through so-called tone tests and other means (see also Siefert, 1995; Thompson, 1995). Furthermore,

musicians had to behave differently for the microphone so as to create fidelity (see also Chanan, 1995). Yet this resulted in a practice through which consumers can listen to their personal set of sound 'copies' at almost any time and any place.

The world since the industrial revolution has become more and more noisy. Social movements such as noise abatement societies (Bijsterveld, 2001; Thompson, 2002) form an important part of the landscape of modernity. How noise is experienced, measured, and responded to and what 'silence' means and how it is produced are key parts of the terrain for 'sound studies'. Today's noisy world is even more complex as mobile sound technologies such as the personal stereo and car stereo enable people to regain some control over their sound environments and at the same time provide an unwanted source of noise nuisance for others. The problematic of noise with which Murray Schafer began takes a new form when we pay attention to the introduction of audio and recording technologies at home and elsewhere (Bijsterveld, 2003).

Overall, the papers in this special issue contribute to our understanding of the dominant place of music in contemporary life and of technology's role in it. They show that sound studies and S&TS share some problematics and that each can be enriched by the other in what we hope will be a continued dialogue. Sound and listening matter!

Notes

1. Other examples are Corbin (1999), Folkerth (2002), Kahn (1992, 1999), Smith (1999), and Sterne (2003). See also Bull & Back (2003).
2. See, for instance, Braun (2002), Douglas (1999), Jones (1992), Hennion (1989), Kraft (1996), Pinch & Trocco (2002), Siefert (1995), Taylor (2001), Théberge (1997), Thompson (1995, 2002), Waksman (1999), and Sudnow (2001 [1978]).

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