Fifty years of electronic music in Israel

ROBERT J. GLUCK

University at Albany, PAC 312, 1400 Washington Avenue, Albany, New York 12208, USA
E-mail: gluckr@albany.edu

The history of electronic music composition, technologies and institutions is traced from the founding of the State of Israel in 1948. Core developments are followed beginning with the founding generation including Joseph Tal, Tzvi Avni and Yizhak Sadai, continuing with the second and third generations of musicians and researchers, living in Israel and the United States. The institutional and political dynamics of the field in this country are explored, with a focus on the challenges of building an audience and institutional support, as well as prospects for the future.

1. INTRODUCTION

For a small country, Israel's electronic musical heritage is historically long and musically diverse. This should not be surprising given Israel's identity as a magnet for Jews from many cultures and geographic locations. The heritage of electronic music in Israel is as old as the State itself. Israeli independence in 1948 coincided with Pierre Schaeffer's initial experiments, in Paris, with *musique concrète*. This emerging body of work made its way to Israel within a decade, when it was first publicly presented on Israeli radio. Ironically, Israel's first electronic music pioneer, Joseph Tal, was among those who experimented, in Germany in the 1920s, with the use of electricity to generate sounds. The pre-State period and the pre-history of electronic music are thus linked as well.

Since electronic music first developed internationally as an expansion of European and, subsequently, American musical ideas and vocabulary, it is not surprising that the first Israeli works in this medium would also reflect movements in those locales. Important influences included the Parisian *musique concrète* of Pierre Schaeffer and its integration, pioneered by Edgard Varèse, with the German approach to electronically generated sounds. New possibilities were opened up when Joseph Tal toured the studios of Europe and New York, Tzvi Avni encountered the Columbia-Princeton Electronic Music Center in New York, and Yizhak Sadai visited Schaeffer's GRM studio. The reception at home was, however, less than welcoming and accepting.

2. JOSEPH TAL (1910–)

Composer and educator Josef Tal, née Joseph Gruenthal, is universally acknowledged as the founding figure of electronic music in Israel. Born in present-day Poland, Tal studied during his teen years at the Staatliche Akademische Hochschule fur Music in Berlin. Among his teachers was Paul Hindemith who, he recalls, 'pointed me in the direction of electronic music' (Tal 2003), specifically to the studio of engineer Friedrich Trautwein, best known as inventor of the Trautonium, a synthesizer prototype created in 1928. Tal was one of a handful of students at the lab who 'learned electronics theory, to create, measure and do experiments . . . creating sounds, but not yet music, using electronic tools (vacuum tubes)' (Tal 2003). Tal never worked directly with Trautwein, but he was involved in the life of Trautwein's studio during the period when the Trautonium was coming to fruition. The studio was equipped with sound generators, wire recorders and other devices and its goal was the emulation of acoustical instrument sounds.

Tal arrived in Israel in 1934. He did not continue his involvement with electronic music until the late 1940s. As he notes, 'We didn't have access to electronic instruments to produce sounds and there was no [perceived] need for them by the public' (Tal 2003). Tal became active as a composer and teacher of composition and piano at the Jerusalem Academy of Music, at its founding in 1936. It was renamed the Israel Academy of Music and Dance in 1948, when Tal became its director. He remained there through 1952. Tal's early compositional style was a point of some controversy, due to his departure from – and criticism of – the so-called 'Mediterranean school' favoured by many Israeli composers at the time. This was an approach pioneered by Paul Ben Haim and other composers, who set traditional Middle Eastern Jewish melodies within a European, often Impressionist, harmonic vocabulary. For this reason, Tal observes that he was viewed as an 'enfant terrible'.

Tal remained rooted in European music, at times composing using dodecaphonic techniques. Over the course of his career, his works have included music for choir and orchestra, ballet and opera (often on biblical themes), music for solo instruments including piano, harp, woodwinds, strings and brass, music for orchesra, percussion ensemble, accompanied voice and other instruments, chamber music and music on

electronic tape. His eclectic music has been described as 'broad dramatic gestures and driving bursts of energy generated, for example, by various types of ostinato or sustained textural accumulations . . .' (Ringer 1980).

2.1. Tal returns to electronic music

Tal re-engaged with electronic music after visiting Europe, shortly after World War II:

> I received a UNESCO fellowship for research in electronic music and I travelled to the studios cross Europe and America and I learned what there was to learn. When I returned home, I brought with me a tape recorder, which was a source of great interest and excitement to people. Slowly I hired engineers interested in the field to conduct experiments in creating sounds.

Through his efforts, the Israel Center for Electronic Music at the Hebrew University was founded. A work of Tal's, an oratorio with electronic tape, became the first electronic work to be broadcast on Israeli radio, most likely in 1959 (Avitsur 2003). One of his former students, composer Reinhard Flender recalls Tal's thinking about the nature of electronic music:

> To Josef the sound produced by a Moog synthesizer was absolutely equal to the quality of a traditional instrument (e.g. Violin or Cello). He was very philosophical in his approach to electronic music. It was somehow clear to him that it [electronically generated sound] was the highest level of sound production because it had overcome all limits of a traditional instrument in terms of speed, colour, pitch, etc. He contradicted with all the authority he had my theory that a sound produced by a musician was fundamentally different from a sound produced by the turning of the button of a synthesizer. For him the production of electronic music was in no way different from playing the piano. The only difference for him was that in electronic music the composer is united with the performer. It is a way of direct communication between composer and audience without the intermediary state of notation and interpretation of the written score. (Flender 2005)

Tal speaks of having been the beneficiary of unfriendly criticism for his electronic compositions and organising efforts. He saw himself as a lightening rod for public reluctance to accept electronic music:

> I had the patience to get hit by all the stones at my head [he patiently received all of the criticism]. [At one point,] I played a concert for piano and electronic music in one of the festivals. The [news] papers objected. There was a front-page article the next day with the title 'Terror . . .' (Tal 2003)

Others received his work approvingly. Tal credits the positive response, especially by students, as a consequence of a policy in Israeli high schools that allowed students to invite visiting lecturers to speak on subjects of special interest. Exposure to forward-thinking

musicians set the groundwork for greater openness to electronic and new music. Fellow composer Tzvi Avni (2003: 1) considers Tal's best-known works to be his two concertos for piano and tape, a harp concerto, and the opera *Masada* for tape and singers. He has been awarded many prizes at home and abroad, including the Israel Prize (1971), Arts Prize of the City of Berlin (Germany, 1975), Johann Wenzel Stamitz Prize (Germany, 1991), and others.

With respect to his identity as an Israel composer, Tal observes:

> . . . I don't think that a national expression ends with a quotation of old music. There are national elements and there is the behaviour in the street, how the people behave. What's their morality? What is their degree of aggression? And so on. And this is a nationality. This should come out in the music, you see, because I live it and I'm confronted with it day by day. If you start now to translate those things, then already you are on the borderline between language and music, common language and music language. Because to speak about music in itself is principally an impossibility . . . if I wouldn't have decided to go to Palestine in the early 1930s or would have gone to London or new York, I don't think I would have written the same music . . . there would be the same elements of twelve-tone music in it, or electronic music, or any other thing . . . my environment is not only Israeli, my environment is absolutely international . . . So I am a member of the whole world, but I am living in a certain country, which is called Israel and very near to all that interests us – our fight in life, our struggle in life. And this certainly comes out in the music, no matter if it is written for piano or for electronics, or for whatever you want. (Tal 2003)

Tal continues to consider issues about electronic music. Among his interests is effective and replicable scoring of electronic music, work that has been presented at the 1988 and 1992 International Computer Music Conferences (Shimony, Markel and Tal 1988; Shimony, Gerner, Markel and Tal 1992). He recently published an extended essay, 'Musica Nova in the Third Millennium' (Tal 2002), addressing the gradual development of timbre as a musical organising principle through the history of Western music.

2.2. The Israel Center for Electronic Music at the Hebrew University

In 1958, Tal visited the studios of Europe and the United States facilitated by the Institute of International Education, affiliated with UNESCO, which provided a grant to support the six- month trip. As his travels drew to a conclusion in New York City, Vladimir Ussachevsky spoke of a new invention by Canadian instrument-designer and composer, Hugh Le Caine (1914–1977), the 'Multi-track'. This was an instrument designed to facilitate composing using the *musique concrète* techniques of Pierre Schaeffer in

Paris, by which recorded sounds on tape would be transformed by playing them back at different speeds and direction and using cutting and pasting; multiple layers of such sounds would then be mixed together.

Tal was intrigued by this new instrument, which he described as 'an ingenious construction because of the very rare combination of technique and imagination. It should be the nucleus of the professional equipment for the electronic music composer' (Young 1996). The Multi-track, invented in 1955,

> was able to play six tapes simultaneously, changing the playback speed of each tape independently and recombining the resulting sound into a single recording. The tapes were played on a single capstan at the left of the instrument while the speeds were controlled by a three-octave keyboard on the right'. (Young 1999)

> Keyboards provided convenient and immediate methods of controlling the instrument, as they could be easily operated by musicians and the pitch changes produced in the pre-recorded sounds exactly matched those of the standard keyboard. Playing an octave on the keyboard would double (or halve) the playback speed and the sound would rise (or fall) by an octave. (Canadian Science and Technology Museum 2004)

Tal immediately began conversations with Le Caine towards purchasing a Multi-track (Young 1996:

> By the end of August negotiations were underway for NRC to build another Multi-track for Tal's new studio in Jerusalem. An NRC memo outlined the estimated cost of a new Multi-track at $1000 in materials, 500 hours of machine shop work, and 200 hours of electrical work. This turned out to be an optimistic estimate. The memo continues: 'Our electronic music project has reached an important and critical phase in its development. Serious musicians are taking an interest in it for the first time. Both Arnold Walter and Josef Tal want to open studios with the Multi-track as central instruments.

Tal initially lacked the funding to build an Israeli electronic music studio where he could continue his work. He was fortunate to gain the interest of instrument inventor, Canadian engineer Hugh Le Caine, after some successful fund-raising by Shalhevet Freier (Ringer 1980). Freier was a physicist and government leader closely associated with Shimon Peres and later, Vice President of the Weizmann Institute of Science and the son of Recha Freier, founder of the important new music festival, Testimonium, discussed below. Tal remembers Freier with admiration and appreciation:

> He was an extraordinary man – one of a kind. His whole family was very special. Shalhevet helped organise and find support, people and money for the Jerusalem studio, but this was for him a personal initiative and not an official role. He was very helpful. He was very interested in electronic music and without him there would be no studio in Jerusalem. (Tal 2004)

With Freier's support, Tal purchased Le Caine's early electronic keyboard instrument, the Multi-track. Despite hopes that it could be constructed and delivered by the end of 1959, it was not ready until May 1961. This particular version used a combination of vacuum tubes and transistors, which had recently been invented. Tal's new studio was the Electronic Music Center, founded in 1961. Additional equipment was funded through his UNESCO fellowship, which Tal (2003) notes '[was all at] my initiative'.

Setting up the Multi-track and the rest of the studio did not prove to be a simple matter. After acknowledging the arrival of the new device, in October 1961, Le Caine received a November telegram from Tal alerting him that there were problems:

> Tal reported that the 'engineer wants to know if it was tested before shipping'. Le Caine immediately wrote a five-page letter outlining several testing procedures to determine whether all the bolts were tight, all the cables were moored, and the vacuum tubes and fuses were in operation. After several weeks during which the Multi-track was still not operation, it was decided that Le Caine would have to go to Israel himself to repair the instrument. He and his wife arrived in Jerusalem on February 19, 1962, and stayed for two weeks. They were well received in Israel, given official dinners and tours of the city, but Le Caine barely noticed these things. He was totally preoccupied with the Multi-track, which he had found in pieces on the floor of an almost empty room that was the electronic music studio. (Young 1996)

It became clear to Le Caine that Tal personally lacked technical expertise nor had sufficient technical support at his disposal. Gayle Young notes that 'Le Caine had to make special arrangements to have the engineer relieved from military duty during his visit'. Additional equipment had not yet arrived and the studio was thus in disarray.

Nonetheless, Tal's studio did eventually effectively function. A former student in the studio from 1977–1981, composer Reinhard Flender, recalls that 'Tal himself was not a technician. He always worked with Sailes, his sound engineer. Sailes was an Iraqi Jew who followed with devotion Tal's instructions' (Flender 2005). Flender himself composed one major work in the studio, 'Ba Voh le Tishrei', an oratorio for mezzo soprano, cello, recitation and electronic tape. It was premiered at the Jerusalem Theatre in 1980.

As an educator, Josef Tal considered electronic music, including hands-on work, to be a useful and important subject for all music students. Reinhard Flender wrote: 'Josef offered seminars in this subject to all students of musicology. But he encouraged all of the participants to do their own work, which meant to create a piece of electronic music' (Flender 2005). Tal served as studio director until he retired in 1980. Menachem Zur then became director until, in the 1990s, for a variety of reasons, the University closed the studio.
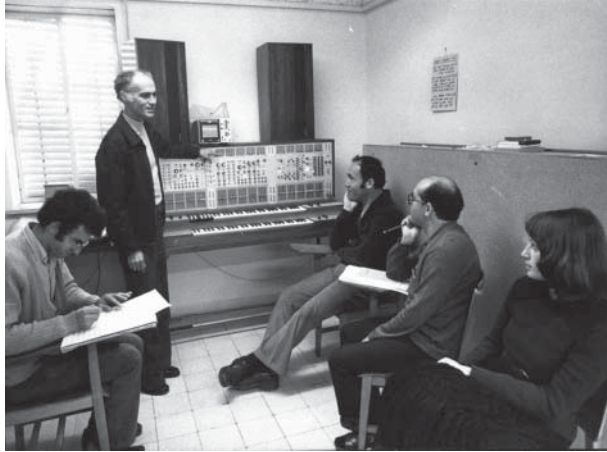
Figure 1. Tzvi Avni in the mid-1970s with students in the Jerusalem Rubin Academy Electronic Music Studio (photo courtesy of Tzvi Avni).

3. TZVI AVNI (1927–)

Born in Germany, Avni (née Steinke) immigrated to Israel in 1935. His formal musical studies began at the Tel-Aviv Academy of Music (later called the Rubin Academy of Music). Avni has been a student of Abel Erlich, Paul Ben-Haim, Mordecai Seter, and of Aaron Copland and Lukas Foss at Tanglewood (1963). Avni's works have included electronic music and music for orchestra, chamber ensemble, voice and chorus, ballet, theatre, art films and radio plays.

It was Edgard Varese who pointed Avni in the direction of electronic music. Avni recalls:

> . . . I actually wanted to study with him and he said, 'No you don't need any studies. If you want me to teach you new tricks, I wouldn't teach you anyway. I want to keep my tricks for myself, you find your own tricks' . . . he called up Otto Luening and spoke with him and said, 'I have here a young man . . .' . . . They gave me a scholarship there for a year in the Columbia-Princeton Electronic Music Center. (Fleisher 1991)

At Columbia-Princeton, Avni worked with Vladimir Ussachevsky between 1963 and 1964. Avni notes that '[Mario] Davidovsky was already assistant instructor' (Avni 2003: 1). It was there that Avni composed his first electronic work *Vocalise* (1964) about which he notes:

> My late first wife, Penina, who was a singer, was with me in New York and when I started thinking about a piece I thought it would be a good idea to use her voice versus electronic sounds, as a dramatic encounter of the warm human voice with the colder and alienated electronic sounds. Having these two kinds of materials, I decided to use the sonata form, namely: an exposition (1 minute), a longer section of 'development' (4 minutes) and a recapitulation plus coda. Altogether it is less than 6 minutes long. (Avni 2003: 2)

His arrival at Columbia-Princeton represented an immersion in an unfamiliar aesthetic. His return to Israel became a time of assimilating this new learning into his musical world view:

> . . . I tried to find my own world in the new sound environment. Then, when I came back here (to Israel) it took quite a few years somehow to adjust and to choose what I felt was right and good for me, and sincere. And to remain myself, although I wanted very much to use new sound elements like, of course, tone clusters and tone rows and sonoristic elements and electronics and so on . . . (Avni 2003: 1)

One of his electronic works from this period is *Collage* for voice, flute, percussion and tape (1967). The text for this work was by the noted Israeli poet Yehuda Amichai. During this period, Avni's music was influenced in important ways by his Israeli cultural environment, in particular the shaping of its national identity in light of its Jewish and historical roots:

> I would say my music became more Jewish, if you can say so, in the late 1960s and 1970s. Especially in the melodic area and perhaps some kind of nostalgic elements. I cannot define it exactly. But I feel that now it's much more important to me to know what it means to be a Jew. Let's say in the 1950s and the 1960s I was very busy, like many others, trying to understand what it meant to be an Israeli. But now, you know, we have a kind of national identity here, and you look for the wider cultural identity much more than local nationalism, which is now perhaps already established. (Avni 2003: 1)

3.1. Founding of the Electronic Music Studio at the Academy of Music and Dance in Jerusalem

Upon his return to Israel, Avni began to teach at what was then named the Rubin Academy. In 1971, he established a studio, the second in Israel. Here is how Avni describes the studio set-up:

> The studio in Jerusalem started with the ARP 2600 and a couple of Revox tape-recorders. Later on we acquired a professional Reverb plate (Studer) and then we bought two B62 Studer tape-recorders. (Avni 2004: 1)

The ARP 2600 was a *ca* 1970s analogue synthesizer whose voltage-controlled modules were integrated within a single unit. The studio staff included the director with the assistance of a technician, as Avni recalls:

> The classes I used to teach since 1971 were mainly for the theory and composition students (compulsory course) and they got individual help from the technician, who was also responsible for the maintenance of the equipment. Usually, each student did a piece during the seminar.

The impact of electronic music on students of that era was enhanced by the requirement that all music students work in the studio. Avni's own electronic compositions from this early period of the studio include *Lyric Episodes* for oboe and tape (1972), and

Synchromotrask for female voice, tape and a door (1976). During this time, he was awarded the Engel Prize (1970) and Lieberson Prize (1973).

3.2. Avni's creative work in the 1980s

In the 1980s, Avni enriched his musical learning at the Musikhochschule in Stuttgart, Germany (1981), and in the studios of Iannis Xenakis in Paris (1984). His works from this period include *A Monk Observes a Skull* for mezzo-soprano, cello and tape (1981), and *Five Variations for Mr. K.* (1982) for percussion and tape. He continued to receive recognition at home and abroad, being awarded the ACUM Prize for life achievements (1986), the Culture Prize of the Saarland (1998) and, more recently, The Israel Prime Minister's Prize for life achievements (1998), and the coveted Israel Prize (2001).

4. YIZHAK SADAI (1935–)

Born in Sofia, Bulgaria, Sadai immigrated to Israel in 1949, shortly after the founding of the State. He is known as a composer, educator and theorist, whose interests include musical perception and meaning. Like Tal and Avni, Sadai studied electronic music abroad. In the early 1960s, he began his first works, at the Groupe de Recherces Musicales (GRM) in Paris, with Pierre Schaeffer, Francois Bayle and Guy Reibel. Sadai's philosophy and compositional practice are strongly intertwined, as he observes:

> I first became interested in electroacoustic music (this term covers *musique concrète* and electronic[ally gener-ated] music) in the early sixties, as a natural evolution in my creative compositional activity. At the same time I discovered, through musical experience, phenomenology as a method, a philosophy, an attitude, and even a belief that expresses a way of thinking, of feeling, and of regarding the world. (Sadai 2004)

Sadai explains his affinity to Schaeffer's approach and, conversely, his discomfort with the approach of the Cologne-based *Elektronische Musik*:

> My phenomenological attitude to music was triggered by the constant discovery of some important gaps and incompatibilities between the way in which a musical phenomenon is perceived and the way in which it is explained by music theory and re-explained by analytical procedures. Thus it becomes easy to understand not only my affinity to the empirical and theoretical attitude of Pierre Schaeffer, as manifested in his famous *Traité des objets musicaux* and *Solfège des objets sonores*, but also my somewhat opposed attitude to the musical approach and way of thinking of the Köln 'formalistic' electronic music composers. (Sadai 2004)

As an educator, Sadai's courses focused on the composition and perception of electronic music from the perspective of *musique concrète*. Not surprisingly,

his books, *Harmony in its Systemic and Phenomeno-logical Aspects* and *Traité de sujets musicaux – vers une épistémologie musicale* are dedicated to Pierre Schaeffer. His electroacoustic compositions include *Song into the Night* (1971); *La prière interrompue* (The Interrupted Prayer, 1975), composed following the Yom Kippur War; and *Trial 19* (1979), an audio-visual composition, after records from the Spanish Inquisition trial. Works for acoustic instruments and tape include *Aria da capo* (1966), *From the Diary of a Percussionist* (1972), *Anagramme* (1975) and *Canti Fermi* for orchestra and tape.

4.1. Don Goodman (1938–) and the Electronic Music Studio at the Rubin Academy of Music at Tel-Aviv University

The third electronic music studio in Israel was founded at Tel-Aviv University, in 1974, by Yizhak Sadai. It was sponsored by the University's Faculty [College] of Fine Arts and by the Tel-Aviv Foundation for Literature and Art. The Tel-Aviv studio was designed and constructed by Don Goodman, who became the studio technician. Goodman immigrated to Israel from England in 1967, shortly before the Six Day War:

> I was originally an electronic-based technician specia-lising in analogue audio electronics [working with] mixers, boxes . . . Without [academic] qualifications I'm a design engineer. I built up the knowledge for myself by reading magazines, experimentation. I was working [in England] at EMI, as a technician. I listened to pre-recorded tapes, before disks and before cassettes [were commercially marketed]. I was on the quality control side. I was in the same department where they were recording from the master tapes to the copy masters. You had to listen on Tannoy horn-loaded loudspeakers. They would take up half the room in my house. There were all sorts of notes on the score. When you get to a particular note, you have to change the levels . . . I was working at the time with a small group who imported professional equipment to Israel and I was an installation and testing engineer, for hospitals, security places . . . I got tired of travelling and I always had interest in the music side. I tried making my living freelance building stuff, such as mixing consoles for Kibbutzim. (Goodman 2004)

Goodman recalls how he came to work with Sadai:

> I knew one of the students in Yizhak Sadai's class, Danny Handlesman. One day Sadai announced in class: 'I'm going to start a new class with electroacoustic music. I have the equipment but I have so many problems with these technicians and engineers . . . I don't know whether it will start; it's a complex problem'. He was anxious to get it going. Danny said, 'Professor, I have an idea about a person'. Danny gave me Sadai's phone number and I went to his house. We talked for about two hours and he thought that this seemed to be OK. I worked on a contract basis. Sadai invited Pierre Schaeffer for an honorary professorship at Tel Aviv University and I

linked up with Schaeffer to help him play back his music. Schaeffer said 'you keep that fellow; he knows what he was talking about'. (Goodman 2004)

The original analogue equipment included three Studer reel-to-reel tape recorders, a sizeable Moog synthesizer, which featured two keyboards, nine oscillators and two filter modules; a Revox amplifier and a pair of JBL loudspeakers. One distinctive feature of the studio reflected Goodman's interest in periodically building new devices, including a vocoder, ring modulators and a custom mixer. In the 1980s, the studio became a digital facility, the Center for Computer Aided Music, featuring a Synclavier II Digital Music System. After Sadai's retirement, Raviv Gazit became director. The studio has been a member of the International Federation for Electroacoustic Music, affiliated with UNESCO, but ceased operation in 2003. Around 1996, the University's Music Academy constructed a new concert hall, which included elaborate recording equipment, constructed and maintained under Goodman's direction. Goodman retired in 2003 and the recording studio remains in operation.

5. THE SECOND GENERATION OF COMPOSERS: EDUCATED IN TEL-AVIV

The first generation of composers to be educated in Israel were born during and immediately following World War II. Most were born in Israel and several were students of Yizhak Sadai and Don Goodman, in Tel-Aviv, including Joseph Dorfman, Yossi Mar-Haim and Raviv Gazit. Arie Shapira studied composition with Sadai, but graduated before the studio opened and thus developed his electroacoustic composition skills independently. All of these composers have remained in Israel, unlike many of those born a decade later.

Two other composers are known primarily for their works for acoustical instruments. Tsippi Fleischer (1946–) has composed several electronic works, including: *The Gown of Night* (1988) for magnetic tape, drawing upon the voices of Bedouin children; *Ramblings on a Volcano* (1997, composed with Rajmil Fischman); and *Saga-Portrait* (2003) for voice and tape. Another composer, Dan Yuhas (1947–), winner of several Israeli awards, continued his studies of electronic music in London, in 1980, with Hugh Davies, and recently began to actively compose electronic works. He opened a small studio, operated by Didi Fire, created as a recording space for the Israel Contemporary Players. The studio was temporarily closed in 2003 due to a fire, and was scheduled to re-open in 2004.

Joseph Dorfman (1940–) was born in the Ukraine, and has served as a mentor to numerous students at the Israel Rubin Academy of Music, Tel-Aviv University. Largely a composer of instrumental and vocal music, he composed electronic music between 1974 and 1980 on the Synclavier II at the Jerusalem Academy, as well at the Electronic Music Center in Columbia University (Dorfman 2003, 2004). His electronic compositions include: *The Stones of Jerusalem* (1977), with sound material created from striking together Jerusalem stones, and texts from the Hebrew Bible that glorify stones; *De Profundis* (1976), using electronically processed recorded singing voices; and *Viribus Unitis No.1* (1977) for piano, three tape recorders, ring modulator and mixer.

Born in Jerusalem, Yossi Mar-Haim (1940–) encountered electronic music in the early 1960s, when he heard Josef Tal's music in the Hebrew University studio and, on recording, music by composers at the Columbia-Princeton Electronic Music Center, including Milton Babbitt, and Vladimir Ussachevsky. Yizhak Sadai introduced him to the sound world of Pierre Schaeffer and Pierre Henry. Mar-Haim found his own compositional direction while at Julliard, in works for instruments and tape by Mario Davidovsky, Charles Wourinen, Tzvi Avni, Karlheinz Stockhausen and his own teacher, Luciano Berio. He soon began his own attempts to compose:

> In 1969 I started to collect gadgets like oscillators, wah-wah for guitar, echoes . . . but I had no connection with a proper lab, so my first experiments were done with tape loops played backwards, controlled feedback . . . The results were closer to Cage in spirit than to any other figures like Stockhausen. I still love low-tech cheap electronic effects. (Mar-Haim 2003)

His work came to focus on music for outdoor environments and live electronic performance. *Music in the Trees* (1980) includes the instructions that the musicians perform in the higher region of trees. Listeners choose their own walking paths through the woods and thus hear the work from varying perspectives; *Declaration of Independence* (1988) for orchestra, band, echo device, narrator and tape, includes clips from a recording of first Prime Minister David Ben Gurion reading the Declaration. Mar-Haim teaches sound for film and sound for virtual media at Tel-Aviv University. The most recent of the prizes he has received is the 2003 ACUM (Israeli ASCAP) Prize.

Born in Tel-Aviv, Raviv Gazit (1949–) is best known for his film and theatre soundtracks, and as an educator. With a background bridging electroacoustic and rock music, he seeks to 'synthesize all my different ways of expression into a unique style of electronic music, hopefully not classifiable as Experimental, Ambient, Dance or whatever' (Gazit 2003). Gazit studied electronics engineering, especially computing, at Tel-Aviv University, and in his early thirties, musical composition with Yizhak Sadai. His first electronic compositions were on the Tel-Aviv studio's Synclavier Digital Music System (1983), where he subsequently taught, directing the studio after Sadai's retirement, until the studio's closing, in 2003.

5.1. Arie Shapira and the Haifa University Studio

Arguably the most individual composer among graduates of Tel Aviv University is Arik (Arie) Shapira (1943–). Shapira began learning electronic music composition on his own in 1962, working with tape recorders. During his college years, he studied harmony and counterpoint and after graduation in 1968, he attended concerts by students and faculty at the University, rejecting their aesthetic and compositional approaches. He learned about the Vocoder and pitch-to-voltage synthesizer in professional audio magazines in the early 1980s, which helped motivate his return to electroacoustic composition. (Shapira 2005) Shapira views himself as an iconoclast, seeking to break new expressive ground and to offer political commentary through his work, as he observes, 'Rebellion and contradiction, that's the key. I am an extremist. I write radical music . . . My music is definitely not middle-of-the-road!' (Shapira 1996)

Shapira's music seeks to provoke critical thinking and reaction. His tape work *Upon Thy Ruins Ophra* (1990) criticises the policies of West Bank settlers. *Gustl in Theresienstadt* (1999) imagines Gustav Mahler, having remained Jewish, ending up in a concentration camp (historically accurate) established by the Nazis to house musicians and artists as a phoney show-case for public relations purposes. *Missa Viva* (1977) is an orchestral work that includes a rock group.

Arguably his most important work is the *Kastner Trial, Electronic Opera in Thirteen Scenes* (1994). The opera is a setting of the trial transcript from a highly politically controversial trial involving questions of Jewish complicity with the Nazis during World War II and political expediency in addressing this explosive issue. Shapira's music engages questions of Israeli identity and Jewish history. Many of his works, like *Kastner*, *Gustl* and others focus upon text and language, rather than timbre and abstraction, offering

Figure 2. Arie Shapiro at the piano (photo courtesy of the composer).

commentary upon those texts and their subjects in a manner that may be seen as following in Jewish traditions of verbal textual commentary. Shapira, however, denies that his music is tied to any particular identity:

> Being an Israeli composer for me is only a label. I compose for myself. I use Western notation, but its only technique; notation is only technique. I'm interested in disintegration, not building. That's aesthetics to me, modern aesthetics. (Fleisher 1991)

In 1986, Shapira won the Prime Minister's Prize, followed, in 1994 by his becoming the first musical composer since 1970 to receive the Israel Prize Laureate. The award was controversial among some Israeli composers and critics. Shapira concludes that his music is 'too modern, too aggressive' for the Israeli audiences, who prefer 'traditional, old fashioned music' (Shapira 1996). Following sharp political criticism of his tape work *Upon Thy Ruins Ophra* and the award of the Israel Prize, Shapira left Tel-Aviv University and joined the faculty of the University of Haifa.

In 2000, Arie Shapira founded the Haifa University studio, which he serves as director. The studio has become a growing centre of activity among Israeli composers. Avi Elbaz is its main instructor. While the primary function of the studio is to support the studies of pop, rock and jazz-oriented music students, as well as Art students, a number of electroacoustic composers have begun to emerge.

The studio computer is equipped with a SCOPE Creamware audio card and Cubase SX, Logic Audio, Reaktor, Kontact, Intakt and a variety of digital processing plug-ins, a MIDI keyboard controller, Neve two-channel strip, and a pair of Dynaudio BM6 studio monitors, Telefunken 372 pre-amps, UREI LA 4 Compressors and UAD cards (Elbaz 2004: 2). Elbaz observes:

> In the last years we are organising more concerts involving a lot of young musicians. At the University of Haifa three courses of electronic music are filled with students and it seems like younger musicians are getting into it. (Elbaz 2004: 1)

6. THE SECOND GENERATION OF COMPOSERS: EDUCATED AT THE ACADEMY IN JERUSALEM

Eitan Avitsur (1941–), best known as a conductor and composer of instrumental and vocal music, founded the Computer Music Laboratory at Bar-Ilan University in Ramat Gan, in 1995. He also directs the University's Electroacoustic Music Program, founded in 1990. Avitsur has composed several electronic works including *Ele Habanim* ('These are my Sons', 1975), dramatic oratorio for baritone solo, orator, symphonic orchestra, and electroacoustic music; and

Figure 3. The Haifa University Electronic Music Studio (photo courtesy of Avi Elbaz).

Figure 4. The Haifa University Electronic Music Studio (photo courtesy of Avi Elbaz).

Megillat Haesh ('The Scroll of Fire', 1976), dramatic oratorio for solo soprano, orator, chamber orchestra, and electroacoustic music.

Composer and educator, Menachem Zur (1942–) sees his work as following in the tradition of American electronic music composers, especially those associated with the Columbia-Princeton Electronic Music Center:

> The electronic music experience that shaped my sound views was done at Columbia University under the guidance of Mario Davidovsky during my studies for the Doctor of Musical Arts, 1972–1975. That view erased everything I ever experienced before in Israel, Europe, or in the United States. The works of colleagues such as Arthur Kreiger, Eric Chasalow, James Primosch – and Mario Davidovsky above all – continue to influence me. (Zur 2004)

Zur prides himself on close attention to every individual sound and the shaping of sound gestures, in his works such as *Chants* (1975) for magnetic tape;

Shiluvim (Combinations, 1986) for children's choir and magnetic tape; *Alleluia* (1999), for vocal sextet and magnetic tape; *Translations* (2003) for percussion and electronics. 'In working with sounds from pre-existing menus the composer must hide the identifiable sound source by techniques of detuning, filtering, ring modulating, etc., to acquire a sound that is divorced from conventional associations.' He describes his aesthetic as 'based mainly on short sounds', paying close attention to motivic development and pitch organisation. 'The main interesting component of sound rests in its attack. This is why it is easy to create varied electronic music based on varied envelopes of attacks' (Zur 2004). Zur's compositional method includes conceptualising and scoring his sounds prior to working in the studio, as opposed to a more improvisational approach:

> Sketching the entire composition with its complex waveforms is necessary in order to conceive of a plan, especially since many new sounds are destined to join the world of acoustic possibilities and they surprise composers and technicians alike. A composer must conceive of enough contrast and nuance at the planning stage and be ready to change initial plans according to the many surprises that sound production introduces. (Zur 2004)

Zur has won many awards, including several ACUM prizes, a Guggenheim Fellowship and the 2001 Prime Minister's prize. He is on the faculty of the Hebrew University of Jerusalem and at the Academy of Music and Dance in Jerusalem, where he serves as Director of the Electronic Music Studio. It is his belief that all composition and conducting students should study electronic music.

7. CHAMPION OF ISRAELI CONTEMPORARY MUSIC, RECHA FREIER, AND TESTIMONIUM

One of the truly remarkable figures in Israeli history is Recha Freier (1892–1994), poet and founder of *Aliyat Hanoar* (Youth Aliyah), an effort that rescued thousands of young people from the Nazi Holocaust. Freier herself immigrated to Israel in 1941, escaping from Germany through Yugoslavia.

In Israel, Recha Freier became a champion of contemporary music. Among her efforts was the founding, in 1958, of the Israeli Composer Funds (Avni 2004: 2) and, in 1966, Testimonium. Her co-organiser was Roman Haubenstock-Ramati, a Polish-born composer who immigrated to Israel and later settled in Vienna, Austria. At one point, he worked at Pierre Schaeffer's Studio de Musique Concrète in Paris.

David Flusser (1979), an Israeli biblical scholar and member of the Directory Council of Testimonium, describes the rationale for the organisation as:

> . . . to give musical expression to historical events and spiritual creations during two millennia of exile of the Jewish People. The compositions are commissioned from

local and foreign composers, Jewish and non-Jewish and given their world premiere at the Testimonium . . .

The name 'Testimonium' is based upon the Latin word meaning testimony. Flusser describes the goal as the giving of offering testimony regarding the history of the Jewish people:

> The life of Israel in its entirety, the sufferings, the hopes and the service to God embodied therein, all constitute a lasting and varied testimony. Testimonium not only tries to give artistic expression to the experiences of previous generations of Jews, but aims also at offering testimony of ourselves as well as of the artists taking part. The artists, the performers and the audience are witnesses who offer their evidence on what happened in Jewish history. Thus, this manifestation offers contemporary evidence for the identification of the nation with its past.

The idea for Testimonium arose from discussions between Freier and Haubenstock-Ramati about a possible artistic collaboration. Each Testimonium was to be organised around a theme rooted in Jewish history. Often Freier wrote or selected a text with which a chosen composer would work and she would personally solicit the composer's interest. Joseph Tal (2004) recalls: 'Resha would travel to them personally and convince them to write, and they did'.

Themes for the triennial festival, which took place from 1968 through 1984, not long before Freier's death, included Jerusalem (1968), The Middle Ages (1971), *Deprofundis* (1974), *Lucem cumfulgeret* (1976), and The Jews of Spain (1979). The final Testimonium (1984) lacked a theme. Each festival was to take place at the Jerusalem Theatre and the Tel-Aviv Museum. The featured ensemble was the Jerusalem Symphony Orchestra, conducted, starting with the 1974 festival, by Chilean maestro Juan-Pablo Izquierdo.

The six festivals that took place during the two decades of Testimonium included new works by Karlheinz Stockhausen, *Michael's Youth* from the opera *Licht* (one of the only included works not connected to the year's theme), Iannis Xenakis's *Nishima*, Tzvi Avni's *Destruction of the Temple* and *Jerusalem of the Heavens*, Yizhak Sadai's *Trial 19* (from the Records of the Spanish Inquisition), Yehoshua Lakner's *Mohammed's Dream*, Mauricio Kagel's *Vox Humana*, Andre Hajdu's *Ludus Pascalis*, Mark Kopytman's *Chamber Scenes From the Life of Susskind Von Trimberg*, a chamber opera for soloists, choir, dancers and orchestra with libretto by Recha Freier, and works by Roman Haubenstock-Ramati, Sergiu Natra, Luigi Dallapiccola, Abel Ehrlich, Lukas Foss, Arnold Schoenberg (in memoriam), Leon Shidiowsky, Samuel Adler, Alexandre Tansman, Hans-Joachim Hespos and others. Several of the commissioned works included electronic sounds.

Recha Freier had hoped to organise a seventh Testimonium, which was to tentatively include new works by Luciano Berio and Stephen Horenstein, the latter to a text by poet Uri Tzvi Greenberg (Horenstein 2004). Unfortunately, following her death, it became impossible to raise the funds to continue the festivals. Tzvi Avni recalls:

> A few weeks before her death at a very old age, Recha Freier invited me for a discussion on the future of the Testimonium, of which she was very worried. I advised her to hand it over to the Jerusalem Foundation (under the auspices of the municipality), which she agreed, but somehow it did not work out. [Her son] Shalhevet spoke with me after her death and expressed his wish to continue his mother's legacy but nobody could apparently manage to find the funds, which Recha somehow used to collect. (Avni 2004: 2)

8. THE POST-WAR GENERATION OF COMPOSERS

The establishment of the two Jerusalem and Tel-Aviv electronic music studios spawned a new generation of composers. Many of them continued their education and/or found teaching opportunities abroad. This is due to relatively limited resources and musical environment that Israel can afford to electronic music composers, especially when compared to the breadth of possibilities to be explored in the United States. Most of the composers, now in their forties and fifties, who left the country, have travelled to the United States rather than Europe, with the exception of Rajmil Fischman, who went to the United Kingdom. Their influences tend not to be specifically Israeli, although most of them maintain close ties, familial and musical, to Israel.

There are important exceptions, including Stephen Horenstein (1948–), an immigrant from the United States, and Dror Elimelech (1956–), whose works include acoustic instruments and voice with live electronics. Elimelech founded the Other Israeli Music concerts and Night Happening new music forum. His music has been heard in concert venues and in

Figure 5. The home studio of Yossi Mar-Haim (photo courtesy of the composer).

multimedia, dance, video, poetry, and art exhibitions. There is also a younger generation of upcoming composers, students of Arie Shapira at Haifa University, who may represent a new trend in Israeli composers who remain in the country.

8.1. Students of Tzvi Avni and Josef Tal: Jonathan Berger, Shlomo Dubnov . . .

Born in New York City, Jonathan Berger (1954–) was introduced to electronic music through the work of Pierre Schaeffer, Mario Davidovsky, Bulent Arel and Luigi Nono. He studied composition in Israel with Tzvi Avni, Josef Tal and Mark Kopytman at the Academy of Music and Dance in Jerusalem, and subsequently with Milton Babbitt, and in the United States with Morton Subotnick, Barry Schrader, Mel Powell and John Chowning. He was also influenced by the work of Bill Schottstaedt, Jacob Druckman and Bernard Parmegiani.

> I did not feel 'liberated' by electronics until . . . I was working with John Chowning at Stanford. For the most part I recall the experience of composing for tape frustrating, tedious and largely unrewarding. Chowning, however, got me excited by algorithmic composition – particularly the idea of taking structure to the level of timbre and microtime . . . (Berger 2003)

Many of Berger's works are composed for acoustic instruments and interactive electronics, including *The Sound Within the Hammer* (1997) for flute, clarinet, piano, viola, cello and computer; *Arroyo* (1998) for motion-tracked dancer, computer and instruments; and *Con Carne* (1998) for pianist and Disklavier. Berger teaches at the Center for Computer Research in Music and Acoustics (CCRMA).

Born in the Ukraine, Shlomo Dubnov (1962–) is a researcher and composer. As a researcher, he is particularly interested in the fields of advanced audio processing and retrieval methods. Dubnov's education bridges electrical engineering (at the Technion), computer science (at the Hebrew University), and music (at the Academy of Music and Dance in Jerusalem). Dubnov was familiar with electroacoustic music when he learned about computer music as a field of research during a workshop by Jonathan Berger around 1990:

> My main engagement with computer music started when I was considering a PhD in computer science. I met Naftali Tishby, who became my PhD supervisor, who was very interested in language understanding and I thought to investigate music models. Then I became also interested in musical signals, trying to model sound timbre and texture using statistical methods. This continued into work on extracting content from audio signal that I did at IRCAM with Xavier Rodet. In parallel I did some work on modelling music using statistical tools and information theory with Gerard Assayag. (Dubnov 2004)

Dubnov has composed works for live electronic performance, such as *Modes of Discourse* (1996) for Midi Wind Player and MAX Interactive Computer System; and *Me-Oh* (1996) for voice, ensemble and live electronics; and multimedia sound installations. One of these, *Carnet de Voyage*, exemplifies his transparent use of the computer in interactive multimedia settings:

> In the handling of the computer, the visitor has an active role as in a game. Dynamics arise from an interaction between the visitor, the musical movements, the appearance or the disappearance of the material and the colours. The visitor, with a movement of the hand, can also reduce or increase visited space or penetrate in new paintings. Augustine Lenoir's paintings proceed by successive layers, which superimposed, create an increasingly dense texture. The sequence begins with a superposition from all the paintings; then the visitor clears the structure to go towards black and white or the integral black. Displacement takes place by side movements of the mouse without clicking. The sequences of sounds and images vary in time but the user is always free to control the scrolling speed. (IRCAM 2004)

Shlomo Dubnov is on the faculty of the University of California at San Diego, having previously taught at Ben-Gurion University. In 1994, he founded the Israel Computers and Music Forum.

Another former student of Avni is Kiki Keren-Huss (1955–). Fifteen years after graduation from the Jerusalem Academy, she was inspired by music by Amnon Wolman to return to composing using a DAT recorder, microphone and desktop software. 'I composed my first piece *Mi*, for solo violin and tape [2000], using recorded home sounds, fragments of an Yves Montagne song and a sentence from a recorded theatre production by Israeli playwright Nisim Aloni . . . what fascinated me most was the infinite possibilities of the sound and the ways one could play with them and put them together' (Keren-Huss 2003). Subsequently, she has composed works for piano and tape, string quartet and tape, and most recently sound installations.

8.2. Students of Yizhak Sadai at Tel-Aviv University: Amnon Wolman and Daniel Oppenheim

Israeli-born Amnon Wolman (1955–) is best known for having developed a broad body of work that spans music for instrumental soloist and live electronics, works for varied instrumentation about Marilyn Monroe and her meaning to gay people, tape music, radio pieces, music for acoustic ensemble, and other media. His music bridges tonality and abstraction, with a sensitive to sonority and tone colour, bringing a sensibility from electronic music to bear on how he treats instrumental writing. After studying at Tel-Aviv University, Wolman continued his education at the University of Utrecht, Holland, the Institute for

Sonology, Stanford University, and at the Aspen Music School. He has served as director of the Computer Music Studios at Northwestern University and, currently, at Brooklyn College.

Daniel Oppenheim (1954–) is a researcher and composer working in the Human Centric Tools team at the IBM T. J. Watson Research Center in Hawthorne, New York. For a decade he was on the staff of the Center's Computer Music Group, following graduate studies at Stanford University's Center for Computer Research in Music and Acoustics (CCRMA). Oppenheim's interests include the design of intuitive interactive computer user interfaces for composers and the application of those ideas more generally to computing. Among his long-term projects has been DMIX, which 'allows the composer to draw a shape that the notes should follow. Through its graphical user interface, the user can morph one musical passage into another. For example, a Bach concerto can be turned slowly into a tango and then, by tiny increments, transformed again by adding a touch of a salsa beat' (IBM Research 2004). Another project is Qsketcher, 'a new environment for composing music for film. The main focus is the support of early stages of the creative workflow, from idea conception through realisation, rather than the order and synchronisation of musical fragments with film' (Steven Abrams, Ralph Bellofatto, Robert Fuhrer, Daniel Oppenheim *et al.* 2002).

Other students in the studio at Tel-Aviv have included Ron Kolton, Gidon Levenson, Jan Radzinsky and Betty Olivero (1954–), a well-regarded composer of instrumental music.

8.3. International identity: Rajmil Fischman

The music of Rajmil Fischman (1956–) reflects a multiple, hyphenated identity. 'My learned musical experience derives from formal Western education (conservatory studies in Peru, academic music studies in Israel and Britain) as well as performance of popular music and, to a less degree, Latin American folk material' (Fischman 1999). He sees in his music a concern for the indigenous population of the Andes, an interest in Latin American dance rhythms and a political awareness that is often embedded within Latin American music, and Jewish influences that emerge from 'the fact that part of my family suffered and disappeared during the Holocaust because of their Jewish identity', as well as childhood experiences of Jewish religious traditions and culture and a 'familiarity with much of the Old Testament and Jewish liturgy manifested in the treatment of contemporary themes'.

Fischman's composition *Alma Latina* (1996), for instance, very subtly integrates Latin rhythms into an abstract electroacoustic sound tapestry. Fischman

also finds in his work a 'particular use of microtonality to produce melodic lines that may be linked to unconsciously absorbed traits, such as cantillation and certain types of Yiddish song'. His integration of these many influences and ideas may be seen as symbolic of the Jewish 'historical adaptability to continuous changes of environment' (Fischman 1999).

Fischman was born in Lima, Peru to parents who emigrated from present day Moldava immediately prior to the Holocaust. Fischman moved to Israel at age nineteen and attended graduate school in the United Kingdom, where he continues to live and teach. Fischman views the multiplicity of his identity as inherently Jewish (Fischman 1999): 'I consider the diversification of cultural traits in my works and the consciousness of being at home everywhere and, at the same time, nowhere in particular one of my Jewish attributes'.

Fischman first encountered electronic music in the late 1970s, reading books about contemporary music and listening to works associated with the Columbia-Princeton Center for Electronic Music, by Bulent Arel, Vladimir Ussachevsky, Mario Davidovsky, Otto Luening, and Milton Babbitt. When he began composing his own works, in graduate school at York University, 'it was exhilarating and exciting, and there was the promise of vast possibilities as technology advanced' (Fischman 2004). Later influences included Gyorgy Ligeti, Luciano Berio, Witold Lutoslawsky, Trevor Wishart, Jonty Harrison, Denis Smalley, Francis Dhomont and Bernard Parmegianni. In addition to composing, Fischman teaches at Keele University in the United Kingdom and develops compositional software, including KEELEDESK (1991–), AL (Algorithmic Composition Graphics Environment) and ERWIN – COM, a granular synthesis plug-in, in the context of the Composers Desktop Project.

8.4. Stephen Horenstein (1948–) and the Jerusalem Institute of Contemporary Music

American-born Stephen Horenstein is a composer, educator, saxophonist and founder, in 1987, of the Jerusalem Institute of Contemporary Music and its resident experimental music ensemble, the Jerusalem New Music Ensemble. The Jerusalem Institute includes a workshop for electronically expanded musical instruments, including what Horenstein refers to as 'hyperinstruments', a term coined by MIT Media Lab's Tod Machover. This is a reflection of Horenstein's strong interest in composing and performing works for live performance with electronics. Among the most noted features of his work has been his integration of traditional Jewish source material, including, in *Agadot* (1985), sounds suggestive of those described in biblical texts and, in *Andarta* (1986), field

recordings of Holocaust survivors emerging from concentration and displaced persons camps.

Horenstein's interest in electronic music developed gradually. In college, he heard Luciano Berio's *Visage* and Karlheinz Stockhausen's *Mikrophonie I*, and as a faculty member at Bennington College, he learned from his mentor, Bill Dixon, who 'manipulated the trumpet physically to simulate electronic effects' (Horenstein 2004), and he listened to the sounds of Joel Chadabe's studio immediately above his office. After Horenstein immigrated to Israel in 1980, his music began incorporating interactive electronics, tape and mixed media. The first such work was an environmental composition, a sound environment for the Israel Museum, *Seven Faces of a Garden* (1981), which included processed sounds diffused around a garden, in conjunction with dancers and work by architect Isamu Noguchi. He considers his work in this domain, "explorations in outdoor environmental and spatial applications of sounds, including the blending of musical and physical architectural principles" to be among his most significant artistic contributions and "a way to bring electroacoustic music to a wider audience in Israel." (Horenstein 2005)

Horenstein's work has been influenced in subtle ways by living in Israel, as he observes:

> I'm in the middle of a tornado here, in the most volatile place in the world, and I feel it's a very vital place to be – the tension emanates from the day-to-day compression that one feels. I use these opposite extremes in my music. Thus, my work is very much rooted in collage, very much an extension of an Ivesian approach to the unity of opposite qualities of sound. (Fleischer 1996: 233)

Stephen Horenstein has taught at Bennington College, the Jerusalem Academy of Music, and Tel Aviv University. He has founded music programmes and curricula in Israeli and Jewish-American high schools in Boston, Massachusetts. He has been a Jerusalem Fellow and the recipient of awards from the National Endowment of the Arts and the America Israel Cultural Foundation.

8.5. Students of Arie Shapira at Haifa University

The studio at Haifa University is now the most active environment for training upcoming electronic music composers in Israel. Among the composers who have studied with Shapira are Avi Elbaz, who teaches in the Haifa University studio, Uri Pesach, Itsik Mizrachi, live electronic performer Gil Wasserman, Guy Rosenfarb, and Offir Ilzetzki and Dganit Elyakim, who are both continuing their graduate studies in The Netherlands.

Avi Elbaz (1961–) immigrated to Israel from Morocco with his family in 1970. A few years after hearing a work by John Cage while at Berkeley College of Music in Boston ('I was shocked and confused . . .'), he experienced music by Arie Shapira

on the radio. 'I still felt confused but I could feel that he was talking to me in a new language that one has to know if you want to understand. That was the first time that the term modern music or electronic music started to act on my imagination' (Elbaz 2004). Elbaz began to study privately with Shapira, composing a text-based piece using analogue equipment. A distinct aspect of his work has been its non-Western influences:

> I am trying in my work to connect modern language as electronic with older cultures like Moroccan music and language and trying to keep a very delicate balance between modern music and feel. Modern music needn't be disconnected to very simple and natural elements that can bring people to feel something and to get excited. (Elbaz 2004)

Gil Wasserman (1965–) performs with Ilan Green (1963–) in the live electronic duo, Krechtz. Green and Wasserman design and build their own instruments, including feedback circuits, new-fangled devices like 'Disconnections Gtr', 'Prepared Toys' and 'Baloonon', circuit-bending electronic toys like 'Koto-Tea', 'Egg-Harp Ventilation' and various kitchen appliances, all used in combination with hi-tech equipment. The duo describe themselves as:

> two musician-inventors composing 'serious' music in the space of their basement lab . . . the music of feedback circuits combined with the sound of processed kitchen bowls played with marbles . . . Krechtz music usually grows from building or programming curious instruments, playing around with them, and composing a piece from the results . . . It's not about melodies or harmonies, it's about playing the instruments in both senses of the word. (Green 2004: 2)

Keren Rosenbaum (1970–) is a multimedia artist in New York City. Her work integrates music, video, dance and theatre with electronic music and art, in multimedia works such as the opera *CHAT* (2001–),

Figure 6. *Krecht* in performance (photo courtesy of Ilan Green).

Figure 7. *Krecht* in performance (photo courtesy of Ilan Green).

Washing Machine (1999) for piccolo, violin, voice, pre-recorded soundtrack and video installation; and *Construction Site* (2000) for video art and installation. She has also played a notable role as a pioneer of multimedia performance in Israel through her direction of the New Voices Festival and her work with the Reflex Ensemble.

8.6. Researchers: Israel Computers and Music Forum, Dan Gang

ICMF was organised by Shlomo Dubnov in 1994 to facilitate two-way dialogue between people in the fields of music and technology, with hopes that each discipline can inform the other. Its goals were defined in this manner:

> to conduct multi-disciplinary research in computer science, engineering and acoustics in the field of music; to encourage composers into producing new works of music using new technologies; to promote computer-aided musicological research, and to serve as a means of exchange among those researchers; to establish continuous relationships with the international musical and scientific communities; to promote pedagogic efforts in the field; to promote production of public events that bring to the public eye the results of computers and music activity and the evolution of musical thought. (Dubnov 1996a)

The membership of ICMF has reflected the range of research and composition taking place in Israel, including Shlomo Dubnov, Naftali Tishby, Dalia Cohen, Dan Gang, Daniel Leman, Claudia Goldman, Jeffrey Rosenschein, Naftali Wagner, Ron Vinocourt, Hezi Yeshurun, Joseph Tal, Uri Shimony and Mira Balaban. The ICMF has held five meetings to date, 1994–1996, that have rotated around major centres of activity: the Academy of Music and Dance in Jerusalem, Ben Gurion University, Bar-Ilan University, Rubin Academy in Tel-Aviv, and the Technion in Haifa, where Joseph Tal and Uri Shimony have worked on notation systems for electronic music. The organisation maintains a listserv (il-cmf@cs.huji.ac.il) and an ftp site.

Among the researchers who have been connected with the ICMF is Dan Gang (1962–). Gang's work explores the intersection of artificial intelligence, music and cognition. Born in Haifa, he studied at the Hebrew University and at Stanford University's Center for Computer Research in Music and Acoustics (CCRMA). Among his interests are applications of Recurrent Neural Networks to understand the real time choices of performers, as they learn chords, harmonise melodies and create polyphony, and the perceptual experience of listeners, as their expectations are met or confounded (Gang 2004: 1). Gang founded the company Music Genome, in 2000, based in Ramat Gan, Israel and Sunnyvale, California to apply artificial intelligence and music cognition models to predict the musical preferences of listeners to facilitate retail sales (MusicGenome 2004: 2).

8.7. Gil Weinberg and a musicology computer music lab at Tel-Aviv University

Gil Weinberg (1967–) is a researcher, composer and educator, and Director of Music Technology at the George Institute of Technology (Georgia Tech). Weinberg is interested in designing hardware and software that allows expressive group musical engagement (Weinberg 2003a). This has included Beat Bug, a core element in Tod Machover's *Toy Symphony* (2003), and the *Voice Network Installation*, *Squeezables* and *Fireflies*. Beat Bug is a musical instrument that allows children and novice musicians to join in collaborative music-making, what he calls 'Interconnected Musical Networks (IMNs)'. Weinberg seeks to:

> design algorithms that would bridge between the thoughtful and the expressive . . . by embedding cognitive and educational concepts in newly designed interconnect instruments and applications . . . live performance systems that allow players to influence, share, and shape each other's music in real-time. (Weinberg 2003b)

Weinberg was educated at Tel-Aviv University, in the Musicology Department, where, in 1994, he founded a computer music lab for musicology students, and he developed coursework in MIDI, notation, sequencing and recording. Students also work with graphics and video software on the same workstations. The Musicology Department recently merged with the Rubin Academy.

9. DEVELOPERS OF NEW TECHNOLOGIES: WAVES

Gilad Keren (1959–) and Meir Shashoua (1963–) have pioneered digital audio processing technologies. Their

company, Waves, founded in Israel in 1988 and based in Knoxville, Tennessee and Tel-Aviv, emerged as the fruit of a friendship and a shared love of musical technology. 'Waves is the leading provider of DSP [digital signal processing] solutions for audio professionals in content creation and MaxxTM audio signal processing solutions for consumer electronics . . . Waves' Maxx technology dramatically enhances audio performance in consumer applications and has been licensed to several leading audio companies including Microsoft, Motorola, Samsung and Sanyo' (Keren and Shashoua 2004).

Keren studied at the ORT technical high school and Applied Mathematics at the Technion, in Haifa, and he became a sound engineer. 'Like many teenage boys, I was interested in music, but I didn't play any instruments. I studied electronics and I was involved in these sorts of things . . . When I was 21, one half year before I was done with my military service, I had ideas about sound and I went to a musician and he recommended that I talk to someone . . . and I was referred to Tommy Friedman at the Altec Lansing's multimedia technology department . . . I went to see him at his studio, Tritone. As soon as I walked into the control room, I saw the equipment and things came together for me [in my mind]' (Keren 2004).

Shashoua grew up as a musician and self-taught builder of electronic circuitry, gaining formal training in the army. 'We set out to make a digital Vocoder. Soon we found out that just doing digital synthesis was hard enough. We decided that we would crawl first . . . started writing code in 1988, and we had a prototype in 1989. We showed it in New York City at the AES [Audio Engineering Society] convention' (Keren 2004). The core of their technologies was, from the start in 1986, the Motorola DSP (digital signal processing) 56000 chip, for which there was a digital to analogue and analogue to digital conversion evaluation board, to which Shashoua gained access at a university. And then, 'Gilad surprised me and told me that he bought the evaluation board and that's how the garage studio started. Our first prototype – an equaliser – was [developed] right then' (Shashoua 2004).

An important influence on the development of Waves' products was mathematician and audio theorist, Michael Gerzon (1945–1996), best known for his development of Ambisonics, an approach to surround sound. After his death, Keren and Shashoua (2004) wrote in his obituary, 'We have been working with him during the last 5 years at Waves and if there is anything like a father to a company – this is what Michael was for Waves'. His work played an important role in the Waves' TrueVerb plug-in, S1 Stereo Imager, L1 and L2 ultamaximisers, C1 [Compressor, Gate, Expander], StereoMaker, and the Increased Digital resolution. At present, the company is considering moving into publishing information technologies, expanding beyond plug-ins to books and other resources.

10. OBSERVATIONS

Electronic music composition and performance has a long history in the State of Israel. Its composers, those living in Israel and abroad (mostly in the United States), approach their creative work from a great variety of perspectives and backgrounds. It is thus difficult to generalise about the nature of this musical genre. Nonetheless, there are some basic commonalities about which one may comment. Composer Jonathan Berger makes an apt observation when he notes that 'Israeli music explores national identity, and incorporates multiculturalism; it often has uncharacteristic (perhaps 'un-cool') expressivity – which I find most appealing' (Berger 2004).

Berger's comments are relevant to many Israeli composers in general, those who compose electronic, as well as acoustic instrumental and vocal music. Israel is a multi-ethnic and multi-cultural society, although most of the historical models for electronic music and most of its Israeli composers are European by heritage. Israeli identity, because of the young age of the nation, founded in 1948, and the complexities and varieties of Jewish identity (religious, secular, post-Holocaust, immigration from Middle Eastern, European, African and Asian societies), which represents one of the core aspects of Israeli identity, often leads Israeli artists and musicians to explore identity issues in their work, directly or indirectly. Some Israeli composers create in a more European, abstract, musical language, among them Yizhak Sadai and Menahem Zur. A number of composers create works that draw upon Hebrew language texts, integrating the sounds of Hebrew into the sonic texture. Among these are Tzvi Avni, Joseph Dorfman, Stephen Horenstein, and Arik Shapira, most notably a feature in his predominantly text-based opera *The Kastner Trial*. Although the Israeli composers discussed in this article are secular and distant from religious identity, the work of Tzvi Avni, Rajmil Fischman, Stephen Horenstein and others at times contains inflections of traditional Jewish music and traditional Jewish historical references, especially the Bible and the Holocaust. There has been little electronic music to date reflective of the surrounding Middle Eastern cultures where many Israelis were born. One exception is Avi Elbaz, who integrates elements of Moroccan music and culture into his work. Horenstein (2004) speaks of an Israeli 'utilising a different time sense emanating from Middle East'.

It is difficult to say whether the trend is more towards abstraction or to an identifiable Israeli

flavour. Certainly, with the exception of new immigrants, the creation of an Israeli identity is a task that is not presently in flux. Recall Tzvi Avni's statement, quoted earlier:

> Let's say in the 1950s and the 1960s I was very busy, like many others, trying to understand what it meant to be an Israeli. But now, you know, we have a kind of national identity here, and you look for the wider cultural identity much more than local nationalism, which is now perhaps already established. (Fleisher 1996)

Whether changes in the unstable regional political situation will cause shifts that will be reflected in future music is unknown. It is possible that continued tensions and a lack of political resolution might lead more composers to create politically inspired works. I have encountered few Israeli composers who are apolitical. It is also possible that the sharp divide between religious and secular Israelis will narrow, with the emergence of non-Orthodox religious forms, resulting in a reconsideration of identity issues. Certainly, most, if not all, Israeli electronic music composers are secular in orientation. Fewer are currently exploring biblical themes than had composers of the earlier generation. It is equally possible that religious divisions, which have political consequences in Israel due to the politicised nature of religious authority, could increase, also influencing musical expression.

11. CHALLENGES

A major issue facing Israeli composers is that their creative work has not been received with a high level of critical acceptance or institutional support in their home country. The only music familiar to masses of Israelis, and that uses electronic media, is popular dance music, especially trance. Most Israelis are largely, if not entirely, unaware of the composers or forms of music discussed in this paper. Avi Elbaz notes:

> We have a lot of difficulties but I think that the major are radio and television. We don't have any regular time to play our music or the chance to connect more audiences to that kind of music. Stations are refusing to play modern music. (Elbaz 2004)

Rajmil Fischman adds:

> Perhaps the most difficult problem is that of funding for arts, which cannot become completely independent of sponsoring, since they do not have mass appeal. This is accompanied by lack of media interest and exposure. There are artistic pursuits that are bound to remain within minorities (not only electronic music but also some traditional folk genres, classical concerts which are not digests of masterpieces) . . . (Fischman 2004)

It has not been common for electronic music composers to receive major national prizes or receive substantial State support. In fact, when the coveted Israel Prize was granted to Arik Shapira in the early 1990s, the announcement was met with great controversy, largely on the part of fellow composers. Some felt that the Prize should be granted to a more mainstream, more senior composer. To this observer's mind, the controversies at least in part point to the very limited degree of acknowledgement available in Israel today for any electronic music composer, leading to an unfortunate degree of competition.

There are now only three surviving electronic music studios among all of those that were established at universities. The recent closing of the studio at the Tel-Aviv Rubin Academy leaves only the Jerusalem Academy studio, the decade-old Bar-Ilan Laboratory and the Haifa University studio remaining active. In addition to this is the 'hyper-instrument' workshop of the Jerusalem Institute of Contemporary Music. The closing of the Israel Center for Electronic Music at the Hebrew University, founded by Joseph Tal, and the Electronic Music Studio at the Rubin Academy of Music in Tel-Aviv, founded by Yizhak Sadai, both after several decades in operation, represents a loss of not only educational and creative resources, but of a historical legacy. Composers outside of academia have even more limited options.

Finally, many of the most significant composers in their thirties and forties have moved to the United States, where they can find academic employment, support for their work, and venues for performance. Some composers now in the United States return to Israel for extended visits or teaching, but the locus of activity for Israeli-born composers and performers of electronic music is not in the land of their birth. This is unfortunate, although it allows the work of Israeli composers to flourish.

I believe that the situation is well described in a conversation between Shlomo Dubnov and Joseph Tal:

> *Tal*: It [the 1950s] was a difficult period. Today is difficult too. It is typical for Jewish history, but then we remain . . .
>
> *Dubnov*: You can't compare then and today.
>
> *Tal*: For Moses it was hard to carve the Ten Commandments in stone.
>
> *Dubnov*: So then it was like Egypt and now like in the desert?
>
> *Tal*: Something like that. (Tal 2004)

12. HOPEFUL SIGNS

The number of Israeli composers and the level of activity over the past half century suggest that electronic music has been a lively and engaged movement, even as it remains marginal to Israeli public life. Stephen Horenstein (2004) observes that an important

attribute of composers in Israel has been their ability to 'maximise modest resources for maximum effect'. He adds that despite the challenges, Israeli composers have exhibited 'necessity and artistic drive, in the midst of many obstacles: lack of public funding, audience. . .'.

It is worth considering whether a new generation of Israeli composers, working in more popular genres, will move outside of the commercial world that they currently inhabit. Yossi Mar-Haim notes:

> Right now most electronic activity is done by young people who are closer to pop music, done at home with smaller equipment, mostly samplers, and performed at clubs and fringe theatres. The university labs did not produce major works in the pure electro-acoustic sense. There are however some new voice artists that [are] find[ing] a new way, combined with visual ideas. (Mar-Haim 2003)

Avi Elbaz adds that 'In high schools more institutes have started to teach electronic music as part of their programmes' (Elbaz 2004: 1). Joseph Tal found that such programmes had helped build support for his work in the 1970s. Elbaz concludes 'I believe that the audience will grow in the future and more young musicians will create music in that area, so it is currently a question of time but it is very hard to say how long'.

Is it possible that the availability of small, relatively inexpensive equipment will result in a creative synthesis of popular forms with more experimental models? Will the rise of multimedia performance (including live video mixes by vj's) in popular music veins have a positive effect on such output? Unless there is an exposure to experimental forms, currently a rarity, this seems less likely.

Rajmil Fischman sees the possibility that the marginalisation of electronic and computer music could end:

> After a dynamic beginning in the 1960s and 1970s, electronic music in Israel became constrained to pockets of activity (for example, Yitzhak Sadai in the 1980s, Raviv Gazit and Arie Shapira in the 1980s and 1990s, Josef Tal, consistently since the 1950s, Tsippi Fleischer, sporadically in the 1990s), which were rather dependent on the particular aesthetic approach of a few practitioners. I believe that this is changing due to more international exposure, availability of tools, use of technology in popular music, contemporary musical pluralism, the Internet revolution and the emphasis put on electroacoustic music in educational institutions such as Haifa University, and that there is a new generation emerging, which promises vitality and creative drive. (Fischman 2004)

Stephen Horenstein describes his hopes of future possibilities:

> I dream of establishing a world-class studio, available to all composers who are affiliated with the center, raising money from interested donors, here and abroad.

> I envision a move to create interactive projects (musicians/electronics) in the major academies, building collaborative relationships between performers and composers.

> I dream of a new repertoire that builds on the indigenous sound material found in the Middle East, and from echoes of Jewish history and consciousness.

> I hope for a new renaissance of collaborations between composers and artists from other media, utilising the potentials of electronic sound. (Horenstein 2004)

Despite all challenges, Israeli composers of weight and significance continue to compose and perform, sometimes in their homeland. Arie Shapira, Stephen Horenstein, Menahem Zur, Yossi Mar-Haim and others remain active within Israel. The live electronic duo, Krechtz, featuring Ilan Green and Gil Wasserman, thus represents a spark of new life and a new direction for Israeli performance. There is an Israeli presence of merit within international computer music and throughout American universities, among them Amnon Wolman, Jonathan Berger, Gil Weinberg, and Shlomo Dubnov. Keren Rosenbaum, based in the United States, is an increasingly active composer who maintains a presence and influence in Israel. The Haifa University studio, under Arie Shapira, is a growing hotbed of activity. In summary, the heritage of Joseph Tal, Yizhak Sadai and Tzvi Avni remains alive and creative, albeit facing an uncertain future in its land of origin.

ACKNOWLEDGEMENTS

Two web resources about Israeli composers worthy of reference include the Israel Composer's League:

http://www.go.to/israelcomposers (2004); and the Israel Music Institute: http://www.imi.org.il/ (2004). There is also a listserv for the Israel Computers and Music Forum at il-cmf@cs.huji.ac.il. Additional material about Yizhak Sadai may be found in *The Grove Dictionary of Music and Musicians*; *Dictionary of Twentieth Century Music 1974*, London, Thames & Hudson; and *The Concise Oxford Dictionary of Music*, 1980, Oxford University Press.

REFERENCES

Abrams, S., Bellofatto, R., Fuhrer, R., Oppenheim, D., Wright, J., Boulanger, R., Leonard, N., Mash, D., Rendish, M., and Smith, J. 2002. QSketcher: an environment for composing music for film. In *Proc. of the Fourth Conf. on Creativity & Cognition*, October.

Anonymous. 2003. Biography of Joseph Tal. http://www.kith.org/jimmosk/israel.html

Avitsur, E. 2003. Personal correspondence, 27 July.

Avni, T. 2003. Personal correspondence, 27 July, p. 1.

Avni, T. 2003. Personal correspondence, 11 August, p. 2.

Avni, T. 2004. Personal correspondence, 13 January, p. 1.

Avni, T. 2004. Personal correspondence, 7 December, p. 2.

Berger, J. 2003. Personal correspondence, 18 August.

Canadian Science and Technology Museum. Website of their collection, which includes instruments designed and built by Hugh Le Caine. http://www.sciencetech.technomuses.ca/english/collection/music13.cfm

Dorfman, J. 2003. Personal correspondence, 3 August 2003 and 18 January 2004.

Dubnov, S. 1996a. Israel Computers and Music Forum website. http://www.cs.huji.ac.il/labs/learning/il-cmf/

Dubnov, S. 1996b. http://www.kunstradio.at/VR_TON/texte/9.html

Dubnov, S. 2004. Personal correspondence, 10 February.

Elbaz, A. 2004. Personal correspondence, 20 November, p. 1.

Elbaz, A. 2004. Personal correspondence, 12 December, p. 2.

Eppstein, U. 1998. New music voices in Israel. *The Israel Review of Arts and Letters – 1996 / 103*. Posted at http://www.israel.org/MFA/MFAArchive/1990_1999/1998/7/New%20Musical%20Vois%20in%20Israel (2004)

Fischman, R. 1999. Global Village, Local Universe: a statement of identity. *Leonardo Music Journal* 9: 55–8, Journal of the International Society For the Arts, Sciences and Technology. San Francisco: MIT Press.

Fischman, R. 2004. Personal correspondence, 22 November.

Fleischer, T. 1998. Structural aspects of my music as illustrated in the tape work *The Gown of Night* and the cantata *Like Two Branches*. *Organised Sound* 3(1): 51ff, November 1998, and an accompanying audio CD.

Fleisher, R. 1991. *Twenty Israeli Composers: Voices of a Culture*, pp. 67–78 (Joseph Tal), 183 (Arik Shapira), 210 (Tsippi Fleischer). Detroit: Wayne State University Press.

Flender, R. 2005. Personal correspondence, 5 January.

Flender, R. 2005. Website: http://www.davidflender.com

Flusser, D. 1979. Programme notes to *Testimonium V: The Jews of Spain*. Personal collection of Yizhak Sadai.

Freier, S. 2004. Recha Freier und Testimonium, http://www.hagalil.com/israel/deutschland/freier-recha.htm, date unknown. Viewed in 2004.

Gang, D. 2004. http://ccrma-www.stanford.edu/~dang/, p. 1.

Gang, D. *et al.* 2004. http://www.musicgenome.com/, p. 2.

Gazit, R. 2003. http://www.tau.ac.il/~ravivg/

Gazit, R. 2004. Personal correspondence, 12 January.

Goodman, D. 2004. Telephone interview, 17 February.

Gradenwitz, P. 1996. *Music of Israel: From the Biblical Era to Modern Times*, p. 363. Portland, Oregon: Amadeus Press (first edition, 1949).

Green, I. 2004. Personal correspondence, 19 April. Augustine Lenoir, p. 1.

Green, I. 2004. http://www.greenet.co.il/krechtz/, p. 2.

Gruber, P. Musical Border Crossers. *Weiner Zeitung*, posted at http://www.wienerzeitung.at/frameless/lexikon.htm?ID = 13514

Halpern, O. 2002. Packaging Judaism, art and politics. *Haaretz*, 13 December. Also posted at http://www.schechter.edu/news/media_haaretz1202_art.htm

Ha'aretz. 1999. *Interdisciplinary Fantasies Composer Keren Rosenbaum's*, 2 December.

Holland, S., and Oppenheim, D. 1999. Direct combination. In *Proc. of the SIGCHI Conf. on Human Factors in Computing Systems: the CHI is the Limit*, May.

Horenstein, S. 2004. Personal correspondence, 6–9 December.

Horenstein, S. 2005. Personal correspondence, 17, April.

IBM Research. 2004. http://domino.research.ibm.com/comm/wwwr_thinkresearch.nsf/pages/cyberband297.html. Musical examples at http://domino.research.ibm.com/Comm/bios.nsf/pages/morphdemo.html

ICMA. 2003. http://www.computermusic.org/array.php?artid = 58

Immanuel, A. 2003. Personal correspondence, 21 August.

IRCAM. 2004. Project description of 'Carnet de Voyage' by Shlomo Dubnov. Avi Elbaz and http://www.ircam.fr/44.html?&encryptionKey = &tx_ircam_pi2[showUid] = 1&cHash = 8de0593096&L = 1

Keren, G. 2004. Telephone interview, 21 January.

Keren, G., and Shashoua, M. 2004. Obituary first posted on the Compuserve Waves Forum, available at http://www.york.ac.uk/inst/mustech/3d_audio/obit.htm

Keren, G., and Shashoua, M. 2004. http://www.waves.com/

Keren-Huss, K. 2003. Personal correspondence, 13 August.

Mar-Haim, Y. 2003. Personal correspondence, 18 August.

The Media Management Group. 2004. http://www.classicthemes.com/studioLogos.shtml

Mishori, N. 1980. Sadai, Yizhak. *New Grove Dictionary of Music and Musicians*, Vol. 22, p. 80. London: MacMillan Publishing Ltd.

Ringer, A. 1965. Musical Composition in Modern Israel. In P. H. Land and N. Broder (eds.) *Contemporary Music in Europe: A Comprehensive Survey*, pp. 288–90. New York: W. W. Norton & Company.

Ringer, A. 1980. Tal, Josef. *New Grove Dictionary of Music and Musicians*, Vol. 22, p. 289. London: MacMillan Publishing Ltd.

Sadai, Y. 2004. Personal correspondence, 11 January.

Shapira, A. 1996. Contemporary composer teaches contra-diction, rebellion. *Focus*, Spring. Haifa: University of Haifa.

Shapira, A. 2005. Personal correspondence, 14-15, May.

Shashoua, M. 2004. Telephone interview, 17 February.

Shimony, U., Markel, S., and Tal, J. 1988. Icon notation for electroacoustic and computer music. In *Proc. of the 1988 Int. Computer Music Conf*. International Computer Music Association.

Shimony, U., Gerner, M., Markel, S., and Tal, J. 1992. Studio Report: a new musical notation system – TAL. In *Proc. of the 1992 Int. Computer Music Conf*. International Computer Music Association.

Tal, J. 2002. *Musica Nova in the Third Millennium*. Jerusalem: Israel Music Institute.

Tal, J. 2003. Interview, conducted by Shlomo Dubnov at Tal's home in Jerusalem in September 2003, based upon questions by Bob Gluck.

Tal, J. 2004. Telephone interview by Shlomo Dubnov, 12 December.

Universal Edition Website. Biography of Roman Hauberstock-Ramati. http://www.universaledition.com/

truman/en_templates/view.php3?f_id = 8294&spr = en (2004)

Villas, G. 2002. Interview with Bob Moog, 25 April. http://www.d-i-r-t-y.com/index2.html?first = http://www.d-i-r-t-y.com/textes/int_bobmoog.html

Weinberg, G. 2003a. *Interconnected Musical Networks – Bringing Expression and Thoughtfulness to Collaborative Group Playing*, p. 1. PhD Thesis. Cambridge, MA: Massachusetts Institute of Technology.

Weinberg, G. 2003b. Interconnected Musical Networks: bringing expression and thoughtfulness to collaborative group playing. Keynote address at the Australasian Computer Music Association Conference 2003, p. 2. http://acmc.waapa.ecu.edu.au/

Weinberg, G. 2004. iltur. http://www.cc.gatech.edu/~gilwein/iltur.htm

Weinberg, G. 2005. Personal correspondence, 4 January.

Young, G. 1989. *The Sackbut Blues: Hugh LeCaine Pioneer in Electronic Music*, Chapters 8 and 9. Toronto: National Museum of Science and Technology.

Young, G. 1999. LE CAINE: an inventor's notebook. http://www.hughlecaine.com/en/sptape.html

Zur, M. 2004. Personal correspondence, 20 January.