Tech-nically, It's Music

Caltech now has two courses in which music can overlap comfortably and creatively with science and technology

Although a particular affinity of scientists for music may not be provable, the "fact" of a large incidence of musicians among scientists has been remarked so often that to some it seems almost a cliché.

The overlap, real or imagined, of music with physics and mathematics does have a long history. Among others, Pythagoras was intrigued by the numerical relationships in harmonies; Galileo (and the French mathematician Mersenne) demonstrated the relation between the number of vibrations per second and the musical pitch of a note; Kepler based the laws of planetary motion on musical notation; and the 18th-century mathematicians Leonhard Euler and Daniel Bernoulli used differential equations to determine a formula for the vibrating string. There also seem to be a great number of contemporary scientists who leave their labs behind for a bit of Bach on the piano or a string quartet with some colleagues.

By inference, one could conclude that many Caltech students might be musicians. But, although numerous extracurricular opportunities exist for student musicians to sing and to play in chamber orchestras and smaller groups, Caltech is not primarily in the business of music education. Until recently, with little incentive in the form of credit courses for musically talented students to continue their involvement, music instruction and performance has stopped for many Caltech students because other studies of higher priority demanded so much of their attention and time. That situation seems to be changing.

"Music for Piano Ensemble: History, Analysis, Performance" — Mu 18 — has been offered for the past three years. It is the only credit course for performance in the curriculum, but it's in no way just a course for "playing" around. In keeping with the Caltech spirit of mental rigor, it is an intellectually demanding introduction to a very specific area of musical literature. A large part of the orchestra repertoire does not include the piano, so pianists seldom get the training and discipline that come from ensemble playing. (Piano concerto is a specialized form of solo.)

Performing in at least one public concert is necessary for course credit, and students are required to spend a minimum of ten hours per week in preparation for three hours of class. Actually, the three hours of class usually stretch out to eight or nine when a performance is coming up, says Elma Schonbach, who originated the course and teaches it, using the two grand pianos in her own home near campus. The course is open to students of varying skill levels (last year's students had from 3 to 15 years piano experience) and all classes from sophomore through graduate. Students have invariably praised the course as "one of the few outlets for creative expression on campus" and "especially rewarding for those of us who have spent a fair amount of time during our lives in this endeavor."

Schonbach, who holds a degree from the Cincinnati Conservatory of Music and has been teaching at Caltech since 1976, became interested in piano ensemble as a teaching discipline about 20 years ago. It's also known as piano duet, but Schonbach generally avoids this designation because of the image it evokes of reluctant children plinking out elementary pieces for admiring relatives.

What Schonbach teaches in the ensemble course is a historical survey, through interpretation, of the literature written specifically for two players at one piano. (Two-piano music, much different in character, is also included in the course to a lesser extent.) Four-hand piano is considered chamber music and possesses the intimate style and mathematical complexity of that form. It demands a great amount of discipline and sensitivity. Playing ensemble piano is less subjective than solo playing; it does not allow the musicians arbitrarily to accommodate their own weaknesses (or emphasize their own strengths). The pianist is forced to become more aware of the composer's intentions and to try to work them out in balance with

Students in Mu 18 — Music for Piano Ensemble: History, Analysis, Performance — work together at two Steinways under the direction of their instructor, Elma Schonbach.

another musician as close as his, or her, own elbow.

Schonbach focuses the course on interpreting the stylistic trends of various periods. The 19th century was the most prolific period for four-hand piano literature; Schumann, Brahms, and, especially, Schubert created a great number of compositions for ensemble piano. Today this genre is enjoying a resurgence of recognition among composers as well as among concert and recording artists. Some original piano literature for eight hands also exists, and the Caltech class studies this form of ensemble piano also. Fortunately the different parts are often composed for varying levels of piano skill.

An eight-hands piece (one of Dvorak's Slavonic dances) was included in a short recital at the faculty dinner last May, at which students Carolyn Venger, Bruce Baskir, Don Berry, Ernest Cohen, Kurt Bachmann, and Vincent Powers performed. (Concerts were also given at the Westridge School and for the Pasadena Symphony Associates.) Combining the Athenaeum's dining rooms into an L-shaped space for large dinners does not provide ideal acoustics for music of any sort, and having to balance the sound produced by two pianists playing on a spinet with that of two others at a concert grand compounded the problem. But listening to each other and balancing their tone was something the students had learned in the course, and the faculty dinner entertainment was a hit.

Coping with surroundings not originally intended for perfect sound may be a fact of life for any Caltech music course. The room in the subbasement of Thomas where EE/Mu 107 meets bears remnants (pipes, faucets, sinks) of the kind of laboratory it used to be, but the odd swatches of shag rug on the floor and the acoustic mats hanging from the ceiling, as well as an assortment of speakers, amplifiers, and turntables, indicate that something new is going on here.

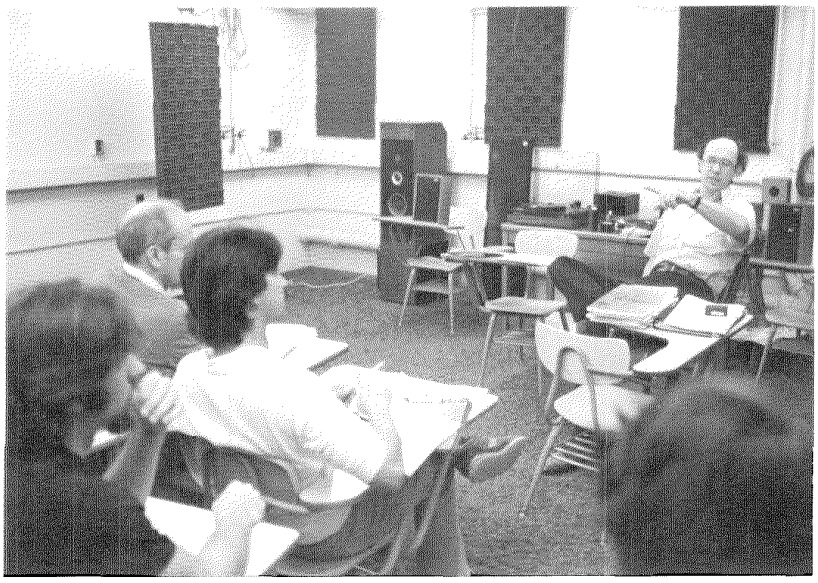
And indeed it is. "Projects in Music and Science," cross-listed in Humanities and Social Sciences and in Engineering and Applied Science (with credit in either division) is a course unique in the country, as far as anyone knows. It began last year with help from the President's Venture Fund and with the advice and cooperation of John R. Pierce, professor of engineering, now emeritus, who has long been interested in the strong link between music and technology. Pierce thinks Caltech is the ideal place to tackle such things as the meaning of musical sound.

Musical sound from a sophisticated scientific point of view (or rather, point of hearing) is the primary concern of the course and of its teacher, James Boyk, who came to Caltech as artist in residence in 1974. He has particularly fortunate qualifications to teach such a course — in addition to being a concert pianist with a Harvard degree in mathematics, he runs his own stereo consulting firm — Sound Decision — and record company — Performance Recordings. Boyk sees the course as an integration of the analytical and perceptual, the intellectual and emotional. It's not a matter of bringing science into music, he says; it's already there. Unfortunately, most engineers involved in audio design do not really know how to hear the sound of live music, he maintains, and most musicians ignore much of the content of performance training because it is scientific in language.

The first third of the course is an "acute listening experience"; students listen to and analyze live and reproduced sound. Last year they ranged far afield from their basement studio, visiting a well-known stereo manufacturer (the students were not impressed with the sound quality), a record-cutting laboratory known for the fidelity of its products, and a piano showroom, to compare the sounds of several "live" pianos. Then individual projects took up the rest of the year, after Boyk and his students had "hustled" $12,000 worth of equipment in gifts, loans, and rentals.

Seven official students last year (other students and faculty members often wan-

Hanging acoustic mats and "hustled" sound equipment help transform a former lab into a makeshift studio where Jim Boyk conducts EE/Mu 107 — Projects in Music and Science.



dered in) chose projects expressing their interests and experience. The class included both undergraduate and graduate students, whose music backgrounds ranged from zero to substantial. Some projects focused more on the musical aspects of the course than on the engineering. One of these, the project of senior Eric Saund, investigated the neurological aspects of music perception — how the brain's sound-processing neural networks work, and why music is perceived as a "good" sound. His study included experiments on perception of critical band width (in which the ear cannot differentiate separate tones).

In another project, which dealt with music as a language of the emotions, Mike Kong tested a theory formulated by musicologist Deryck Cooke that associates particular emotions (joy, anguish, and so on) with each degree of the scale (major third, minor sixth, for example). He played on the piano some of 18 musical phrases for several groups of subjects, asking them to write down what they perceived to be the emotional content of a particular note and of the musical quotation it was a part of. Although the responses tended to support some of Cooke's ideas, the scope of the experiment was too limited for the results to be considered conclusive.

Other projects dealt more with audio hardware — the electrical engineering side. William Snyder and Bruce McArthur attempted to find out what matters in microphone placement. Although the best stereo sound is recorded with coincident mikes (at the same point in space but aimed in different directions) rather than with mikes at opposite sides of a stage or studio, they wondered how much difference small distances between the microphones would make in the sound. They build an apparatus to move two microphones from one and a half feet apart through coincidence and away again and used it to tape two fellow classmates playing Bach's double violin concerto. (The class correctly guessed which tape was made with the moving mikes and which with coincident, but decided that it was the motion that was disturbing rather than the placement.) For another project Snyder also designed and tested a turntable mounted on a three-point spring suspension to achieve maximum isolation from room noise.

Fan-Chia Tao worked with quadraphonic sound to try to reproduce the true "imaging" (the placement of apparent sound sources) of a piano being played in a concert hall, so that someone listening to the recording would hear a piano in front of him with the sound of the room around him. (Most quadraphonic systems give the listener the feeling of sitting on top of the piano, or in the middle of an orchestra, with music coming at him from all four speakers.)

Since specifications for audio equipment have little bearing on the actual sound, junior Bill Gross, whose project involved pulse testing of speakers, tried to correlate good sound quality with direct measurements. Gross manufactures and sells his own stereo speakers (Gross National Products — see *Caltech News*, January 1980).

Graduate student Pierre Schnoeller's study of room acoustics provided a valuable service for the class, since the room he studied (measuring the frequency range with a spectrum analyzer) happened to be the Thomas basement classroom. The end result of his experiments — hanging acoustical foam absorbers from the ceiling in particular patterns — made a big difference in the room's acoustics for a group that, by the end of the year, was extremely knowledgeable about and sensitive to sound.

Both courses are being given again this year. Caltech may never become a Juilliard, but, as Boyk and Schonbach agree, it is a place where many students possess an unusual blend of intellectual and musical talent. Boyk claims Caltech is the only place he has taught music where he can mention things like harmonic series and be sure people know what he's talking about. Certainly it is a place where music and science and technology can overlap comfortably and creatively. □