"Telharmonium" by Reynold Weidenaar
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Teisco. The name of a range of synthesizers manufactured by KAWAI from the late 1970s.

Teixeira, Manuel Machado. Portuguese organ builder, father of ANTÓNIO MACHADO E CERVEIRA.

Teke. Struck vessel idiophone of the Dhola people of Mbale district, Uganda. It comprises an inverted bowl.

Teke bora. Wooden concussion sticks of the Bariba people of Benin. It is used by men as rhythmic accompaniment to *teke* music, together with hourglass and cylindrical drums, for the enthronement of kings.

Tekerő. HURDY-GURDY of Hungary. Semi-professional peasant musicians play mainly traditional dance music on it, either as a solo instrument or, more often, with a melodic instrument (usually the clarinet). If its melody string is tuned to *f♯'*, the tuning of the two accompanying strings, which provide a drone accompaniment, is *B* and *b*.

Te-keya. Rattle of Gbaya women of the Central African Republic. It is made from two spherical fruit shells filled with small pebbles and joined by a cord. The singer uses a pair in each hand and by a regular movement brings the shells together. The instrument is used to accompany singing, often of sad songs. See S. Arom and G. Dournon-Taurelle: 'Afrique: complaintes et incantations', HMU 946 [disc notes].

Tekpede. Ground harp of the Dan people of the Ivory Coast (for illustration *see* GROUND HARP). See H. Zemp: *Musique Dan* (Paris, 1971), 52.

Tēku. A general term for drum in Okinawa, Japan, corresponding to the Japanese TAIKO. It generally designates two shallow-bodied barrel drums used in tandem: the *ufudēku*, a drum with tacked heads (*see* HIRADAIKO), placed vertically at the player's left; and the *kudēku*, a drum with lapped heads of the *nōdaiko* kind (*see* SHIMEDAIKO), placed in front of the player. This set accompanies both classical song and folksong. The term may sometimes also designate the CHIJIN drum, both in its Okinawan and Amami uses.

DAVID W. HUGHES

Telempong. GONG-CHIME used in the *makyung* theatre ensemble in the Serdang area on the east coast of North Sumatra. The *telempong* is also used in the *biola mendu* ensemble for theatre performances in Riau (Indonesia) and West Malaysia. The gongs are about 17 cm in diameter, with a boss about 4 cm wide. They are made of bronze, mostly in southern Thailand, and are beaten with lightly padded sticks. *See also* TALEMPONG.

MARGARET J. KARTOMI

Teleng [kediding]. Idiochord TUBE ZITHER of the island of Alor, Indonesia. Its eight strings, about 50 mm wide, are prised out of the surface of an old stout tube of bamboo about 1 metre long. They are each raised on bridges at both ends. The two outer strings (*kingkong*) are the highest pitched and the two innermost strings (*gong ele*) the lowest.

MARGARET J. KARTOMI

Télé-sculpture musicale. *See* ELECTROMAGNETIC MUSICAL.

Telford, William (*d* Dublin, 1885). Irish organ builder. He established himself in Dublin in 1830, the firm later becoming known as Telford & Telford. It built a number of organs in the mid-19th century, ranging in size from the 47-stop instrument for St Peter's College, Radley (*c*1850), to small church barrel organs. Other important organs included those for Trinity College, Dublin (1838), and the church of St Malachy, Belfast (1849). While the bulk of his work was in Ireland, Telford was known and respected in England, where he was one of the adjudicators of musical instruments at the Great Exhibition of 1851 held at the Crystal Palace.

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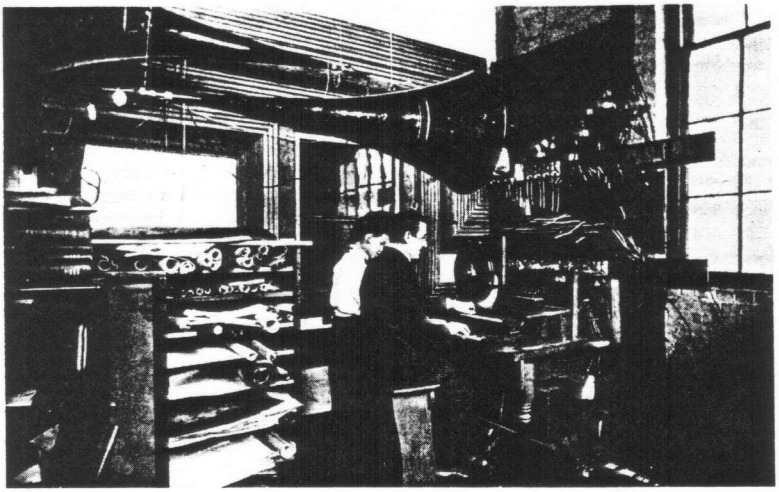
BARBARA OWEN

Telharmonium [Dynamophone]. An electromechanical keyboard instrument developed in Washington, DC, Holyoke, Massachusetts, and New York between 1892 and 1914 by Thaddeus Cahill (*b* Mount Zion, Iowa, 1867; *d* New York City, 12 April 1934). 'Dynamophone' eventually became Cahill's preferred name for his instrument, but it was not widely adopted. Three instruments were completed, none of which fully embodied the construction specifications contained in Cahill's five American patents. Cahill was also granted 30 patents for other inventions, including piano actions, electric typewriters and typesetting equipment.

After experimenting for three years, Cahill applied for a patent in 1895 and began to construct the first complete model of the Telharmonium, a small prototype for the later versions. The sound-generating system of the instrument was based on the tone-wheel principle: the basic component was a rheotome – a rotor with alternate conducting and insulating sections – in contact with stationary metal brushes. The rheotomes were grouped as rheotome cylinders, single rotors on which six simple rheotomes were machined, corresponding to the fundamental and first five overtones. The plans show 12 shafts (one for each note of the octave) on each of which seven cylinders (one for each octave) were to be mounted; the shafts were rotated by belts mounted on a single driveshaft, powered by a constant-speed, direct-current electric motor. A large dynamo supplied current directly into the mainframe; the current travelled through the pitch shafts into the conducting sections of the revolving rheotomes, so that the brushes received interrupted electrical signals. The waveforms thus produced were filtered into sine waves by means of four sets of transformers and then combined into a composite signal, which was transmitted to multiple telephone receivers and to 'loudspeakers' made of piano soundboards. The instrument was played from a keyboard, and a hammer mechanism, dependent on key velocity, controlled volume by moving a transformer coil.

Cahill completed work on the first version in 1900 and used it to test designs for a larger model. In 1903 it was moved to Holyoke, where Cahill set up a laboratory. In the final form of the first Telharmonium (completed in 1906) the rheotome cylinders were removed and replaced by 35 alternators; those pitched above the lowest octave were used simultaneously to create the fundamental of one note and one of the overtones of



Two performers seated at the console of the Telharmonium, with larger speaker horn overhead (1906)

various lower notes. Each alternator consisted of a toothed section of a rotor made of soft iron; up to eight sections, usually in octaves, were machined on a single rotor. The rotor revolved in the presence of an electromagnetic field (for illustration *see* ELECTRONIC INSTRUMENTS, fig.2*a*). This induced an alternating current in an armature coil located within the field and also in close proximity to the teeth of the rotor. The armature coil emitted as many cycles per revolution as the rotor had teeth. Eventually another type of alternator, with magnetic pole pieces mounted on stationary and rotating discs, was employed for the low notes. The shafts were now connected by steel gears. Rheostats controlled the amplitude of each partial separately (the seventh and eighth harmonics were added, and later the tenth, 12th and 16th for the lowest notes), so that various timbres could be produced. The instrument had two manuals with a total range of five octaves, and could produce tremolo, crescendo and diminuendo. The piano soundboard 'loudspeakers' were replaced by telephone receivers to which large paper horns were attached.

The second Telharmonium, built in Holyoke from 1903 to 1906, was on a much larger scale than the first, being intended for commercial use. Its 145 alternators were mounted on eight steel shafts 28 cm (11″) in diameter supported by a frame 18·3 metres (60′) long and made of steel girders. The driveshaft was powered by a 185-h.p. motor and some of the alternators generated up to 19 h.p. each. The output signal was far stronger than the inductive noises of the telephone lines (which were effectively masked) and it supplied as much as 1 amp to each receiver so that the sound could be heard without holding the receiver to the ear. The three five-octave, 144-key manuals (up to 36 keys per octave) allowed simultaneous operation in equal temperament and just intonation, at frequencies from 40 to 4000 Hz. There were up to eleven small switches on each key; each switch actuated one of nearly 2000 heavy-duty switches, routing the signals generated by the alternators to the circuits for the fundamental and each harmonic. The entire apparatus weighed nearly 200 tons and cost $200,000.

The second Telharmonium was completed in March 1906 and in June was installed in Telharmonic Hall, New York, on Broadway at 39th Street; by December daily concerts were being presented and transmitted to subscribers along a system of lines drawn through the conduits used by the telephone network (the telephone lines themselves could not be used because conversations were drowned by the signals from the far more powerful Telharmonium). However, the longstanding interest of the telephone company (A.T. & T.) in the instrument waned when it was discovered that interference caused by induction between the parallel sets of wires could not be eliminated, and the contract for the use of the telephone conduits was cancelled. The city authorities then offered a franchise to lay Telharmonium lines in telegraph and electrical power conduits, but a shortage of investment capital and the ensuing withdrawal of the Telharmonium's main backer, Oscar T. Crosby, prevented the adoption of this option. Nor was the musical quality of the transmissions satisfactory: the players (often two performed together) had little opportunity to practise at the unfamiliar and awkward keyboard, but were obliged nevertheless to give daily performances, which left much to be desired; technical imperfections included a frequent reduction in volume as voices were added, an exaggerated staccato, a 'growling' effect in the bass and a constant tone quality that was said to become highly irritating. In May 1907 the project had only 12 subscribers and the position did not improve; the final concerts were transmitted early in 1908.

Cahill was already back in Holyoke, at work on the third Telharmonium, which was even bigger than the previous one and even more costly. It had 140 newly designed and much more powerful alternators, mounted on 24 steel shafts 21·5 cm in diameter which were held in a frame 20 metres long and 4 metres wide. It had two standard manuals and reintroduced the volume control of the first Telharmonium, which had been missing from the second version. The newly designed receiver had a larger, heavier diaphragm and a more powerful magnet, and prevented the 'growl' in the bass. In March 1911 Cahill signed a franchise contract with the city of New York and in April moved his laboratory and the completed Telharmonium there; the instrument was installed at 535 West 56th Street. Financial difficulties and lack of public interest were compounded by the awareness that the development of amplification systems and wireless were rendering the Telharmonium obsolete. Experiments and adjustments were carried out for several years but no commercial service was estab-

lished. Noncommercial transmissions were made to the Pabst Grand Circle Hotel on Columbus Circle and the Chapter Room of Carnegie Hall along the only cable installed by the company. In December 1914 the company went bankrupt. The third Telharmonium survived in working order at least until 1916, but the fate of all three instruments is unknown.

Cahill's younger brother George F. Cahill, who had assisted in the enterprise, later invented the Cahill glareless duplex floodlight projector, which made night-time sports events possible. Thaddeus became a junior partner in the firm of Cahill Brothers, whose floodlights were widely used in the USA and Britain. The youngest brother, Arthur T. Cahill, was later granted two patents in the 1940s for his own keyboard instruments based on some principles of the Telharmonium. They had tonewheels, a piano action, movable circuits and hydraulic decay controls. He also preserved the first Telharmonium in storage in New Jersey for many years. In 1951 he circulated letters attempting to locate a permanent home for the instrument. As far as is known, he was not successful, and the first Telharmonium was probably sold for scrap upon his death in 1962.

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REYNOLD WEIDENAAR

Telincă. *See* TILINCĂ.

Telio-chordon. A microtonal grand piano built by CHARLES CLAGGET of London in 1788. The octave was divided into 39 intervals, each key (with the help of pedals, as on the harp) operating three notes. There were two extra bridges near the hammers with movable bars of wood or metal directly over them; when these bars were pressed on the strings by means of the pedals the power of the original bridge was transferred to the secondary bridges or bars.

Tellern (Ger.). CYMBALS.

Telt. Large oboe of Egypt. *See* MIZMĀR.

Telyn. Welsh harp, long recognized as the main national instrument. Literary references to it are frequent from around the 12th century onwards. In its early single-strung form it remained distinct from its Irish counterpart, but developed a variety of shapes and dimensions. Around 1700, Welsh musicians adopted the Italian-devised chromatic triple harp and this remained in use until the 20th century, by which time native harps, both single- and triple-strung, had been largely superseded by the pedal harp. Attempts have since been made to revive the triple harp.

See also HARP, §4 (v) and figs.19–20.

D. ROY SAER

Tematne are. Aerophone of Ambrym Island of Vanuatu. *See* TEMES NAAINGGOL.

Tembe. *See* TAMBE.

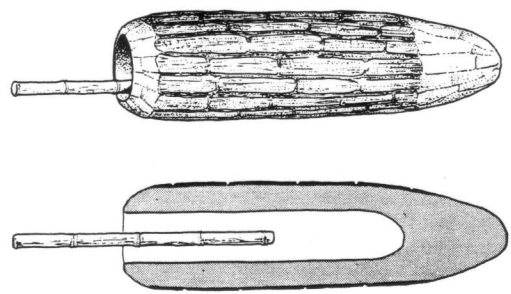
Tembir. Lute of the Uighur people of Central Asia, akin to the ṬANBŪR of the Uzbeks and Tajiks.

Tembol. Drum of Chad. (1) WATER-DRUM of the Kotoko people of the Logone river area. It consists of an inverted half-calabash floating on water within a larger calabash or other receptacle. The inverted calabash is struck with a straight stick, and the player is always female. The sound is composite: a clear sound from the stick on the calabash and a deeper sound from the resonance of the air in the calabash amplified by the water. These drums can be tuned by choosing a specific size of calabash. In the Hollom region in Kotoko dialect the drum is called *kwashi*.

(2) Double-headed drum of the Kanembu people. *See* TUMBOL.

MONIQUE BRANDILY

Temes naainggol. Aerophone of south-western Malekula, Vanuatu. It is similar to the *tematne are* of Ambrym, Vanuatu. Both instruments consist of a wooden vessel, rather like a deep mortar (60 to 180 cm long), into which the performer blows through a reed tube, producing a booming tone. The performer uses several of these vessels, each of a different pitch, and dexterously withdraws his reed pipe from one and inserts it into another as he accompanies the singing. See A. B. Deacon: *Malekula, a Vanishing People in the New Hebrides* (London, 1934), 391.



Temes naainggol (aerophone with reed tube) of Vanuatu: general view and section

Temir komuz. Metal JEW'S HARP of the Kirghiz people of Central Asia.

Ṭemko. *See* ṬYĀMKO.

Tempérament égal (Fr.; It. *temperamento equabile*). EQUAL TEMPERAMENT.