an acid reaction to litmus. It possesses a nauseous metallic taste and produces vomiting when taken internally, whilst in large doses it is poisonous. It is used medicinally, and also as a mordant in dyeing and calico-printing.

**TARTARIC ACID** (dihydroxy-succinic acid), C4H6O6, or HO2C∙CH(OH)∙CH(OH)∙CO2H. Four acids of this composi­tion are known, namely dextro- and laevo-tartaric acids, racemic acid and mesotartaric acid, the two last being optically inactive (see Stereo-Isomerism). Their constitution follows from their formation from dibromosuccinic acid and from their synthesis from glyoxal cyanhydrin, these two methods pro­ducing the inactive racemic form which may then be split into the active components. Dextro-tartaric acid occurs in the free state or as the potassium or calcium salt in grape juice and in various unripe fruits. During the alcoholic fermentation of grape juice it is deposited in the form of an impure acid potassium tartrate which is known as argol, and when purified as cream of tartar. For the preparation of the acid the crude argol is boiled with hydrochloric acid and afterwards precipi­tated as calcium tartrate by boiling with milk of lime, the calcium salt being afterwards decomposed by sulphuric acid. It may also be obtained (together with racemic acid) by oxidiz­ing milk sugar, saccharic acid, &c., with nitric acid, and by the reduction of oxalic ester with sodium amalgam (H. Debus, *Ann.,* 1873, 166, p. 109). It crystallizes from water in large prisms which melt at 168-170º C., and on further heating gives an anhydride and finally chars, emitting a characteristic odour and forming pyroracemic and pyrotartaric acids. It behaves as a reducing agent. Chromic acid and potassium permanganate oxidize it to formic and carbonic acids, whilst hydrogen peroxide in the presence of ferrous salts gives dihydroxymaleic acid (H. J. H. Fenton, *Jour. Chem. Soc.,* 1894, p. 899; 1895, pp. 48, 774; 1896, p. 546). Hydriodic acid and phosphorus reduce it to malic acid and finally to succinic acid. Calcium chloride gives a white precipitate of calcium tartrate in neutral solutions, the precipitate being soluble in cold solutions of caustic potash but re-precipitated on boiling. It prevents the precipitation of many metallic hydroxides by caustic alkalis. It carbonizes when heated with strong sulphuric acid, giving, among other pro­ducts, carbon monoxide and carbon dioxide. A small crystal of oxalic acid added to concentrated sulphuric acid containing about 1 per cent. of resorcin gives a characteristic violet red coloration.

Laevo-tartaric acid is identical in its chemical and in most of its physical properties with the dextro-acid, differing chiefly in its action on polarized light, the plane of polarization being rotated to the left. By mixing equal quantities of the two forms in aqueous solution heat is evolved and racemic acid, (C4H6O6)2·2H2O, is obtained. This variety is also formed by the hydrolysis of glyoxal cyanhydrin (F. Pollak, *Monats.,* 1894, 15, p. 469); by heating a solution of desoxalic acid; by the oxidation of fumaric acid with potassium permanganate; by the action of silver oxide on dibromosuccinic acid, and by the oxidation of mannite, dulcite, inulin, &c., with nitric acid. In the anhydrous state it melts at 205-206º C. Mesotartaric acid is formed when cin­chonine tartrate is heated for some time at 170° C. (L. Pasteur, *Ann.,* 1853, 88, p. 212); by heating tartaric or racemic acid for some time with water to 165º C. ; by the oxidation of laevulose; and by the oxidation of phenol or maleic acid with an alkaline solution of potassium permanganate (O. Doebner, *Ber.,* 1891, 24, p. 1755; A. Kekulé and R. Anschutz, *ibid.,* 1881, 14, p. 714). It crystallizes in prisms, and in the anhydrous state melts at 140° C. On pro­longed boiling with aqueous hydrochloric acid it yields racemic acid. The sodium ammonium salt is not capable of decomposition into its optical antipodes, as is sodium ammonium racemate.

Tartaric acid as used in medicine is derived from potassium acid tartrate. Its impurities are lead, oxalic acid, lime and potassium tartrate. It is incompatible with potassium, calcium, mercury and vegetable astringents. Tartaric acid is rarely used alone, but is contained in *pilula quininae sulphatis* and in Seidlitz powder (see Sodium), and is a constituent of many proprietary granular effervescent preparations. If taken in overdose or in a concentrated form tartaric acid produces severe gastro-enteritis. In these cases lime-water, alkalis and magnesia should be used as antidotes, and opium may be required.

**TARTARUS,** in Greek mythology, the son of Aether and Gaea, father of Typhoeus and the giants. In the *Iliad* the word denotes an underground prison, as far below Hades as earth is below heaven, in which those who rebelled against the will of Zeus were confined. In later writers Tartarus is the place of punishment of the wicked after death, and is used for the underworld generally. Cf. Abyss.

**TARTINI, GIUSEPPE** (1692-1770), Italian violinist, com­poser and musical theorist, was bom at Tirano in Istria on the 12th of April 1692. In early life he studied, with equal want of success, for the church, the law courts, and the profession of arms. As a young man he was wild and irregular, and he crowned his improprieties by clandestinely marrying the niece of Cardinal Cornaro, archbishop of Padua. The cardinal re­sented the marriage as a disgraceful mésalliance, and denounced it so violently that the unhappy bridegroom, thinking his life in danger, fled for safety to a monastery at Assisi, where his character underwent a complete change. He studied the theory of music under Padre Boemo, the organist of the monastery, and, without any assistance whatever, taught himself to play the violin in so masterly a style that his performances in the church became the wonder of the neighbourhood. For more than two years his identity remained undiscovered, but one day the wind blew aside a curtain behind which he was playing, and one of his hearers recognized him and betrayed his retreat to the cardinal, who, hearing of his changed character, readmitted him to favour and restored him to his wife.

Tartini next removed to Venice, where the fine violin-playing of Veracini excited his admiration and prompted him to repair, by the aid of good instruction, the shortcomings of his own self- taught method. He left his wife with relations and returned to Ancona, where he studied for a time. In 1721 he returned to Padua, where he was appointed solo violinist at the church of San Antonio. From 1723 to 1725 he acted as conductor of Count Kinsky’s private band in Prague. In 1728 he founded a school for violin in Padua. The date of his presence in Rome does not seem to be clearly established, but he was in Bologna in 1739. Afterwards he returned to his old post in Padua, where he died on the 16th of February 1770.

Tartini’s compositions are very numerous, and faithfully illustrate his passionate and masterly style of execution, which surpassed in brilliancy and refined taste that of all his contem­poraries. He frequently headed his pieces with an explana­tory poetical motto, such as “ Ombra cara,” or “ Volgete il riso in pianto o mie pupille.” Concerning that known as *II Trillo del Diavolo,* or *The Devil’s Sonata,* he told a curious story to Lalande, in 1766. He dreamed that the devil had become his slave, and that he one day asked him if he could play the violin. The devil replied that he believed he could pick out a tune, and thereupon he played a sonata so exquisite that Tartini thought he had never heard any music to equal it. On awaking he tried to note down the composition, but succeeded very imperfectly, though the *Devil’s Sonata* is one of his best productions.

Tartini is historically important as having contributed to the science of acoustics as well as to musical art by his discovery (inde­pendently of Sorge, 1740, to whom the primary credit is now given) of what are still called "Tartini’s tones ” (see Sound and Hearing), or differential tones.

The phenomenon is this:—when any two notes are produced steadily and with great intensity, a third note is heard, whose vibration number is the difference of those of the two primary notes. It follows from this that any two consecutive members of a harmonic series have the fundamental of that series for their difference tone —thus, E/C*,* the fourth and fifth harmonic, produce C, the prime or generator, at the interval of two octaves under the lower of those two notes; E/G, the third and fifth harmonic, produce C, the second harmonic, at the interval of a 5th under the lower of those two notes. The discoverer was wont to tell his pupils that their double- stopping was not in tune unless they could hear the third note; and Henry Blagrove (1811-1872) gave the same admonition. The phenomenon has other than technical significance; an experiment by Sir F. A. G. Ouseley showed that two pipes, tuned by measure­ment to so acute a pitch as to render the notes of both inaudible by human ears, when blown together produce the difference of tone of the inaudible primaries, and this verifies the fact of the infinite upward range of sound which transcends the perceptive power of human organs. The obverse of this fact is that of any sound being deepened by an 8th if the length of the string or pipe which