heating potassium thorium chloride or the tetrachloride with sodium (see W. von Bolton, R. J. Meyer and H. Karstens, *Journ. Chem. Soc.,* 1909, vol. 96). It forms microscopic hex­agonal plates having a silver-white streak. It is very heavy, its density being about II; it inflames when heated in air and is not attacked by alkalis; it readily dissolves in nitric acid and aqua regia, but with difficulty in hydrochloric acid.

In its salts, thorium is tetravalent, and in the periodic classification it occurs in the same sub-group as titanium, cerium and zirconium.

*Thorium dioxide* or *thoria,* ThO2, is the most important compound, being manufactured commercially in comparatively large quantities from monazite sands, with \_a view to its utilization for gas mantles (see Lighting, Gas). It is an amorphous white powder; but it may also be obtained in crystals isomorphous with cassiterite by heating the amorphous form with borax to a very high temperature. An oxide Th2O2 is formed by heating the oxalate.

*Thorium fluoride,* ThF4, is obtained as a heavy white insoluble powder by dissolving the hydrate in hydrofluoric acid and evaporat­ing. By precipitating a thorium salt with a fluoride, a gelatinous hydrate, ThF4∙4H2O, is obtained. Acid potassium fluoride pre­cipitates K2ThF6∙4ThF4∙H2O from a solution of thorium chloride. Potassium thorofluoride, K2ThF6∙4H2O, is a heavy black powder formed by boiling the hydroxide with potassium fluoride and hydrofluoric acid. *Thorium chloride,* ThCl4, is obtained as white shining crystals by heating a mixture of carbon and thoria in a current of chlorine. Baskerville *(Journ. Amer. Chem. Soc.,* 1904, 26, p. 922) divided the product into three fractions according to their volatility. He concluded that the first contained the chloride of *berzelium,* having an atomic weight of 212, the second contained thorium chloride, and the third the chloride of *carolinium,* having an atomic weight of 255∙6. E. Chauvenet *(Compt. rend.,* 1908, 147, p. 1046) obtains it by heating thoria in a current of carbonyl chloride. Thorium chloride readily deliquesces on exposure and forms double salts with alkaline chlorides.

*Thorium sulphate,* Th(SO4)2, is obtained by dissolving the oxide in sulphuric acid. It forms several crystalline hydrates. Evapora­tion of a solution at ordinary temperatures gives colourless mono­clinic prisms of Th(SO4)2∙9H2O, which is isomorphous with uranium sulphate, U(SO4)2∙9H2O. Above 43° Th(SO4)2∙4H2O is deposited. B. Roozeboom (*Zeit, phys. Chem.,* 1890, 5, p. 198) has described several other hydrates. Thorium sulphate forms double salts with the alkaline sulphates. *Thorium nitrate,* Th(NO2)4·12H2O, forms white deliquescent tables very soluble in water. It forms double salts such as MgTh(NO2)6∙8H2O, which are isomorphous with the corresponding cerium compounds. *Thorium sulphide,* ThS2, is obtained by burning the metal in sulphur. It cannot be produced by precipitation.

The atomic weight has been variously given. Berzelius found 235·5; Delafontaine, 229·7; Cleve, 232∙6 by analyses of the sulphate, and 232·2 by analyses of the oxalate. Krüss and Nilson derived the value 230∙7 (H = 1) from analyses of the carefully purified sulphate.

For the so-called “ disintegration of the thorium atom ” and the relation of this element to the general subject of radio-active emanations, see Radio-Activity.

A number of salts of thorium have been prepared for therapeutic use, including the hydroxide, nitrate, salicylate, oleate and lactate. The oleate has been used in chronic eczema and psoriasis and locally in cancer. Inhalations of thorium emanations produced from thorium nitrate through a wash-bottle inhaler are said to have a bactericidal action in diseases of the lungs. F. Soddy has used them in phthisis, and Louisa Chesney speaks favourably of the emanations in chronic and acute laryngitis and in tuberculous laryngeal ulcerations.

**THORN** (Polish *Torun),* a fortress town of Germany, in the Prussian province of West Prussia, situated on the right bank of the Vistula, near the point where the river enters Prussian territory, 85 m. by rail N.E. of Posen, 92 m. S. of Danzig and 12 m. from the Russian frontier at Alexandrovo. Pop. (1895), 30,314; (1906), 43,435. Its position as a bridge head commanding the passage of the Vistula makes it a point of strategic impor­tance; it was strongly fortified in 1818, and in 1878 was converted into a fortress of the first class. The defensive works consist of a circle of outlying forts, about 2½ m. from the centre of the town—eight on the right and five on the left bank of the river. The “ old town,” founded in 1231, and the “ new town,” founded thirty-three years later, were united in 1454, and both retain a number of quaint buildings dating from the 15th and 16th centuries, when Thorn was a flourishing member of the Hanseatic League. The town-hall of the 14th and 16th centuries, the churches of St John of the Virgin, and of St James (all of the 13th-14th centuries), the ruined castle of the Teutonic order (a tower, the so-called “ Dansker ”), and a leaning tower, the sole remnant of the old environing walls, are among the most inter­esting of the ancient edifices. Among modern buildings may be mentioned the Artushof, containing concert and assembly halls, the new garrison church (1897), and the monument erected in 1853 to Copernicus, who was a native of Thorn. The ancient wooden bridge, now burned down, at one time the only permanent bridge across the lower Vistula, has been succeeded by a massive iron railway viaduct, 3300 ft. long. Thorn carries on an active trade in grain, timber, wine, groceries and minerals, and has ironworks, saw-mills, and various other manufactures. It is famous for its *Pfefferkuchen,* a kind of gingerbread. Part of the trade is carried on by passenger and cargo vessels on the Vistula, which ply as far as Warsaw.

Thorn, founded in 1231 by the Teutonic order as an outpost against the Poles, was colonized mainly from Westphalia. The first peace of Thom, between the order and the Poles, was concluded in 1411. In 1454 the townspeople revolted from the knights of the order, destroyed their castle, and attached them­selves to the king of Poland. This resulted in a war, which was terminated in 1466 by the second peace of Thom. In the 15th and 16th centuries Thorn was a Hanse town of importance, and received the titles of "Queen of the Vistula ” and “ the beautiful.” It embraced the Reformation in 1557, and in 1645 it was the scene of a *colloquium charitativum,* or discussion betwixt the doctors of the rival creeds, which, however, resulted in no agreement. In 1724 a riot between the Protestant and Roman Catholic inhabitants was seized upon by the Polish king as a pretext for beheading the burgomaster and nine other leading Protestant citizens, an act of oppression which is known as the “ blood-bath of Thom.” The second partition of Poland (1793) conferred Thom upon Prussia; by the treaty of Tilsit it was assigned to the duchy of Warsaw; but since the congress of Vienna (1815) it has again been Prussian.

See Wernicke, *Geschichte Thoms* (Thom, 1839-1842); Hoburg, Die *Belagerungen der Stadl und Festung Thorn* (Thorn, 1850) ; and Steinbrecht, *Die Baukunst des deutschen Ritterordens in Preussen* (1st part, Berlin, 1884); Uebrick, *Thorn* (Danzig, 1903).

**THORN** (O. Eng. *Vorn,* cf. Du. *doorn,* Ger. *Dorn,* &c), in botany, a hard pointed structure, also termed a “ spine,” generally representing a small branch, as in hawthorn, where a normal branch arising in the axil of a leaf is replaced by a sharply pointed thorn; accessory buds on each side of the thorn and developed in the same leaf-axil will grow in the next season into ordinary branches. The similarly developed thorns of the honey-locust *(Gleditschia)* are branched. In other cases, as the sloe or the wild pear, branches become spiny at the apex tapering into a stiff leafless point. On a cultivated tree these branches dis­appear owing to their more vigorous growth. Leaves may be modified into spines, as in barberry, the leaves of which show every gradation between a leaf with a spiny-toothed edge and those which have been reduced to simple or multiple spines. In some species of *Astragalus* the petiole of the pinnately com­pound leaf persists after the fall of the leaflets as a sharp spine. In the false acacia *(Robinia)* the stipules are represented by spines.

The reduction of the leaf-surface, of which the spinous habit is often an expression, is associated with growth in dry or exposed windy places. Thus, in the gorse, a characteristic plant of exposed localities such as open commons, the smaller branches, instead of being leaf-bearing shoots, are reduced to slender green spines, while the leaves on the main shoots are also more or less spinous in character. As the giving off of water from its surface is one of the chief functions of a leaf, this process is thus reduced to a minimum in situations where water is scarce or would be liable to be given off too rapidly. An extreme case is afforded by the cacti and cactus-like euphorbias, which are a characteristic type of desert vegetation where water is extremely scarce. The whole plant is reduced to a simple or branching succulent, leafless, columnar or flattened stem, the branches of which arc represented by small clusters of thorns. Incidentally the