cuts the four spheres at right angles; this “orthotomic ” sphere corresponds to the orthogonal circle of a system of circles.

The investigation of triangles and other figures drawn upon the surface of a sphere is all-important in the sciences of astronomy, geodesy and geography. In astronomy, we are principally con­cerned with the orientation of points on a sphere—the so-called celestial sphere—with regard to certain planes and points within the sphere; this subject is treated in the article Astronomy (*Spheri­cal).* In “ geodesy,” and the cognate subject “ figure of the earth,” the matter of greatest moment with regard to the sphere is the determination of the area of triangles drawn on the surface of a sphere—the so-called “spherical triangles”; this is a branch of trigonometry, and is studied under the name of spherical trigono­metry. In mathematical geography the problem of representing the surface of a sphere on a plane is of fundamental importance; this subject is treated in the article Map.

**SPHERES, MUSIC OF THE,** in Pythagorean philosophy, the harmony produced by the heavenly bodies in their orbits, inaudible to human ears. Pythagoras (cf. Arist. *de Caelo,* ii. 9) held that the movements of stars were governed by fixed laws which could be expressed in numbers according to the numbers which give the harmony of sounds (see Pythagoras, *ad fin.).* It is this theory to which Shakespeare alludes in *The Merchant of Venice* (Act. v. i. seq.: “ such harmony is in immortal souls, but . . . we cannot hear it ”). According to Gomperz *{Greek Thinkers,* i. 118, Eng. trans.) “ there was nothing fanciful in the Pythagorean doctrine except only the belief that the differences of velocity in the movements of the stars were capable of producing a harmonious orchestration and not merely sounds of varying pitch.”

**SPHERES OF INFLUENCE.** “ Spheres of influence,” “ spheres of action,” “ spheres of interest,” “ zones of influence,” “ field of operations,” “ Machtsphäre,” “ Interessen- sphäre,” are phrases in international law which have come into use to describe regions as to which nations have agreed that one or more of them shall have exclusive liberty of action. These phrases became common after 1882, when the “ scramble for Africa ” began, to describe diplomatic arrangements with respect to it. Some definitions may be quoted—when secretary of state for the colonies, Lord Knutsford, replying to a deputation in 1890, said: “ ' Sphere of action ’ is a term I do not wish to define now; but it amounts to this: we should not allow the Portuguese, Germans, or any foreign nation or republic to settle down and annex the territory ” (quoted in Keane’s *Compendium of Geography,* i. 21). “ The term

'sphere of influence ’ implies an engagement between two states that one of them will abstain from interfering or exercising influences within certain territories which, as between the contracting parties, are reserved for the operation of the other ” (Ilbert, *Government of India,* 2nd ed., p. 370). “ Unter 'Inter-

essensphäre ’ oder 'Machtsphäre ’ versteht man nämlich das auf Grund von Vereinbarungen unter den betheiligten Kolonial- staaten abgegrenzte Gebiet, innerhalb dessen ein Staat ausschliesslich berechtigt ist, seine koloniale Herrschaft durch Besitzergreifung oder Abschluss von Protectoratsverträgen zu begründen, oder doch einen für die in diesem Gebiete vorhandenen Völkerschaften massgebenden politischen Einfluss auszuüben ” (Stengel, *Die deutschen Schutzgebiete,* p. 18). “The term 'sphere of influence or sphere of interest' has been given an extended meaning by recent developments. Formerly it was used to signify a region wherein a nation, through its citizens, had acquired commercial or industrial interests without having asserted any political protectorate or suzerainty. To-day, as used in China and elsewhere, the term applies rather to a region pre-empted for further exploitation and possibly for political control ” (Dr Reinisch’s *Politics,* pp. 60, 61). “A portion of a non-Christian or uncivilized country which is the subject of diplomatic arrangements between European states, but has not yet developed into a protectorate ” (Jenkyn’s *British Rule and Jurisdiction beyond the Seas).* See also Hall, 6th ed., 129.

The reasons for making these arrangements are to be explained partly by reference to the history of international law as to occupation. The Roman jurists recognized certain “ natural modes ” of acquiring property, in particular *traditio* and *occupatio.* The doctrines which the Roman jurists had worked out as to acquisition of private property by occupation were applied to the appropriation by states or their subjects of vacant lands *{res nullius),* including lands in the possession of barbarous tribes. “ Quod enim nullius est, id ratione naturali occupanti conceditur” (*Institutes,* ii. 1-12). The Roman law required the *animus domini—*there must be seizure for and on behalf of the owner. There must be “ *apprehensio.* Apiscimur possessionem corpore et animo, neque per se animo aut per se corpore ” *{Dig.* xli. 2-3). Professing to act on these doctrines, and relying also on an assumed right on the part of Christian nations to subdue obdurate non-Christian communities, the navigators and explorers of the 15th and 16th centuries made exorbitant claims. Having occupied certain points on the coast-line, they claimed to have occupied a whole island or continent (De Martens i. 462). They made vast claims under Papal bulls; for example, under the bull of Nicholas V. of 1454, and the bull of Alexander VI. of 1494, which assigned to the Portuguese the empire of Guinea just discovered. It was one of Grotius’s services to diffuse sounder ideas, and to point out that Roman law gave no support to these pretensions: “ Invenire non illud est oculis usurpare, sed apprehendere ” (*Mare liberum,* c. 2). He insisted that “ occu- patio autem publica eodem modo fit quo privata territoria sunt ex occupationibus populorum ut privata dominia ex occupa- tionibus singulorum.” In recent times the old doctrine that discovery without occupation confers an independent right to the land so discovered of any extent is discredited. The tendency is to insist on actual occupation as a condition of legitimate possession or sovereignty (see correspondence between Great Britain and Portugal, State Papers 79, p. 1062), and to treat the discoverer’s right as merely inchoate. Thus, in opening the conference at Berlin in 1884, Prince Bismarck said: “ Pour qu’une occupation soit considérée comme effective, il est, de plus, à désirer que l’acquéreur manifeste, dans délai raisonnable, par des institutions positives, la volonté et le pouvoir d’y exercer scs droits et de remplir les devoirs qui en résultent.” This doctrine is recognized in articles 34 and 35 of the General Act of Berlin, the former of which states that “ any Power which henceforth takes possession of a tract of land on the coast of the African continent outside its possessions, or which being hitherto without such possessions shall acquire them, as well as the Power which assumes a protectorate, shall accompany the respective act with a notification thereof, addressed to the other Signatory Powers of the present act, in order to enable them, if need be, to make good any claim of their own.” To a similar effect wrote Lord Salisbury in 1887 with reference to the claims of Portugal in East Africa. “ Great Britain considers that it has been admitted in principle by all the parties to the act of Berlin that a claim of sovereignty in Africa can only be maintained by real occupation of the territory claimed; and that the doctrine has been practically applied in the recent Zambezi delimitation (State Papers 79, p. 1063). No paper annexation of territory can pretend to validity as a bar to the enterprise of other nations.” At its session at Lausanne, in 1889, the Institut de Droit International adopted the following principles:—

“ Article I.—L’occupation d’un territoire à titre de souveraineté ne pourra être reconnue comme effective que si elle réunit les conditions suivantes: 1° La prise de possession d’un territoire enfermé dans certaines limites, faite au nom du gouvernement. 2° La notification officielle de la prise de possession. La prise de possession s’accomplit par l’établissement d’un pouvoir local responsable, pourvu de moyens suffisants pour maintenir l’ordre et pour assurer l’exercice régulier de son autorité dans les limites du territoire occupé. Ces moyens pourront être empruntés à des institutions existantes dans le pays occupé. La notification de la prise de possession de fait, soit pour la publication dans la forme qui, dans chaque état, est en usage pour la notification des actes officiels, soit par la voie diplomatique. Elle contiendra la détermination approximative des limites du territoire occupé ” *{Annuaire* x. 201).

This development of international law naturally led to arrangements as to “ spheres of influence.” Nations which had not yet settled or occupied, or established protectorates, in regions contiguous to their existing possessions, were desirous to retain a