are P, the total pressure from within, and a force T at each side due to the circumferential stress. *P=plRδθ* and *T=flt.* But by the triangle of forces (fig. 42) P = T*δθ*. Hence *f*= *pR/t.*

The ends of the cylinder may or may not be held together by longitudinal stress in the cylinder sides; if they are, then, whatever be the form of the ends, a transverse section, the area of which is 2πR*t*, has to bear a total force *pπ*R2. Hence, if *ff* be the intensity of longitudinal stress, *f' = pR∣2t =* 1/2*f.*

A thin hollow sphere under internal pressure has equal circumferential pull in all directions. To find its value consider the plate of fig. 42. There are now four equal forces T, on each of the four sides, to equilibrate the radial force P. Hence P = 2T*δθ* and *f=p*R/2*t*

*Thick Cylinder.—*When the thickness is not small compared with the radius, the radial pressure is transmitted from layer to layer with reduced intensity, and the circumferential pull diminishes towards the outside. In the case of a thick cylinder with free ends@@1 we have to deal at any point with two principal stresses, radial and circum­ferential, which may be denoted by *p* and *pf* respectively. Sup­posing (as we may properly do in dealing with a cylinder which is not very short) that a transverse section originally plane remains plane, the longitudinal strain is uniform. Since there is no longi­tudinal stress this strain is due entirely to the lateral action of tne stresses *p* and *p'* and its amount is (*p+p'*)/σE, Hence at all points *p+p'* =constant.@@2 Further, by considering the equilibrium of any thin layer, as we have already considered that of a thin cylinder, we have d*/*dr*(pr)=p'.*

These two equations give by integration, *p = C+C'/r2,* and *p' = C-C'/r2.*

If r1 be the external and r2 the internal radius, and *p0* the pressure on the inner surface, the conditions that *p=p0* when r = r2 and *p = 0* when *r* = *r1* give C = — *p*0*r*2/(*r*1*2* - *r*22) and C'= - Cr12. Hence the circumferential stress at any radius *r* is *p-*p0r22(1+r12/r2)/(n2-r22). At the inside, where this is greatest, its value is - p0(*r*1*2* + *r*22)/*r*1*2* - *r*22*)*—a quantity always greater than *p0,* however thick the cylinder is.

In the construction of guns various devices have been used to equalize the circumferential tension. With cast guns a chilled core has been employed to make the inner layers solidify and cool first, so that they are afterwards compressed by the later contrac­tion of the outer layers. In guns built up of wrought-iron or steel hoops the hoops are bored small by a regulated amount and are shrunk on over the barrel or over the inner hoops. In J. A. Long- ridge’s system, largely used for heavy ordnance, the gun is made by winding steel wire or ribbon, with suitable initial tension, on a central steel tube.

The circumferential stress at any point of a thick hollow sphere exposed to internal fluid pressure is found, by a process like that of the last paragraph, to be -*p0r23*(1+*r*13/2r3)/(*r*1*3* - *r*23), which gives, for the greatest tension, the value

- p0(*r*1*3* + 2*r*23)/2*r*1*3* - *r*23*)*. (J. A. E.)

**STRESA,** a village of Piedmont, Italy, in the province of Novara, situated on the west side of Lago Maggiore, on the Simplon railway, 10 m. N. of Arona, 673 ft. above sea-level. Pop. (1901), 1477. It is remarkable for the beauty of its scenery and for its fine villas, and is a favourite resort in spring, summer and autumn.

**STRICKLAND, AGNES** (1806-1874), English historical writer, was born in 1806, the third daughter of Thomas Strickland, of Reydon Hall, Suffolk. Her first literary efforts were historical romances in verse in the style of Walter Scott—*Worcester Field* (published without date), *Demetrius and other Poems* (1833). From this she passed to prose histories, written in a simple style for the young. A picturesque sketch of the *Pilgrims of Walsingham* appeared in 1835, two volumes of *Tales and Stories from History* in the following year. Then, with the assistance of her sister, she projected a more ambitious work, *The Lives of the Queens of England,* from Matilda of Flanders to Queen Anne. The first volume appeared in 1840, the twelfth and last in 1849. Miss Strickland was a warm partisan on the side of royalty and

the church, but she made industrious study of “ official records and other public documents,” gave copious extracts from them, and drew interesting pictures of manners and customs. While engaged on this work she found time in 1843 to edit the *Letters of Mary, Queen of Scots,* whose innocence she championed with enthusiasm. In 1850 she followed up her *Queens of England* with the *Lives of the Queens of Scotland,* completing the series in eight volumes in 1859. Unresting in her industry, she turned next to the *Bachelor Kings of England,* about whom she published a volume in 1861. the *Lives of the Seven Bishops* followed in 1866—after a longer interval, part of which was employed in producing an abridged version of her *Queens of England.* Her last work was the *Lives of the Last Four Stuart Princesses,* published in 1872. In 1871 she obtained a civil-list pension of £100 in recognition of her merits. She died on the 8th of July 1874.

A *Life* by her sister, Jane Margaret Strickland, appeared in 1887.

**STRICKLAND, HUGH EDWIN** (1811-1853), English naturalist and geologist, was born at Righton, in the East Riding of York­shire, on the 2nd of March 1811, and was grandson of Sir George Strickland, Bart. As a lad he acquired a taste for natural history which dominated his life. He received his early education from private tutors and in 1829 entered Oriel College, Oxford. He attended the anatomical lectures of Dr John Kidd and the geological lectures of Dr W. Buckland and he became greatly interested both in zoology and geology.· He graduated B.A. in 1831, and proceeded to M.A. in the following year. Returning to his home at Cracombe House, near Tewkesbury, he began to study the geology of the Vale of Evesham, communicating papers to the Geological Society of London (1833-1834). He also gave much attention to ornithology. Becoming acquainted with Murchison he was introduced to William John Hamilton (1805-1867) and accompanied him in 1835 in a journey through Asia Minor, the Thracian Bosporus and the Island of Zante. Mr Hamilton afterwards published the results of this journey and of a subsequent excursion by himself to Armenia in *Researches in Asia Minor, Pontus and Armenia* (1842). After his return in 1836 Strickland brought before the Geological Society several papers on the geology of the districts he had visited in southern Europe and Asia. He also described in detail the drift deposits in the counties of Worcester and Warwick, drawing particular attention to the fluviatile deposits of Cropthorne in which remains of hippopotamus, &c., were found. With Murchison he read before the Geological Society an important paper “ On the Upper Formations of the New Red Sandstone System in Gloucestershire, Worcestershire and Warwickshire” *(Trans. Geol. Soc.,* 1840). In other papers he described the Bristol Bone-bed near Tewkesbury and the Ludlow Bone-bed of Woolhope. He was author likewise of ornithological memoirs communicated to the Zoological Society, the *Annals* and *Magazine of Natural History* and the British Association. He also drew up the report, in 1842, of a committee appointed by the British Association to consider the rules of zoological nomenclature. He was one of the founders of the Ray Society suggested in 1843 and established in 1844, the object being the publication of works on natural history which could not be undertaken by scientific societies or by publishers. For this society Strickland corrected, enlarged and edited the MS. of Agassiz for the *Bibliographia Zoologiac el Geologiae* (1848).In 1845 he edited with J. Buckman a second and enlarged edition of Murchison’s *Outline of the Geology of the neighbourhood of Cheltenham.* In 1846 he settled at Oxford, and two years later he issued in conjunction with Dr A. G. Melville a work on *the Dodo and its kindred.* In 1850 he was appointed deputy reader in geology at Oxford during the illness of Buckland, and in 1852 he was elected F.R.S. In the following year, after attending the meeting of the British Association at Hull, he went to examine the cuttings on the Manchester, Sheffield & Lincolnshire railway near Retford, and he was there knocked down and killed by a train on the 14th of September 1853. He was buried at Deerhurst church near Tewkesbury, where a memorial window was erected.

Sec *Memoirs of H. E. Strickland,* by Sir William Jardine, Bart. (1858).

@@@1 This condition is realized in practice when the fluid causing internal pressure is held in by a piston, and the stress between this piston and the other end of the cylinder is taken by some other part of the structure than the cylinder sides.

@@@2 The solution which follows in the text is applicable even when there is longitudinal stress, provided that the longitudinal stress is uniformly distributed over each transverse section. If we call this stress *p''* the longitudinal strain is *p''*/E+*(p+p')∣σ*E*.* Since the whole strain is uniform, and *p”* is uniform, the sum of *p* and *p'* is constant at all points, as in the case where the ends are free.