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Spines and Topology of Thin Riemannian 3-Manifolds. Preliminary report.

Lagunov and Fet constructed a 3-dimensional Euclidean domain $M$ whose boundary is a 2-sphere with normal curvature $|\kappa_{\partial M}| \leq 1$ and whose inradius is $\sqrt{3/2} - 1 + \epsilon \approx .225$ for every $\epsilon > 0$. We consider abstract Riemannian manifolds $M$ of sectional curvature $|K_M| \leq 1$, with simply connected boundary such that $|\kappa_{\partial M}| \leq 1$, and with inradius $< .108$. Then the cut locus of the boundary has been proved by us in a previous paper (Advances in Mathematics, 155, 23-48, (2000)) to be a 3-branched simple polyhedral spine of $M$. In dimension 3, these spines are fake surfaces. In this case we classify the possibilities for $M$ up to homeomorphism, namely, they are connected sums of $p$ copies of $P^3$, $t$ copies of the lens spaces $L(3, \pm 1)$, and $\ell$ handles either $S^2 \times S^1$ or the twisted $S^2$ bundle over $S^1$, with $\beta$ 3-balls removed, where $p + t + \ell + \beta \geq 2$. By modifying the example cited above we show that our inradius bound is sharp up to a factor of 2. (Received January 23, 2001)