$$\left\{\begin{aligned} ((\theta_2^2\theta_1)^2 &= P_5 \\ \theta_2^2 &= P_7 \\ \theta_2^{-1}P_5 &= P_6 \end{aligned}\right\}. \tag{9}$$

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PSEUDO-ISOTOPICALLY CONTRACTIBLE SPACES

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The space M is called pseudo-isotopically contractible provided that if A is a compact subset of M there is a continuous function $r(x, t)$ of $M\times[0, 1]$ into M such that (1) if $t<1$, $r|M\times t$ is a homeomorphism onto, and (2) if $t=1$, $r|A\times 1$ is a point.

Let X be a locally euclidean n-dimensional space with the property that each pair of points lies in the interior of some n-ball. Clearly X is a connected n-manifold without boundary.

THEOREM. *If M is a locally euclidean n-dimensional space with the property that each pair of points lies interior to some n-ball, then M is an open n-cell if and only if M is pseudo-isotopically contractible.*

LEMMA. *If M is pseudo-isotopically contractible and p is a point of M, the function $r(x, t)$ may be chosen so that $r(A, 1)=p$.*

PROOF. Let U be the interior of a ball containing p and q. Suppose U is given a co-ordinate system $(x_1, \cdots, x_n)$, where $x_1^2+\cdots+x_n^2<1$ and $(x_1, \cdots, x_n)\in\overline{U}\setminus U$ if and only if $x_1^2+\cdots+x_n^2=1$.

Let $0<\epsilon<1$; then the mapping

$$x_1' = x_1 + \epsilon t\rho, \quad 0 \leqq t \leqq 1,$$
$$x_i' = x_i, \quad i > 1,$$

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where ρ is the distance from $(x_1, \cdots, x_n)$ to $\overline{U}\backslash U$, defines an isotopy of U on itself that is fixed on $\overline{U}\backslash U$ and carries the origin into $(\epsilon, 0, 0, \cdots, 0)$.

The composition of a finite number of such isotopies will give the desired result.

PROOF OF THE THEOREM. Since M is locally separable and connected, it is separable. Since M is also locally compact, $M = \bigcup_1^\infty A_i$, where A_i is compact and $A_{i+1} \supset A_i$. Let B_i denote the closure of the spherical $1/i$ neighborhood of p.

To each $i = 1, 2, \cdots$, there is a continuous function $r(x, t; i)$ on $M \times [0, 1]$ that is a homeomorphism onto for $t < 1$, and, for $t = 1$, A_i is contracted to p. Let us choose $t_i < 1$ such that $r(x, t; i)$ shrinks $A_i \times t_i$ to a subset of the interior of B_i. Suppose $r^{-1}(x, t_i; i)$ maps B_i on E_i. Then E_i is an open n-cell and $M = \bigcup_1^\infty E_i$. For, if $q \in M$, $q \in A_j$ for some j. Then $r(x, t_j; j)$ carries q onto q^1 in B_j and $r^{-1}(x, t_j; j)$ carries q^1 back onto q.

By a recent result of M. Brown, M must be homeomorphic to euclidean n-space, E^n [1].

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