$\alpha\gamma E\lambda\nu$. 3. Construction: $\alpha\beta\gamma K$, $\lambda\mu\nu K$ imply the existence of ξ, η such that $\lambda\mu K\lambda\xi$, $\lambda\mu\nu K\lambda\xi\eta$, $(\alpha\beta,\ \beta\gamma,\ \gamma\alpha)E(\xi\lambda,\ \lambda\eta,\ \eta\xi)$, that is, $\alpha\beta E\xi\lambda$, and so on. 4. Linear uniqueness: $\alpha\beta K\alpha\xi$ and $\alpha\beta E\xi\alpha$ imply $\xi=\beta$. 5. Planar uniqueness: $\alpha\beta\gamma K\alpha\beta\xi$, $\alpha\gamma E\alpha\xi$, $\beta\gamma E\beta\xi$ imply $\xi=\gamma$. 6. Equality of angles: If $\alpha\beta\gamma K$, $\lambda\mu\nu K$, $(\alpha\beta,\ \beta\gamma,\ \gamma\alpha)\ E\ (\lambda\mu,\ \mu\nu,\ \nu\lambda)$ then $\alpha\xi\eta I\alpha\beta\gamma$ (that is, $\alpha\xi K\alpha\beta$, $\alpha\eta K\alpha\gamma$) implies the existence of ζ, τ such that $\lambda\zeta\tau I\lambda\mu\nu$ and $(\alpha\xi,\ \xi\eta,\ \eta\alpha)\ E\ (\lambda\zeta;\ \zeta\tau,\ \tau\lambda)$. Definitions: 1. The angle of the triangle $\alpha\beta\gamma$ at α is the class of triads $\alpha\xi\eta$ such that $\alpha\xi\eta I\alpha\beta\gamma$ and $\alpha\beta\gamma K$. 2. The angles of the triangles $\alpha\beta\gamma$, $\lambda\mu\nu$ at α and λ are equal, $A\beta\gamma=\Lambda\mu\nu$, if and only if, $\alpha\beta\gamma K$, $\lambda\mu\nu K$ and $\alpha\xi\eta I\alpha\beta\gamma$ implies the existence of ζ, τ as indicated under axiom 6. Reference is made to a paper previously reported in Bull. Amer. Math. Soc. vol. 43 (1937) p. 475. (Received May 18, 1945.)

136. A. R. Schweitzer: *A theory of congruence in the foundations of geometry*. III.

Relatively to the set of axioms in the preceding abstract, equality of dyads, $\alpha\beta=\lambda\mu$, "modulo K" and "modulo E" is defined to be $\alpha\beta K\lambda\mu$ and $\alpha\beta E\lambda\mu$ respectively. If E is replaced by K in the preceding axioms then axiom 3 is contradicted, axiom 4 is ineffective ("vacuously satisfied") and the remaining axioms are satisfied. If to the hypothesis of axiom 3 is added "$E\neq K$" then for $E=K$ axiom 3 is ineffective; thus a descriptive or metrical system results according as $E=K$ or $E\neq K$. Correspondingly, equality of angles is defined modulo E ($E\neq K$) and modulo K ($E=K$). In the latter case angles are equal if and only if they coincide. Finally, an alternative set of axioms ($E\neq K$) results from replacing the symbol $(\xi\lambda,\ \lambda\eta,\ \eta\xi)$ by its conjugate $(\lambda\xi,\ \xi\eta,\ \eta\lambda)$ in axiom 3, assuming that $\alpha\beta K\alpha\beta$ implies $\alpha\beta E\beta\alpha$, and replacing the dyad $\xi\alpha$ by its conjugate $\alpha\xi$ in axiom 4. (Received May 18, 1945.)

TOPOLOGY

137. R. F. Arens: *The linear homogeneous continua of G. D. Birkhoff.*

A linear homogeneous continuum (LHC), in the sense of Birkhoff, is a linearly ordered set L in which every increasing (or decreasing) sequence of elements converges, and which can be placed in one-to-one, order preserving correspondence with any of its closed subintervals. Vasquez and Subieta (*Sopre los continuous homogeneos linealis de George D. Birkhoff*, Boletin de la Sociedad Matematica Mexicana vol. 1 (1944)) have given the first example of an LHC which is not an ordinary real closed interval. The present paper proves (1) if L is an LHC, then L^{ω}, the class of all sequences in L, lexicographically ordered, is also an LHC, (2) if each well ordered subset of L has only countably many distinct elements, the same is true of L^{ω}, and (3) if L is a real closed interval, L^{ω} is not isomorphic to L. (Received May 10, 1945.)

138. R. H. Bing: *Concerning simple plane webs.*

It is shown that a necessary and sufficient condition that a compact plane continuous curve be a simple plane web is that it remain connected and locally connected on the omission of any countable set of points. Using this characterization of a simple plane web, the author considers some of its properties. (Received May 11, 1945.)

139. Salomon Bochner and Deane Montgomery: *Groups of differentiable and real or complex analytic transformations.*

The authors prove the following results: (1) If a Lie group acts on a manifold in such a way that the transforming functions $f(g; x)$ are continuous in g and x simultaneously and if for fixed g the functions $f(g; x)$ are of class C^k (analytic) in x, then the functions $f(g; x)$ are of class C^k (analytic) in the variables g and x simultaneously. (2) If a complex analytic group is compact it is abelian. From (1) and a known theorem is also obtained (3). If a compact group acts effectively on a connected manifold and if for each $g, f(g; x)$ is of class C^k ($k \geqq 1$) or analytic, then G is a Lie group and the functions $f(g; x)$ are of class C^k or analytic in the variables (g, x) simultaneously. In (1) and (3) the manifold of course must be taken as of class C^k or analytic. The result (2) has been familiar to some mathematicians. (Received May 28, 1945.)

140. R. H. Fox: *Knots in 3-dimensional manifolds.*

Let M be a compact connected 3-dimensional manifold, let γ denote an element of $\pi_1(M)$ and $\bar{\gamma}$ the class of elements of $\pi_1(M)$ conjugate to γ. Let K be any polygonal simple closed curve in M which represents $\bar{\gamma}$ and does not intersect the boundary of M. Let R denote the nucleus of the injection $\pi_1(M-K) \rightarrow \pi_1(M)$ and let $[R]$ denote the commutator subgroup of R. It is proved that the group $\omega(M, \bar{\gamma}) = \pi_1(M-K)/[R]$ is independent of the choice of representative K. The groups $\omega(M, \bar{\gamma})$, determined by the various classes $\bar{\gamma}$ of $\pi_1(M)$, are invariants of the 3-dimensional manifold M. These groups are generally non-abelian and are independent of the homology groups. (Received May 16, 1945.)

141. Dean Montgomery: *Topological groups of differentiable transformations.*

If a locally compact group G acts on a manifold of class C^k in such a way that for a fixed g the transforming functions $f(g; x)$ are of class C^k in x, then all partial derivatives with respect to the x's of order k or less are simultaneously continuous in g and x. It follows that if G is compact and $k \geqq 1$ then G is a Lie group (considered in itself). The author had previously demonstrated this result in the analytic case by another method. (Received May 28, 1945.)

142. A. D. Wallace: *Extension sets.* I.

Although the results to be presented are valid for more general spaces, for simplicity the space H is assumed to be compact metric. By a subspace is meant a closed subset of H. A subspace M will be termed an *extension set* in dimension n (briefly, a J_n) if for each subspace Y any mapping of $Y \cdot M$ into S_n may be extended to Y. (1) Each J_n is a J_{n+1}. (2) The intersection of any collection of J_n's is a J_n. A subset [subspace] Z is said to be n-connected [an n-continuum or a C_n] if every mapping of Z into S_n is inessential on any compact subset contained in Z. (3) The intersection of an ordered (by inclusion) collection of C_n's is a C_n. (4) The intersection of a C_n and a J_n is a C_n. If P is an admissible property for subspaces then a subspace is a P-endelement if it is contained in arbitrarily small neighborhoods with P-boundaries. (5) The intersection of an ordered collection of P-endelements is a P-endelement. (Received April 30, 1945.)

143. A. D. Wallace: *Extension sets.* II.

A point x is an n-cutpoint of a set X if $X-x$ is not n-connected. A subspace will be termed a T_n if each of its subspaces is a C_n. (1) An n-cutpoint of a J_n is an n-cutpoint of H. (2) In order that a subspace be a J_n it is sufficient that its complement be the union of a collection of pairwise disjoint open sets whose boundaries are of type T_n. If f maps the subspace X into S_n then the subspace Y will be termed an essential membrane for f provided that f can be extended to every proper subspace of Y but not to Y. (3) If M is a J_n containing the subspace X, and Y is an essential membrane for the mapping f of X into S_n [a C_n irreducible about X] then Y is contained in M. (4) If X is a subspace not cut by any T_n and maximal relative to this property then X is a J_n. (Received April 30, 1945.)

144. A. D. Wallace: *Extension sets.* III.

Referring to definitions given in previous abstracts, the author proves five theorems. (1) Any T_n is a T_{n+1}. (2) If H is a C_n and for each subspace X each mapping of X into S_n has a unique essential membrane then H is a T_{n+1}. (3) If X is a subspace and Y is a C_n irreducible about X [an essential membrane for some mapping of X into S_n] then no point of $Y-X$ is a T_n-endelement. (4) If H is a C_n and Z is the set of all points not T_n-endelements then Z is n-connected. (5) If H is a C_n and X is a C_n-endelement then X is a C_n. Many of the results presented are valid if H is a compact Hausdorff space. In some cases S may be replaced by a space having the neighborhood extension property. In the paper reference will be made to the work of Ayres, Borsuk, Eilenberg, Hurewicz, and G. T. Whyburn. (Received April 30, 1945.)