

form of  $r$  normally distributed variates, and  $P(z < t | \theta)$  denotes the probability that  $z$  is less than  $t$  calculated under the assumption that  $\theta$  is true. (Received August 11, 1941.)

### TOPOLOGY

487. Samuel Eilenberg and Saunders MacLane: *Infinite cycles and homologies.*

An abelian group  $E$  is an extension of  $G$  by  $H$  if  $G$  is a subgroup of  $E$  and  $H$  is the corresponding factor group. With a suitable definition of equivalence and addition the extensions of  $G$  by  $H$  form a group. The authors consider the  $q$ th homology group of an abstract complex with coefficients in a group  $G$  obtained using infinite cycles and purely formal boundaries. A direct sum decomposition of this group is given, the first member of which is isomorphic with the group of all homomorphic mappings of the  $q$ th integral cohomology group (finite chains and cocycles) into  $G$  and the second with the group of all abelian group extensions of  $G$  by the  $(q+1)$ th cohomology group. Various consequences of this result are obtained. (Received September 4, 1941.)

488. R. L. Moore: *On continua with dendratomic subsets.*

It is shown that in order that a compact continuum should have dendratomic subsets it is necessary and sufficient that it should not be a web. It follows that every compact continuum which is not a triod has such subsets. In particular every compact irreducible continuum between two points has them. (Received September 5, 1941.)

489. N. E. Steenrod: *Topological methods for the construction of tensor functions.*

The space  $M'$  of point tensors (fixed order and weight) over a differentiable manifold  $M$  of class  $r$  is shown to be a differentiable manifold of class  $r-1$  forming a fibre bundle over  $M$  in the sense of Whitney. If  $M''$  is a submanifold of  $M'$  which is still a fibre bundle over  $M$  with fibres  $F''$ , methods are given for attempting to ascertain if a tensor function of class  $r-1$  exists with values in  $M''$ . An approximation theorem reduces the problem to finding a function which is merely continuous. If  $h$  is the smallest integer such that the homotopy group  $\pi_h(F'') \neq 0$ , a function of the required kind may be defined over the  $h$ -dimensional skeleton  $M^h$  of  $M$ . Any such determines a cocycle  $c^{h+1}$  in  $M$  with coefficients in the groups  $\pi_h(F'')$ . It is necessary to use here a homology theory based on local coefficient groups connected by local isomorphisms. In order that a tensor of the required kind exist over  $M^{h+1}$ , it is necessary and sufficient that  $c^{h+1} \sim 0$ . The existence and properties of the characteristic cohomology class are also proved for the more general type of fibre space introduced by Hurewicz and the author. (Received August 5, 1941.)

490. Henry Wallman: *Dimension for general spaces.*

For separable metric spaces there is a body of theorems of deep geometric appeal centering around the concept of dimension. In line with recent trends it seems natural to inquire whether one can extend the domain of application of dimension to spaces of more general character. The three common dimension functions are the Menger-Urysohn dimension  $d_1$ , the Čech dimension-in-the-large  $d_2$  and the Lebesgue covering dimension  $d_3$ . It turns out that although there is not the slightest difficulty in applying these dimension-functions to spaces of the most general sort, one can hardly

proceed thereafter to build up a dimension theory for such general spaces with these for: (a) there exists a countable set for which  $d_1$  is positive, (b) neither  $d_2$  nor  $d_3$  is monotonic ( $A \subset B$  does not imply  $d_2(A) \leq d_2(B)$  nor  $d_3(A) \leq d_3(B)$ ) even for subsets of so regular a space as a bicomact Hausdorff space, (c)  $d_1, d_2, d_3$ , do not coincide. (Upon the coincidence of  $d_1, d_2$ , and  $d_3$  for separable metric spaces rests a very great deal of the power of the dimension concept.) (Received September 3, 1941.)