THE OCTOBER MEETING IN NEW YORK

The four hundred sixty-first meeting of the American Mathematical Society was held at Columbia University on Saturday, October 28, 1950. The attendance was about 175, including the following 160 members of the Society.

M. Y. Aissen, E. J. Akutowicz, C. B. Allendoerfer, Helmut Aulbach, M. C. Ayer, Valentine Bargmann, F. P. Beer, E. G. Begle, Stefan Bergman, Lipman Bers, A. L. Blakers, Samuel Bourne, J. W. Bower, A. B. Brown, J. H. Bushey, W. R. Callahan, K. T. Chen, K. L. Chung, L. W. Cohen, M. L. Conlan, J. W. Cooley, Natalie Coplan, M. D. Darkow, P. H. Daus, Nelson Dunford, R. M. Exner, J. M. Feld, Werner Fenchel, F. G. Fender, W. E. Ferguson, Alvaro Ferlini, F. A. Ficken, Gerald Freilich, Bernard Friedman, Bent Fuglede, H. M. Gehman, Abe Gelbart, Leonard Gillman, Sidney Glusman, Samuel Goldberg, J. A. Greenwood, H. M. Griffin, Laura Guggenbuhl, E. J. Gumbel, Carl Hammer, G. A. Hedlund, Alex Heller, H. L. Herrick, Einar Hille, Abraham Hillman, A. J. Hoffman, T. R. Hollcroft, L. A. Hostinsky, S. T. Hu, E. M. Hull, T. R. Humphreys, Nathan Jacobson, W. S. Jardetzky, R. L. Jeffery, S. A. Joffe, R. A. Johnson, R. V. Kadison, Shizuo Kakutani, Aida Kalish, S. N. Karp, Stanley Katz, M. E. Kellar, B. C. Kenny, J. F. Kiefer, H. S. Kieval, M. S. Klamkin, J. R. Kline, E. G. Kogbetliantz, B. O. Koopman, Marc Krasner, A. W. Landers, R. E. Langer, Solomon Lefschetz, Benjamin Lepson, W. W. Leutert, M. E. Levenson, Howard Levi, Charles Loewner, E. R. Lorch, A. N. Lowan, Janet McDonald, L. A. MacColl, H. M. MacNeille, Wilhelm Magnus, Irwin Mann, A. J. Maria, M. H. Maria, A. E. Meder, Jr., A. N. Milgram, K. S. Miller, W. H. Mills, Don Mittleman, L. J. Mordell, F. J. Murray, J. J. Newman, Morris Newman, L. R. Norwood, C. O. Oakley, A. C. O'Neill, J. C. Oxtoby, J. S. Oxtoby, T. E. Peacock, J. E. L. Peck, A. M. Peiser, R. S. Phillips, M. H. Protter, D. A. Quarles, Hans Rademacher, H. E. Rauch, H. W. Raudenbush, Giovanni Ricci, Moses Richardson, D. E. Richmond, C. E. Rickart, I. F. Ritter, J. E. Robinson, J. E. Rosenthal, Arthur Sard, Robert Schatten, J. A. Schatz, Samuel Schecter, Abraham Schwartz, Esther Seiden, D. B. Shaffer, I. M. Singer, P. A. Smith, H. H. Snyder, D. E. Spencer, V. E. Spencer, M. H. Stone, R. L. Swain, R. M. Thrall, A. W. Tucker, J. L. Walsh, J. V. Wehausen, J. H. Weiner, Louis Weisner, David Wellinger, J. G. Wendel, M. E. White, Albert Wilansky, M. A. Woodbury, Arthur Wouk, L. A. Zadeh, Antoni Zygmund.

The Council of the American Mathematical Society met at Columbia University on Saturday morning, October 28.

The Secretary announced the election of the following fourteen persons to ordinary membership in the Society:

Professor Pedro Abellanas, University of Madrid, Madrid, Spain;
Mr. Donald Lewis Arenson, Armour Research Foundation, Chicago, Ill.;
Mr. Solomon Isaac Ciolkowski, Washington University, St. Louis, Mo.;
Mr. David Robert Clutterham, D-31 Stadium Terrace, Champaign, Ill.;
Mr. Merlin Harry Dipert, Western Union College, LeMars, Iowa;
Mr. Donald Bruce Gillies, University of Illinois;
Mr. Edward Halpern, University of Massachusetts;
Mrs. Marjorie Halpern (Mrs. Edward), 427 North Pleasant St., Amherst, Mass.;
Mr. Lester LaVerne Helms, Bradley University, Peoria, Ill.;

Professor George Kurepa, Mathematical Institute, Zagreb, Yugoslavia;
Professor Lloyd Kenneth Jackson, University of Nebraska;
Professor Theophile Henri Lepage, University of Brussels, Brussels, Belgium;
Dr. Julio Rey-Pastor, University of Buenos Aires, Buenos Aires, Argentina;
Mr. Robert Findley Shaw, Eckert-Mauchly Computer Corporation, Philadelphia, Pa.

The Secretary announced that the following had been admitted to the Society in accordance with reciprocity agreements with various mathematical organizations: London Mathematical Society: Dr. Jeffrey Dennis Weston, King's College, Newcastle-upon-Tyne, England; Société Mathématique de France: Professor Henri Cartan, University of Paris, Paris, France; Swiss Mathematical Society: Professor Walter Robert Baum, University of Tennessee, Knoxville, Tenn.; Unione Matematica Italiana: Professor Dario Graffi, University of Bologna, Bologna, Italy; Wiskundig Genootschap: Professor Johan Cornelis Hendrik Gerretsen, University of Groningen, Groningen, Netherlands.

The following appointments of representatives of the Society were reported: Professor John F. Randolph at convocation for the formal presentation of the Saint Bonaventure University charter on October 4, 1950; Professor J. M. Thomas at inauguration of Gordon Gray as President of The Consolidated University of North Carolina on October 8, 9, and 10, 1950; Professor R. R. McDaniel at inauguration of Earl Hampton McClenney, Sr., as President of St. Paul's Polytechnic Institute on October 12, 1950; Professor Euphemia L. Haynes at inauguration of Robert Prentiss Daniel as President of Virginia State College on October 14, 1950; Professor C. R. Wylie, Jr., at Diamond Jubilee of Brigham Young University on October 16 and 17, 1950; Professor J. S. Taylor at inauguration of John Christian Warner as President of Carnegie Institute of Technology and the Fiftieth Anniversary of Institution on October 27 and 28, 1950; Sister M. Laetitia Hill at dedication of the Science Hall at Incarnate Word College on November 3, 1950; Professor C. R. Wylie, Jr., at inauguration of Louis Linden Madsen as President of Utah State Agricultural College on November 3, 1950; Professor C. T. Bumer at inauguration of Spencer Miller, Jr., as President of American International College on November 8 and 9, 1950; Professor H. E. Bray at inauguration of Marion Thomas Harrington as President of The Agricultural and Mechanical College of Texas on November 9, 1950.

The following additional appointments by the President were reported: Professors H. A. Rademacher (Chairman), H. W. Brinkmann, C. C. MacDuffee as a Committee on the Cole Prize in Number Theory to be awarded at the 1951 Annual Meeting, for papers published in the period 1946–1950; Professors R. E. Langer (Chairman), J. W.

Green, W. T. Martin as a Committee to Nominate Representatives of Society on Policy Committee for Mathematics; Professors T. H. Hildebrandt (Chairman), P. A. Smith, J. W. T. Youngs as a Committee to Consider the Proposal to Add the President as an Ex-Officio Member of the Board of Trustees; Professors B. J. Pettis (Chairman), W. L. Duren, Jr., Harry J. Fleddermann, L. I. Wade, and W. M. Whyburn as a Committee on Local Arrangements for the New Orleans Meeting, 1951; Professor R. V. Churchill as Chairman of the Editorial Committee for the Proceedings of the Symposia in Applied Mathematics.

The Council voted to approve the recommendation of the Editorial Board of the American Journal of Mathematics that Professor P. A. Smith act for Professor Samuel Eilenberg as representative of the Society on that board during the present academic year. Professor Eilenberg is spending this period in France on a John Simon Guggenheim Memorial Fellowship.

The Council voted to accept the resignation of Professor L. M. Graves as a representative of the Society on the Editorial Board of the American Journal, effective December 31, 1950, and authorized and requested the Secretary to send a letter of appreciation to Professor Graves for his work.

The Council voted to accept the recommendation of the Committee on Arrangements for the Fourth Symposium on Applied Mathematics that the date of the meeting be changed from July 26–27, 1951, to June 22–23, 1951.

The Council voted that the following steps be taken in connection with the sale of the library and the housing of the permanent offices of the Society:

(a) That, subject to the approval of the Trustees, the Executive Director be authorized and requested to solicit firm bids for the library.

(b) That, in the event one or more bids of not less than $57,000 are received, the Executive Committee is authorized and requested, on behalf of the Council, to pass on the acceptability of such bids, to select from among several such bids the one best calculated to further the objectives of the Society and to make implementing recommendations concerning their findings to the Trustees.

(c) That, in the event no acceptable offer not less than $57,000 is received, the Executive Committee report their findings, if any, back to the Council.

(d) That, the Council favor continuation of the present exchanges as a matter of policy.

The Council voted that it favors the purchase of a building ade-

quate to house all permanent offices of the Society as soon as an appropriate building, not necessarily in New York City, could be found and financed, and that it authorizes the Executive Committee to act in conjunction with the Board of Trustees in this matter.

Certain invitations to give addresses were announced: Professors G. B. Huff and M. H. Martin for the April, 1951 meeting in New Orleans; Professor Arthur Erdélyi for the April, 1951 meeting in Stanford; Professor Heinz Hopf for the February, 1951 meeting in New York; Professors L. H. Loomis and Herbert Federer for the April, 1951 meeting in New York.

The Council voted to propose to the members of the Society that the By-Laws be amended so as to add the President and the Treasurer of the Society to the Board of Trustees as ex-officio voting members.

The Council voted to accept a proposal of the Editorial Committee for the Proceedings of Symposia in Applied Mathematics, to appoint an editor for each volume for the Proceedings at the time the Symposium is arranged, it being understood that the appointee need not necessarily be a member of the committee.

At 2:30 P.M. Professor C. E. Rickart of Yale University gave an address on *Isomorphisms of infinite-dimensional analogues of the classical groups*. President J. L. Walsh presided at the address and at the business meeting which followed.

At 3:45 P.M. there was a business meeting of the Society. At this time the Secretary proposed amending the By-Laws as recommended by the Council for the purpose of:

1. Permitting a reduction in the number of representatives of the Society on the Editorial Board of the American Journal of Mathematics from three to two.

2. Changing the annual dues of individual members from $6.00 for the first two years of membership, $8.00 for the second two years, and $10.00 thereafter, to $9.00, $11.50, and $14.00 respectively.

3. Changing the minimum annual dues of contributing members from $15.00 to $20.00.

The proposed changes were approved.

There were two sessions for contributed papers, one at 1:00 P.M. in applied mathematics in which Professor Charles Loewner presided, and one at 4:15 P.M. in topology and analysis in which Professor L. W. Cohen presided.

Abstracts of papers presented in person at the meeting follow. Paper number 6 was read by Professor Richmond, paper number 4 by Professor Milgram, and paper number 12 by Professor Blakers. Abstracts of papers presented by title were printed as ab-

stracts numbered 448–452 in the September 1950 issue of the Bulletin, and 454–456, 461–469 in the November 1950 issue of the Bulletin. Mr. Evans was introduced by Dr. B. H. Neumann.

ANALYSIS

1. M. I. Aissen: *A functional which depends upon the shape of a convex domain.*

A function $B_p(D) = \int_C dS_q/h_{pq}$ is defined for all interior points, p, of a convex domain D. By q is meant a point of C, the boundary of D. By h_{pq} is meant the perpendicular distance (regarded as positive) from p to a supporting line to D at q. The functional $B(D) = \text{g.l.b.}_{p \in D} B_p(D)$ is also considered. It is shown that $B(D)$ is diminished (does not increase) by Steiner symmetrization. An explicit rational expression is obtained for the change in $B(D)$, which results from certain special affine transformations applied to domains with symmetries of the rectangle. For a fixed domain, D, it is shown that $B_p(D)$ is a strictly convex function of p, which becomes infinite as p approaches C. Hence there exists one and only one point p' in D, for which $B_{p'}(D) = B(D)$. A strong analogy is displayed between $B_p(D)$ and $2A/r_p^2$, where A is the area of D, and r_p is the inner conformal radius of D with respect to p. [G. Pólya and G. Szegö, *Aufgaben und Lehrsätze aus der Analysis*, vol. 2, p. 16.] (Received September 19, 1950.)

2. M. S. Klamkin: *A note on the Mittag-Leffler expansion theorem.*

For a function which satisfies the conditions of the Mittag-Leffler expansion theorem, $f(x) = f(0) + \sum_1^\infty b_n[1/(x-a_n) + 1/a_n]$. If in addition $\int c_m (f(z)/(z-x))dz \to 0$, then $f(0) = -\sum_{n=1}^\infty b_n/a_n$. This latter expansion is equivalent to the former one. For, if a function $\phi(x) = (f(x) - f(0))/(x-a)$ where a is not a pole of $f(x)$ is chosen, and $\phi(0) = -\sum_1^\infty b_n^1/a_n^1$ is evaluated, the former expansion is obtained. (Received September 13, 1950.)

3. Benjamin Lepson: *The maximum modulus of normalized polynomials on sets of positive transfinite diameter.*

A normalized polynomial is defined as a polynomial with complex coefficients for which the maximum of the moduli of the coefficients is 1. Consider polynomials in the complex variable z on certain point sets in the complex plane. It is known [Fekete, Math. Zeit. vol. 17 (1923) pp. 228–249] that if E is a closed bounded set of transfinite diameter d, then the maximum modulus on E of any polynomial of degree n with leading coefficient 1 is at least d^n. In the following theorem this result is extended to normalized polynomials: *Let E be a closed point set in the circle $|z| \leqq R \geqq 1$ for which there is a constant $c > 0$ such that the maximum modulus on E of any polynomial of degree n with leading coefficient 1 is at least c^n. Then there is a constant $k > 0$, depending only upon c and R, such that the maximum modulus on E of any normalized polynomial of degree n is greater than k^n.* A possible choice for k is $c/(3R)$, while the polynomial $az - 1$ for small a shows that such a dependence on R is necessary. (Received September 14, 1950.)

4. A. N. Milgram and P. C. Rosenbloom: *Heat conduction on Riemannian manifolds in existence and uniqueness theorems.*

We consider exterior differential forms on a closed orientable Riemannian mani-

fold whose coefficients depend on a parameter t. Using the generalization of the Laplace operator defined by de Rham, we study the analogue of the equation of heat conduction. From the fundamental solution for the Euclidean case we construct a parametrix, and derive an integral equation of Volterra type. Thus we prove the existence and uniqueness of the solution with prescribed initial values. If the form is closed initially, then it remains closed for all time, and its periods remain constant. As $t\to\infty$ a solution of the heat equation converges uniformly to a harmonic form. In this way we obtain a simple proof of Hodge's theorem on the existence of harmonic forms with prescribed periods from de Rham's theorem on the existence of closed forms with prescribed periods. (Received October 25, 1950.)

5. I. M. Singer: *Lie algebras of unbounded operators.*

Every strongly continuous unitary representation of an analytic group gives rise to a representation of the corresponding Lie algebra by unbounded skew-symmetric operators with a common, dense, invariant domain. [Gärding, Proc. Nat. Acad. Sci. U. S. A. vol. 33 (1947).] Using techniques involving the Cayley transform of a symmetric operator, one shows that the generators of the one-parameter groups restricted to the domain above (among others) have skew-adjoint closures. Conversely, it is shown that a condition of differentiability on the exponentials of a Lie algebra of unbounded skew-adjoint operators insures that a unitary representation of the local group can be obtained by exponentiating. A counter example is produced to show that the existence of a common invariant domain for a Lie algebra of operators alone is not sufficient for a group representation. A sufficient condition for the existence of the group representation can also be obtained by demanding that on some common domain the exponential power series of the operators in the Lie algebra converge. This condition is shown to be necessary for nilpotent groups. Finally, it is proved that analytic groups which have faithful uniformly continuous unitary representations are direct products of abelian and compact analytic groups. (Received September 13, 1950.)

Applied Mathematics

6. Ralph Gomory and D. E. Richmond: *Boundaries for the limit cycle of van der Pol's equation.*

The authors present a simple and natural method for constructing outer and inner boundaries for the limit cycle of van der Pol's equation, $d^2x/dt^2+\mu(x^2-1)dx/dt+x=0$. The method admits of unlimited improvement but even its simplest application gives results superior to those obtained by La Salle [Quarterly of Applied Mathematics vol. 7 (1949) pp. 1–19]. (Received September 14, 1950.)

7. S. N. Karp: *Natural charge distribution on a conical cup.*

The natural charge distribution for a conical cup has been obtained without approximation. Using spherical coordinates the potential U is expressed in the form $U=\int_{\sigma-i\infty}^{\sigma+i\infty} r^{-\nu}A_1(\nu)P_{\nu-1}(\cos\theta)d\nu$ for $0<\theta<\theta_0$, and $U=\int_{\sigma-i\infty}^{\sigma+i\infty} r^{-\nu}A_2(\nu)P_{\nu-1}(-\cos\theta)d\nu$ for $\theta_0<\theta<\pi$. The two-part boundary value problem in r at $\theta=\theta_0$ then gives rise to a single equation between two functions of ν. This equation is solved by Wiener-Hopf techniques in the complex ν plane. This involves: (a) factorization of $P_{-1/2+\mu}(\cos\theta_0)\cdot P_{-1/2+\mu}(-\cos\theta_0)/\sin\pi\nu$ in the form $K_+(\mu)\cdot K_-(\mu)$, where $K_+(\mu)$ is regular in a right half-plane and $K_-(\mu)$ in a left half-plane; (b) the asymptotic forms of $K_+(\mu)$, $K_-(\mu)$. The necessary results are obtained by employing: (a) the fact that the zeros of $P_{-1/2+\mu}(\cos\theta_0)$ considered as a function of μ are real, symmetric about the origin, and asymptotically

in arithmetic progression; (b) comparison of $K_+(\mu)$ with the gamma function of a suitable argument. The method may also be applied in the case of incident fields. (Received August 30, 1950.)

8. W. W. Leutert: *A new method for the numerical solution of linear parabolic differential equations with constant coefficients.*

A three line difference equation is reduced to a two line difference equation by excluding particular solutions which might cause divergence and instability. The values on a line are obtained from those of the previous line by a simple process which involves only multiplication and addition of known quantities. Thus while the advantage of good convergence [error of order $(\Delta t)^2$] is retained from the three line equation, the new method will insure stability and convergence for all positive values of the mesh ratio $r=\Delta t/(\Delta x)^2$. It follows that von Neumann's test of stability is sufficient but not necessary. (Received July 31, 1950.)

9. F. J. Murray: *The Curie point for three-dimensional order-disorder.* Preliminary report.

The cubical lattice order-disorder problem for which van der Waerden has established the existence of a reference order at low temperatures (Zeitschrift für Physik vol. 118 (1941–1942) p. 473) is investigated in the region of the Curie point. Assuming that the possibility of perfect order has relative weight (Bolzman factor) one, one may consider all the possibilities for a single flaw in the reference order with a prescribed pattern in a fixed position on a face of the cubical lattice. The sum of the relative weights for all these possibilities can be considered as a weight for this pattern if the face pattern is simply connected. If the face pattern is disconnected, weights are assigned for each method of connecting the disconnected pieces. Removing a layer from the given face permits one to express the vector W whose elements are these weights in terms of matrix T and vector w_0 corresponding to the situation in which the fault is confined to the layer removed. $(1-T)W=w_0$. The temperature at which the maximum characteristic value of T is one corresponds to the disappearance of long range order. Methods for the numerical evaluation of the elements of T have been developed and a rough evaluation of the Curie point has been made, but it seems desirable to repeat this computation with automatic machinery. (Received September 26, 1950.)

10. Domina E. Spencer: *On separability in electromagnetic theory.*

The problem of solving Maxwell's equations can be reduced to the problem of solving the vector Helmholtz equation $\nabla^2 A^{\rightarrow}=k^2 A^{\rightarrow}$. Separability of the vector Helmholtz equation is studied in the eleven confocal quadric coordinate systems for which the scalar Helmholtz equation is separable. A method of solution is indicated, even when the differential equation for only one component of $A^{\rightarrow}$ is separable. It is shown that separability methods are applicable to electromagnetic problems in eight of the eleven coordinate systems. (Received September 13, 1950.)

11. L. A. Zadeh: *An operational calculus for time-dependent Heaviside operators.*

The operational relation $v(t)=H(p;t)u(t)$ is defined to mean $v(t)=\mathcal{L}^{-1}\{H(s;t)U(s)\}$ where $\mathcal{L}^{-1}$ represents the operation of inverse Laplace transformation (treating t in $H(s;t)$ as a fixed parameter), and $U(s)$ is the bilateral Laplace transform of $u(t)$. The time-dependent operator $H(p;t)$ is a generalization of the conventional Heaviside

operator $H(p)$. Let N be a linear varying-parameter system and let $u(t)$ and $v(t)$ denote respectively the input and output of N. The system function of N is defined by the relation $H(j\omega; t) = v(t)/u(t)$ for $u(t) = e^{j\omega t}$ (Proceedings of the I.R.E. vol. 38 (1950) pp. 291–299). The fundamental property of the system function is that the output $v(t)$ corresponding to an arbitrary input $u(t)$ is related to $u(t)$ through $v(t) = H(p; t)u(t)$. Let $w(t) = H_2(p; t)\{H_1(p; t)u(t)\}$. This may be replaced by $w(t) = H_3(p; t)u(t)$ where $H_3(p; t)$ is given by the product relation $H_3(s; t) = H_2(p+s; t)H_1(s; t)$ which may be written symbolically as $H_3 = H_2 * H_1$. The inverse of an operator H is defined by the relation $H*H^{-1} = H^{-1}*H = 1$. If $v(t)$ and $u(t)$ are related to each other by a differential equation $L(p; t)v(t) = K(p; t)u(t)$, then $H(s; t)$ satisfies the differential equation $L*H = K$. Based on these relations, an operational calculus for time-dependent Heaviside operators can readily be constructed. (Received September 14, 1950.)

TOPOLOGY

12. A. L. Blakers and W. S. Massey: *The homotopy groups of a union of spheres with a single point in common.*

Let $\mathfrak{S}_k^n = S_1^n \cup S_2^n \cup \cdots \cup S_k^n$ be a topological space which is the union of k different n-dimensional ($n \geqq 2$) spheres S_i^n with a single point in common. By using a theorem of G. W. Whitehead (Ann. of Math. vol. 51 (1950) p. 210, Theorem 4.8) it is not difficult to prove that if $p < 3n-2$ then the homotopy group $\pi_p(\mathfrak{S}_k^n)$ is a direct sum of k subgroups each isomorphic to $\pi_p(S^n)$ and $k(k-1)/2$ subgroups each isomorphic to $\pi_p(S^{2n-1})$. The authors have now determined the structure of the group $\pi_{3n-2}(\mathfrak{S}_k^n)$. It is the direct sum of k subgroups each isomorphic to $\pi_{3n-2}(S^n)$, $k(k-1)/2$ subgroups each isomorphic to $\pi_{3n-2}(S^{2n-1})$, and a free abelian group on $(k+1)k(k-1)/3$ generators. As generators of this free abelian group, one may take the triple Whitehead products $[\iota_p, [\iota_q, \iota_r]]$, where $1 \leqq q < r \leqq k$, $1 \leqq p \leqq r$, and $\iota_i \in \pi_n(\mathfrak{S}_k^n)$ is the image of a generator of $\pi_n(S_i^n)$ under the injection $\pi_n(S_i^n) \to \pi_n(\mathfrak{S}_k^n)$, $1 \leqq i \leqq k$. (Received August 30, 1950.)

13. S. T. Hu: *On the realizability of homotopy groups and their operations.*

Whitehead's realizability theorem for homotopy groups, which gives no information about the Whitehead products of the higher homotopy groups, is strengthened in this paper as follows. Let $\pi_1, \pi_2, \cdots, \pi_n, \cdots$ be a given sequence of abstract groups. All groups except the first one are abelian and written additively, while π_1 is written multiplicatively; also π_1 operates on the left of every group π_n with $n \geqq 2$. Then the strengthened theorem is as follows: There exists an arcwise connected topological space B and a basic point $b_0 \in B$ satisfying the following conditions: (i) There exists, for each integer $n \geqq 1$, an isomorphism $h_n : \pi_n(B) \approx \pi_n$; (ii) For arbitrary elements $w \in \pi_1(B)$ and $a \in \pi_n(B)$, $n \geqq 2$, $h_n(wa) = h_1(w)h_n(a)$; and (iii) For arbitrary elements $a \in \pi_m(B)$ and $b \in \pi_n(B)$, $m \geqq 2$, $n \geqq 2$, the Whitehead product $aob = 0$. The construction can be sketched as follows. To each integer $n \geqq 1$, consider the semi-simplicial complex $P_n = K(\pi_n, n)$ of Eilenberg and MacLane. P_n is an arcwise connected topological space whose homotopy groups are given by $\pi_n(P_n) \approx \pi_n$ and $\pi_i(P_n) = 0$ $(i \neq n)$. Let $X = P_1$ and Y be the topological product of the polytopes P_n $(n \geqq 2)$. Then the space B is constructed as a bundle space with X as base space and Y as fiber. (Received September 12, 1950.)

T. R. HOLLCROFT,
Associate Secretary