LION HOUSE. Completed February, 1903.
Total length, 240 feet; width, including outside cages, 110 feet.

SEVENTH ANNUAL REPORT

OF THE

NEW YORK ZOOLOGICAL SOCIETY

CHARTERED IN 1895

OBJECTS OF THE SOCIETY

A PUBLIC ZOOLOGICAL PARK
THE PRESERVATION OF OUR NATIVE ANIMALS
THE PROMOTION OF ZOOLOGY

1902

NEW YORK
OFFICE OF THE SOCIETY, 11 WALL STREET
APRIL 1, 1903

The Trow Press, New York

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CARTER, ERNEST TROW.....150 West 58th Street
CARTER, L. AVERELL.....204 West 86th Street
CARTER, WALTER S.....176 Brooklyn Avenue, Brooklyn
CASE, E. R.....1 West 81st Street
CASSATT, G. M.....19 West 34th Street

* Deceased.

CASTREE, JOHN W.....150 Central Park South
CASWELL, JOHN H.....11 West 48th Street
CASWELL, W. H.....150 West 58th Street
CATHCART, MISS JENNIE R.....The Barnard, 108 Central Park West
CERERO, R. L.....321 Hancock Street, Brooklyn, N. Y.
CHABOT, S. J.....150th Street and Third Avenue
CHAMBERS, FRANK R.....842 Broadway
CHAMBERS, JAMES.....277 South Street, Morristown, N. J.
CHAMBERS, JOHN A.....277 South Street, Morristown, N. J.
CHAPMAN, FRANK M.....American Museum of Natural History
CHESEBROUGH, ROBERT A.....51 East 49th Street
CHICHESTER, CHARLES DARWIN.....46 Wall Street
CHISHOLM, B. OGDEN.....436 Madison Avenue
CHITTENDEN, JARED.....1 West 30th Street
CHRYSTIE, WILLIAM F.....Hastings-on-Hudson
CHURCH, F. S.....Carnegie Hall
CHURCH, THEO. W.....354 Charlton Avenue, South Orange, N. J.
CLAFLIN, JOHN.....4 East 72d Street
CLARK, D. CRAWFORD.....51 Wall Street
CLARK, J. MITCHELL.....45 Wall Street
CLARK, L. C.....51 Wall Street
CLARK, W. A.....49 Wall Street
CLARK, WILLIAM N.....170 William Street
CLARKE, C. C.....Scarborough, N. Y.
CLARKE, THOMAS F.....1701 Madison Avenue
CLARKE, THOMAS SHIELDS.....50 Riverside Drive
CLAUSEN, GEORGE C.....32 West 69th Street
CLEARY, JOHN.....121 Madison Avenue
CLEVELAND, CHARLES D.....59 East 52d Street
CLYDE, WILLIAM P.....P. O. Box 1194, New York City
COCKERILL, JOHN F.....147 Columbus Avenue
COCKRAN, W. BOURKE.....31 Nassau Street
COFFIN, WILLIAM E.....31 Nassau Street
COHEN, SAMUEL M.....127 Bleecker Street
COLBURN, N. A.....808 Broadway
COLE, E. F.....253 Broadway
COLLARD, GEORGE W.....884 Fifth Avenue
COLLIER, PRICE.....Tuxedo Park, N. Y.
COLLIER, P. F.....29 Fifth Avenue
COLLINS, MRS. ELLEN.....41 West 11th Street
COLLINS, MISS GERTRUDE.....Care Stephen W. Collins, 69 Wall Street
COMFORT, WALTER R.....944 St. Nicholas Avenue
*COMPTON, ALEXANDER T.
COMSTOCK, MRS. H. G.....100 East 17th Street
CONDON, THOMAS GERALD.....Tuxedo Park, N. Y.
COOK, FERDINAND H.....249 West End Avenue
COOLEY, JAMES C.....24 Thomas Street
COOPER, EDWARD.....12 Washington Square North
CORBIN, AUSTIN.....192 Broadway
CORNING, C. R.....Union League Club
CORNING, G. M.....P. O. Box 501, New York City
CORWINE, WILLIAM R.....55 East 76th Street
COSTAINE, EUGENE H.....Shrub Oak, Westchester Co., N. Y.
COSTER, HENRY A.....Westchester, New York City
COWDIN, WINTHROP.....Mt. Kisco, N. Y.
COWL, CLARKSON.....20 West 14th Street
COWLES, DAVID S.....66 Broadway
COX, CHARLES F.....54 East 67th Street
CRAIGIE, ARCHIBALD WALPOLE.....57 West 46th Street

* Deceased.

CRANE, ALBERT.....35 Wall Street
*CRANFORD, J. P.
*CRAWFORD, FRANCIS.
CRAWFORD, DR. W. H.....205 West 57th Street
CROMWELL, JAMES W.....1 Greene Street
CRONIN, CHARLES H.....2496 Cambreling Avenue
CROSBY, LIVINGSTON.....Dobbs Ferry, N. Y.
CRUICKSHANK, JAMES.....275 Central Park West
CUTTER, RALPH L.....219 Clinton Street, Brooklyn
CUTTING, R. FULTON.....32 Nassau Street
CUTTING, W. BAYARD.....24 East 72d Street
DAINTRY, W. MANSELL.....103 East 29th Street
DAMON, WILLIAM E.....222 West 23d Street
DANA, WILLIAM B.....Pine Street corner of Pearl Street
DANIELS, GEORGE H.....Grand Central Depot
DANNE, DR. FREDERIC.....44 West 50th Street
DARDS, CHARLES A.....44th Street and Madison Avenue
DAVENPORT, IRA.....31 East 39th Street
DAVIES, WILLIAM GILBERT.....22 East 45th Street
DAVIS, GHERARDI.....44 Pine Street
DAVIS, JOHN W. A.....21 West 14th Street
DAVIS, JOSEPH P.....201 West 55th Street
DAVISON, CHARLES STEWART.....56 Wall Street
DAVISON, G. HOWARD.....51 East 49th Street
DAY, HORACE LINCOLN.....101 West 84th Street
DEAN, BASHFORD.....Columbia University
DE COPPET, HENRY.....22 West 17th Street
DEEVES, RICHARD.....58 West 83d Street
DE FOREST, GEORGE B.....14 East 50th Street
DE FOREST, ROBERT W.....7 Washington Square North
DEGENER, J. F.....5 West 38th Street
DE KLYN, B. F.....64 Irving Place
DELAFIELD, FREDERICK P.....29 Liberty Street
DELESKER, CHARLES.....680 Tremont Avenue
DEMING, DR. W. C.....Westchester, N. Y.
DENICKE, J. B.....1041 Woodruff Street
DENNERLEIN, GEORGE.....2063 Honeywell Avenue
DERBY, DR. RICHARD H.....3 East 40th Street
DE RHAM, H. CASIMIR.....Tuxedo, N. Y.
DEUTSCH, MORRIS.....407 East 70th Street
DEVEREUX, W. B.....98 John Street
DE VINNE, THEODORE LOW.....300 West 76th Street
DEVLIN, JOHN B.....148th Street and Third Avenue
DEVLIN, JOHN H.....148th Street and Third Avenue
DE WITT, WALTER G.....201 East 12th Street
DE WITT, WILLIAM G.....10 West 30th Street
DEXTER, STANLEY W.....71 Broadway
DEYO, ROBERT E.....106 West 48th Street
DICKEY, CHARLES D.....59 Wall Street
DIEHL, GEORGE H.....18 West 127th Street
DIENST, A. P.....Third Avenue and 140th Street
DILLON, WILLIAM B.....49 Wall Street
DITMARS, R. L.....New York Zoological Park
DIXON, GEORGE A.....15 West 49th Street
DODGE, NORMAN W.....81 New Street
DOHSE, JOHN.....717 Park Avenue
DOMINICK, H. BLANCHARD.....14 West 49th Street
DOMMERICH, L. F.....57 Greene Street

*Deceased.

DOREMUS, F. S.....20 Nassau Street
DORMITZER, MRS. HENRY D.....27 East 74th Street
DOUBLEDAY, F. N.....34 Union Square East
DOUGLAS, JAMES.....99 John Street
DOUGLASS, A. B.....Flagstaff, Me.
DOWS, TRACY.....8 Broadway
DRAKE, JOHN J.....58 William Street
DRAKE, WILLIAM.....37 West 22d Street
DRAKENFELD, B. FERDINAND.....27 Park Place
DRAZ, F.....36 East 57th Street
DRESSEL, JOHN A. H.....Hartford Building
DRUMMOND, I. WYMAN.....436 West 22d Street
DUANE, RICHARD BACHE.....62 East 55th Street
DUER, WILLIAM A.....115 Broadway
DUGMORE, A. RADCLIFFE.....Newfoundland, N. J.
DUNCAN, A. BUTLER.....1 Fifth Avenue
DUNCAN, STUART.....392 Canal Street
DUNHAM, EDWARD K.....338 East 26th Street
DUNHAM, G. H.....19 West 81st Street
DUNN, ISAAC L.....680 East 175th Street
DUNNE, EDWARD B.....54 West 30th Street
DUNNE, JAMES.....31 Nassau Street
DURYEA, HARRY H.....80 Madison Avenue
DURYEA, GEN. HIRAM.....80 Madison Avenue
DUTCHER, WILLIAM.....525 Manhattan Avenue
EBERHARDT, MARCUS.....1462 First Avenue
EDGAR, D.....155 West 58th Street
EDGAR, MISS JULIA L.....28 East 39th Street
EDGAR, NEWBOLD.....28 East 39th Street
EDGAR, HERMAN L. R.....31 Nassau Street
EDGELL, GEORGE S.....192 Broadway
EDMONDS, JOHN W.....128 East 44th Street
EGERTON, M.....9 Seamore Place, Mayfair, London, England
EGGELING, OTTO.....72 East 125th Street
EGLESTON, D. S.....166 South Street
EHLERS, OTTO.....1901 Washington Avenue
EIDLITZ, ROBERT JAMES.....995 Madison Avenue
ELDER, MRS. MATILDA A.....25 East 30th Street
ELDRIDGE, FREDERICK L.....66 Broadway
ELDRIDGE, LEWIS A.....30 Broad Street
ELDRIDGE, ROSWELL.....Great Neck, L. I.
ELLSWORTH, DUNCAN S.....Calumet Club
ELLSWORTH, JOHN MAGEE.....Calumet Club
ELLSWORTH, LINCOLN.....2 West 16th Street
ELLSWORTH, WILLIAM.....16 Lafayette Avenue, Brooklyn, N. Y.
EMERY, JOHN J.....5 East 68th Street
EMMET, MISS L. F.....New Rochelle, N. Y.
EMMET, ROBERT TEMPLE.....11 Front Street, Schenectady, N. Y.
EMMET, W. L. R.....Schenectady, N. Y.
ENDEMANN, WILLIAM.....1263 Franklin Avenue
ENDICOTT, ROBERT.....1 East 35th Street
ENGERMAN, JOHN T.....335 East 18th Street, Flatbush, L. I.
ENGLISH, E. M.....687 Eleventh Avenue
ENO, JOHN CHESTER.....P. O. Box 1889, New York
EPSTEAN, EDWARD.....147 West 111th Street
ERBSLOH, F.....134 East 60th Street
ESCHMANN, F. W. R.....Yonkers, N. Y.
ESLING, WILLIAM W.....1736 Bathgate Avenue
ETTLINGER, LOUIS.....40 East 73d Street

EVANS, MRS. CADWALADER.....12 East 11th Street
EVANS, RICHARD.....93 William Street
EVARTS, A. W.....52 Wall Street
EVARTS, SHERMAN.....52 Wall Street
FAAS, JOHN.....1351 Washington Avenue
FABBRI, ALLESANDRO.....Scarborough, N. Y.
FABBRI, ERNESTO G.....Scarborough, N. Y.
FAHNESTOCK, HARRIS C.....2 Wall Street
FAIRCHILD, DAVID.....182 Benham Avenue, Bridgeport, Conn.
FAIRCHILD, NELSON.....39 East 31st Street
FALK, GUSTAV.....24 East 81st Street
FALVEY, FRANK A.....2081 Crotona Avenue
FARGO, JAMES C.....56 Park Avenue
FARNHAM, PAULDING.....15 Union Square
FIELD, WILLIAM B. OSGOOD.....2 West 52d Street
FISHER, L. G.....42 New Street
FISKE, J. W.....41 Park Place
FITCH, EZRA H.....Montclair, N. J.
FITZGERALD, GEN. LOUIS.....253 Lexington Avenue
FLINT, THOMPSON J. S.....Larchmont, N. Y.
FOOT, J. D.....Rye, N. Y.
FORBACH, CHARLES.....1919 Prospect Avenue
FORBES, W. D.....1300 Hudson Street, Hoboken, N. J.
FOSTER, EDWARD W.....134 Leonard Street
FOSTER, GIRAUD.....18 Wall Street
FOSTER, M. G.....876 St. Nicholas Avenue
FOSTER, PELL W.....126 Liberty Street
FOSTER, SCOTT.....395 Canal Street
FOSTER, W. BERT.....Box 66, Madison Square P. O., N. Y.
FOWLER, OTIS L. R.....1263 East 179th Street
FOX, AUSTEN H.....Holworthy 5, Cambridge, Mass.
FOX, JOHN J.....1908 Bathgate Avenue
FRANKFIELD, MRS. A.....328 West 56th Street
FRASER, ALEX V.....478 Greenwich Street
FULDA, DR. CARL.....107 Kent Street, Brooklyn
FULDA, DR. CLEMENS.....107 Kent Street, Brooklyn
FULLER, CHARLES D.....25 West 9th Street
FULLER, MRS. EUGENE.....252 Lexington Avenue
FUNKE, EDMUND A.....854 East 165th Street
GANNON, BARTHOLOMEW.....1628 Second Avenue
GANZ, ANTHONY.....2146 Boston Road
GARRETT, JOHN W.....11 South Street, Baltimore, Md.
GAUTIER, DUDLEY G.....32 Cliff Street
GAY, JOSEPH E.....Union League Club
GEER, MRS. WALTER.....246 West 72d Street
GERRISH, JOHN BROWN....Care of William L. Gerrish, 102 East 57th Street
GERSTER, DR. ARPAD G.....34 East 75th Street
GHEE, JOHN F.....Poplar Street, Westchester
GHEE, THOMAS.....Eastchester Road, Williamsbridge, N. Y.
GIBNEY, DR. VIRGIL P.....16 Park Avenue
GILBERT, CLINTON.....48 East 50th Street
GILFORT, ROBERT.....203 Main Street, Orange, N. J.
*GILL, GEORGE.
GILLETTE, CURTENIUS.....24 West 40th Street
GILMAN, THEODORE.....311 Palisade Avenue, Yonkers
GILSEY, HENRY, JR.....10 East 36th Street
GODDARD, F. N.....273 Lexington Avenue
GOLDSCHMIDT, S. A.....71 Central Park West

*Deceased.

Good, Martin Q.....233 East 87th Street
Goodhue, Mrs. C. C.....189 Madison Avenue
Goodwin, Rev. Francis.....Hartford, Conn.
Gotthold, Frederic.....165 West 58th Street
Gould, Charles A.....25 West 33d Street
Gould, C. W.....5 Washington Square
Gould, Edwin.....195 Broadway
Gould, George H.....Santa Barbara, Cal.
Goulden, Joseph A.....2433 Creston Avenue, Fordham
Grace, William R.....P. O. Box 2866, New York City
Grant, R. S.....Union Club
Graves, William L.....Calumet Club
Gray, J. H.....313 West 77th Street
Greeff, Ernest F.....37 West 88th Street
Greene, Gen. Francis V.....11 Broadway
Greenough, John.....31 West 35th Street
Greenwood, Isaac J.....271 West End Avenue
Greer, C. M.....Rye, N. Y.
Greer, Charles.....Rye, N. Y.
Griffith, Daniel J.....21 West 59th Street
Grinnell, George Bird.....346 Broadway
Grinnell, William Morton.....873 Madison Avenue
Griswold, Chester.....23 West 48th Street
Gross, Frank.....1345 Lexington Avenue
Grossman, George J.....952 Trinity Avenue
Gudewill, Rev. Rudolph H. E.....30 West 59th Street
Gulliver, W. C.....120 Broadway
Gurnee, W. S., Jr.....417 Fifth Avenue
Haas, Otto.....1882 Bathgate Avenue
Hadden, Dr. Alexander.....155 East 51st Street
Haggerty, Janet B. H.....2 East 45th Street
Hall, Henry E.....1269 East 179th Street
Hallock, Charles.....180th Street and Honeywell Avenue
Halstead, Miss L. P.....110 East 37th Street
Hamersley, Lewis Gordon.....1030 Fifth Avenue
Hamilton, Theodore.....1028 Grote Street
Hammond, Mrs. John Henry.....14 East 72d Street
Hanford, Dr. H. W.....Wyoming, N. J.
Hanson, H. D.....310 East 21st Street
Harbeck, Charles T.....Islip, N. Y.
Hard, Anson W.....107 Wall Street
*Harriman, W. M.
Hart, William W.....365 Fifth Avenue
Hartog, Ferdinand J., Jr.....21 East 99th Street
*Harvey, Alexander.
Hasbrouck, Harold.....39 West 90th Street
Hasslacher, Jacob.....100 William Street
Hatfield, Thomas F.....834 Hudson Street, Hoboken, N. J.
Havemeyer, T. A.....117 Wall Street
Havens, Albert G.....East Orange, N. J.
Haven, George G., Jr.....6 East 53d Street
Hawley, E.....349 Broadway
Haynes, William De Forest.....16 East 36th Street
Heckscher, John Gerard.....31 West 75th Street
Heiman, Abraham.....745 East 175th Street
Heiman, E.....745 East 175th Street
Heins, George L.....303 State Street, Albany
Heinsheimer, L. A.....27 Pine Street

*Deceased.

HEINTZ, JOHN C. ..... 169th Street and Third Avenue
HENRIQUES, DR. H. A. ..... Morristown, N. J.
HERMANN, FERDINAND ..... P. O. Box 477, New York
HERTER, DR. CHRISTIAN A. ..... 819 Madison Avenue
HERZFELD, FELIX ..... 147 West 86th Street
HESS, SELMAR ..... 956 Madison Avenue
HIETEMEYER, CLEMENS ..... 810 Hudson Street, Hoboken, N. J.
HILL, E. B. ..... 11 Sumner Street, Quincy, Mass.
HILL, NICHOLAS S., JR. ..... 243 West 98th Street
HILYARD, GEORGE D. ..... 144 East 49th Street
HINTON, DR. JOHN H. ..... 41 West 32d Street
HITCHCOCK, CENTER ..... Knickerbocker Club
HOAGLAND, MISS FANNY M. ..... 27 West 51st Street
HOE, RICHARD M. ..... 11 East 71st Street
HOE, MRS. RICHARD M. ..... 11 East 71st Street
HOE, MRS. ROBERT ..... 11 East 36th Street
HOLBROOK, MRS. F. S. ..... Stamford, Conn.
HOLBROOK, MISS LILIAN ..... Stamford, Conn.
HOLDEN, EDWIN B. ..... 323 Riverside Drive
HOLDEN, GEORGE A. ..... 185 Riverside Drive
HOLLAND, HEDLEY L. ..... 2244 Bathgate Avenue, New York
HOLST, L. J. R. ..... 1410 President Street, Brooklyn, N. Y.
HOLT, HENRY ..... 29 West 23d Street
HOMER, WALLACE ..... Garrison, N. Y.
HOPPIN, HAMILTON L. ..... Mount Kisco, N. Y.
HORTON, G. B. ..... 83 Gold Street
HOSKIER, H. C. ..... 26 Exchange Place
HOWLAND, G. G. ..... New York Herald
HOWLAND, HENRY E. ..... 35 Wall Street
HOYT, ALFRED M. ..... 1 Broadway
HOYT, COLGATE ..... 36 Wall Street
HOYT, GEORGE S. ..... 72 Gold Street
HUMPHREYS, MRS. EDWARD WALSH ..... 32 East 38th Street
HUNTINGTON, REV. W. R. ..... 804 Broadway
HUTCHINS, AUGUSTUS SCHELL ..... 69 Wall Street
HYDE, B. T. BABBITT ..... 20 West 53d Street
HYDE, CLARENCE M. ..... 80 Broadway
HYDE, DR. FREDERICK E. ..... 20 West 53d Street
INNESS, GEORGE, JR. ..... 145 West 58th Street
INSLEE, MRS. HELEN C. ..... 50 West 72d Street
ISELIN, ADRIAN, JR. ..... 9 East 26th Street
ISHAM, CHARLES H. ..... 30 East 63d Street
ISHAM, MISS JULIA B. ..... 5 East 61st Street
ISHAM, SAMUEL ..... 5 East 61st Street
ITTNER, J. J. ..... 813 Park Avenue
JACKSON, FREDERIC WENDELL ..... Westchester, New York City
JACKSON, DR. GEORGE THOMAS ..... 692 West End Avenue
JACKSON, J. A. ..... Box 86, Springdale, Conn.
JACKSON, R. G. ..... 23 Cedar Place, Yonkers, N. Y.
JACKSON, SAMUEL MACAULEY ..... 692 West End Avenue
JACKSON, THEODORE F. ..... 10 West 43d Street
JACOB, CHARLES ..... 310 West 45th Street
JACOB, LAWRENCE ..... 42 East 49th Street
JACOBI, DR. A. ..... 19 East 47th Street
JACQUELIN, HERBERT T. B. ..... 34 East 38th Street
JACQUELIN, JOHN H. ..... 34 East 38th Street
JAMES, ARTHUR CURTISS ..... 99 John Street
JAMES, DR. ROBERT C. ..... 58 West 55th Street
JAMES, DR. WALTER B. ..... 17 West 54th Street

JENNINGS, F. B.....86 Park Avenue
JENNINGS, PHILANDER R.....190 Water Street
JENNINGS, WALTER.....26 Broadway
JESUP, CHARLES M.....124 East 36th Street
*JESUP, JAMES R.
JEWETT, C. H., JR.....South Orange, N. J.
JEWETT, GEORGE W.....20 Broad Street, South Orange, N. J.
JOHNSON, F. COIT.....110 Worth Street
JOHNSON, DAVID S.....72 East 127th Street
JOHNSTON, THEODORE V., JR.....234 Central Park West
JOLINE, ADRIAN HOFFMAN.....1 West 72d Street
JONES, MRS. JOSEPHINE K.....Fifth Avenue Hotel
JONES, LEWIS Q.....Bay View, Newport, R. I.
KAHN, LOUIS.....172 Broadway
KAHN, MOSES.....172 Broadway
KANE, JOHN INNES.....49 West 23d Street
KANE, S. NICHOLSON.....23 West 47th Street
KARATSONYI, MARTIN.....Glenwood, L. I.
KEECH, FRANK B.....14 East 65th Street
KEIL, WILL. M.....Tuxedo Park, N. Y.
KEITH, D. E.....944 St. Nicholas Avenue
KELLER, ERNEST F.....Mt. Hope, Tremont, New York City
KELLEY, AUSTIN P.....37 Wall Street
KELLY, EUGENE.....763 Fifth Avenue
KELLY, PATRICK.....Kingsbridge Road and Taylor Avenue
KEMP, ARTHUR T.....615 Fifth Avenue
KENT, EDWIN C.....80 William Street
KENYON, ROBERT N.....49 Wall Street
KEUFFEL, WILHELM.....510 Hudson Street, Hoboken, N. J.
KIDDER, JAMES HATHAWAY.....Union Club, Boston, Mass.
KIMBALL, ALFRED R.....15 Wall Street
KING, RUPERT COCHRANE.....27 Waverley Place
KING, WILLIAM F.....871 Madison Avenue
KING, WILLIAM W.....N. & S. R. R., Norfolk, Va.
KIP, IRA A., JR.....South Orange, N. J.
KIPP, FRANK A.....Pelham Avenue and Southern Boulevard
KNAPP, DR. HERMAN.....26 West 40th Street
KNAPP, JOHN M.....66 Broadway
KNOEDLER, ROLAND F.....122 West 13th Street
KNOX, JAMES W.....2032 Bathgate Avenue
KOBBE, LIEUT. FERDINAND W.....Philippine Islands
KOHLMAN, CHARLES.....236 Church Street
KRETS, HOWARD C.....133 West 129th Street
KUHN, GEORGE J.....4400 Park Avenue
KUHNE, PERCIVAL.....7 East 78th Street
KUNHARDT, HENRY R.....124 West 74th Street
KUTTROFF, ADOLF.....17 East 69th Street
LA FARGE, OLIVER H. P...Second Avenue and Cherry Street, Seattle, Wash.
LAGAI, DR. GEORGE.....225 Fourth Avenue
LAMBERT, DR. ALEXANDER.....125 East 36th Street
LANDON, FRANCIS G.....27 William Street
LANE, EDWARD V. Z.....143 Liberty Street
LANE, JAMES WARREN.....4 East 61st Street
LANGE, J. D.....220 West 79th Street
LANGELOTH, J.....784 Fifth Avenue
LANGMANN, DR. GUSTAV.....121 West 57th Street
LAPSLEY, DAVID.....44 West 33d Street
LATHROP, FRANCIS.....29 Washington Square

*Deceased.

LAUDAUER, I. N.....37 East 76th Street
LAWRENCE, CYRUS J.....81 Park Avenue
LAWRENCE, JOHN BURLING.....126 East 30th Street
LAWRENCE, NEWBOLD T.....51 Liberty Street
LAWRENCE, W. V.....969 Fifth Avenue
LAYNG, J. D.....931 Fifth Avenue
LEDOUX, ALBERT R.....39 West 50th Street
LEE, AMBROSE.....Williamsbridge, N. Y.
LEE, PROF. FREDERIC S.....64 Park Avenue
LEE, MRS. FREDERIC S.....64 Park Avenue
LEE, J. BOWERS.....51 Exchange Place
LEFFERTS, MARSHALL C.....34 East 65th Street
LE GENDRE, WILLIAM C.....59 Wall Street
LEITNER, JACOB.....678 Union Avenue
LEITNER, JOSEPH.....938 East 183d Street
LE ROY, ALFRED.....117 Wall Street
LESHER, A. L.....9 East 75th Street
LETKEMANN, H. V.....1278 Fulton Avenue
LEVY, EMANUEL.....280 Pearl Street
LEVY, S. H.....172 Broadway
LEWIS, FREDERIC ELLIOTT.....22 West 38th Street
LEWIS, MISS MARGUERITE.....215 Madison Avenue
LEWIS, PERCY PYNE.....15 West 42d Street
LEWIS, DR. WILLIAM J.....319 West 116th Street
LEWISOHN, ADOLPH.....11 Broadway
LIBBEY, O. B.....Hotel Albemarle, Madison Square
LIEBENAU, ALBERT, JR.....3492 Park Avenue
LIEBERTZ, JOSEPH.....1018 Prospect Avenue
LIPPMANN, DANIEL J.....1974 Bathgate Avenue
LITCHFIELD, EDWARD H.....59 Wall Street
LIVERMORE, JOHN R.....36 West 46th Street
LIVINGSTON, T. G.....Boston Road, Bronxdale
LIVINGSTON, WILLIAM S.....207 Berry Street, Brooklyn
LOBENSTINE, WILLIAM CHRISTIAN.....245 Central Park West
LOCKWOOD, WILLISTON B.....205 West 57th Street
LOEBER, CHARLES.....Bedford Park, N. Y.
LOGAN, WALTER S.....114 Riverside Drive
LONGFELLOW, MRS. FREDERICK W.....Riverdale-on-Hudson
LORING, J. ALDEN.....Owego, N. Y.
LUCKSINGER, JACQUES.....East 198th Street and Pond Place
LUD, DUDLEY OLCOTT.....4 East 53d Street
LUDEWIG, CHARLES H.....996 Tremont Avenue
LUND, MRS. F. A.....512 Madison Avenue
LUSK, PROF. GRAHAM.....11 East 74th Street
LUTTGEN, WALTHER.....P. O. Box 1587, New York City
LYMAN, FRANK.....34 Remsen Street, Brooklyn
LYNDE, FRANCIS E. P.....318 West 86th Street
MCALAN, JOHN.....4 West 84th Street
MCALLISTER, ALEXANDER.....21 Fulton Street
MCALPIN, CHARLES W.....10 West 43d Street
MCALPIN, MRS. CHARLES W.....10 West 43d Street
MCALPIN, GEORGE L.....52 East 55th Street
MCCALL, JOHN A.....346 Broadway
MCCLURE, S. S.....141 East 25th Street
MCCURDY, RICHARD A.....(Personal) 32 Liberty Street
MCKAY, THOMAS.....460 East 10th Street
MACKAYE, BENTON.....51 East 25th Street
MCKIM, REV. HASLETT.....9 West 48th Street
MCKIM, JOHN A.....18 Wall Street

McLaughlin, A. P.....1028 Grote Street
McLean, James.....16 West 55th Street
McLennan, Charles A.....Whatcom, Wash.
McVickar, Edward.....112 East 56th Street
Mace, Arthur J.....Williamsbridge, N. Y.
Mackay, George D.....20 West 69th Street
Magee, John.....Corning, N. Y.
Mahl, William.....200 West 138th Street
Mali, Pierre.....8 Fifth Avenue
Mapes, Daniel, Jr.....1920 West Farms Road
Mapes, Ernest S.....1279 Woodruff Street, West Farms
Marlor, Henry S.....Brooklyn, Conn.
Marsh, C. P.....Country Club, Westchester
Marshall, Louis.....33 East 72d Street
Martin, George C.....106 West 61st Street
Marston, Edwin S.....22 William Street
Martin, F. E.....29 Pine Street
Maslen, Richard R.....217 West 125th Street
Matthews, John H.....90th Street and Riverside Drive
Maxwell, Robert.....64 Worth Street
Mayer, Alfred G..Museum of B'klyn Institute, Eastern Parkway, B'klyn
Mead, Walter H.....222 West 23d Street
Mehl, Henry.....128 Webster Avenue, Jersey City, N. J.
Merkel, Hermann W.....New York Zoological Park
Merz, Philipp.....36 West 93d Street
Meyer, Hermann N.....4532 Park Avenue
Meyrowitz, Emil B.....104 East 23d Street
Middlebrook, Frederick.....Grand Central Station
deMilhau, Louis John.....Harvard University, Cambridge, Mass.
Miles, John.....614 Broadway
Miller, Edward F.....712 Tremont Avenue
Miller, Frank C.....579 Walton Avenue
Miller, William R.....Southern Boulevard and 187th Street
Mills, Abraham G.....71 Broadway
Mills, W. McMaster.....65 East 55th Street
Minott, W. A.....South Orange, N. J.
Mitchell, H. Raymond.....2766 Decatur Avenue, Bronx
Molera, E. J.....2025 Sacramento Street, San Francisco, Cal.
*Monson, A. C.
Montant, Alphonse.....326 West 22d Street
Montgomery, Richard M.....19 West 34th Street
Moore, Charles Arthur, Jr.....Yale University, New Haven, Conn.
Moore, Francis C.....80 Madison Avenue
Morgan, Miss Annie T.....219 Madison Avenue
Morgan, Miss C. L.....121 Madison Avenue
Morgan, Edwin D.....100 Broadway
Morgan, George H.....6 East 40th Street
Morgan, J. P., Jr.....J. S. Morgan & Co., London, England
Morgan, Junius S.....Princeton, N. J.
Morgan, Mrs. Junius S.....Princeton, N. J.
Morrell, Mrs. Robert Lee.....2 East 45th Street
Morris, Dave H.....Westchester, New York City
Morris, Fordham.....16 Exchange Place
Morris, Dr. Lewis R.....60 West 58th Street
Mott, Henry C.....428 Grand Avenue, Brooklyn, N. Y.
Mott, Jordan L., Jr.....17 East 47th Street
Mott, J. L. B.....32 East 42d Street
Mueller, Charles F.....1815 Prospect Avenue

*Deceased.

Mulcahy, H T.....704 East 169th Street
Munn, Henry Norcross.....Orange, N. J.
Munroe, Henry W.....31 Nassau Street
Murgatroyd, John.....128 St. James Place, Brooklyn
Murken, William H.....3 York Terrace, New Brighton, S. I.
Murray, A. S.....10 West 11th Street
Murtha, James J.....339 Alexander Avenue
Neff, Louis.....155 Ainslie Street, Brooklyn, N. Y.
Neilson, Dr. Howard S.....63 West 54th Street
Nesbitt, A. G.....Kingston, Pa.
Nichols, Acosta.....27 Pine Street
Nichols, George L.....66 East 56th Street
Niles, J. Barron.....Bedford Park
Niles, Robert L.....20 Broad Street
Noble, H. G. S.....52 Broadway
Norrie, A. Lanfear.....96 Wall Street
Notman, John.....54 Wall Street
Oakley, H. Cruger.....52 Broadway
Oelrichs, Hermann, Jr.....1 East 57th Street
Ogden, M. C.....98 Chambers Street
Olsen, Charles P.....2796 Pond Place
Olyphant, Robert.....21 Cortlandt Street
Olyphant, R. M.....21 Cortlandt Street
Onativia, J. Victor.....16 East 82d Street
O'Reilly, Rev. Christopher B.....943 East 183d Street
Osborn, Mrs. Henry F.....850 Madison Avenue
Ostrander, Miss Mary M.....50 West 53d Street
Otten, Mrs. Gertrude.....950 St. Nicholas Avenue
Outerbridge, Dr. Paul.....52 West 53d Street
Ovens, James.....770 Tremont Avenue
Owen, Miss Juliette A.....306 North 9th Street, St. Joseph, Mo.
Palmer, Francis F.....922 Fifth Avenue
Palmer, Nicholas F.....922 Fifth Avenue
Palmer, S. S.....52 Wall Street
Pancoast, Richard.....28 Platt Street
Parker, Francis Eyre.....160 West 59th Street
Parsons, Edwin.....958 Madison Avenue
Parsons, Mrs. Edwin.....326 West 90th Street
Parsons, John E.....30 East 36th Street
Parsons, H. de B.....22 William Street
Parsons, William Barclay.....320 Broadway
Parsons, William Barclay, Jr.....51 East 53d Street
Parsons, William H.....Rye, N. Y.
Paterson, R. W.....2 West 51st Street
*Patterson, W. H.
Paul, W. A. O.....Hotel Margaret, Brooklyn
Peabody, Royal C.....11 Broadway
Peek, Henry T.....1820 Monroe Avenue
Pell, Mrs. Alfred.....Highland Falls, N. Y.
Pell, Stephen H. P.....7 Wall Street
Pelton, Franklin D.....Calumet Club
Pendleton, Francis Key.....7 East 86th Street
Penfold, William Hall.....10 East 40th Street
Penniman, George H.....1071 Fifth Avenue
Perkins, Robert P.....3 West 16th Street
Perry, Charles J.....Astor House, New York City
Peters, Charles G.....38 East 50th Street
Peters, Dr. Julius.....937a Summit Avenue, Jersey City

*Deceased.

PETERS, SAMUEL T.....117 East 37th Street
PETERS, W. R.....23 West 73d Street
PHYFE, W. H. P.....12 East 43d Street
PICKHARDT, CARL.....1042 Madison Avenue
PIEL, GOTTFRIED.....Liberty and Sheffield Avenues, Brooklyn
PIERSON, GEN. J. FRED.....29 Broadway
PINCHOT, GIFFORD.....Department of Agriculture, Washington, D. C.
PLYMPTON, GILBERT M.....30 West 52d Street
POGGENBERG, H. F.....115 East 69th Street
POLAND, SAMUEL.....667 Eighth Avenue
POLLOCK, GEORGE E.....28 West 21st Street
PORTER, CLARENCE.....83 Park Avenue
PORTER, WILLIAM L.....P. O. Box 573, Waterford, N. Y.
POST, ABRAM S.....81 Fulton Street
POST, EDWARD C.....350 West End Avenue
POST, GEORGE B., JR.....Mills Building
POSTLEY, CLARENCE A.....817 Fifth Avenue
POTTER, MISS BLANCHE.....33 East 38th Street
POTTER, E. C.....36 Wall Street
POTTER, FREDERICK.....71 Broadway
POTTER, MISS MARTHA.....33 East 38th Street
POTTS, WILLIAM BREVOORT.....127 East 55th Street
PRENTICE, JOHN H.....3 West 37th Street
PRENTISS, GEORGE LEWIS.....University Club
PRINCE, EDWARD S.....2055 Bathgate Avenue
PRINCE, PROF. J. DYNELEY.....University Heights
PROEBSEL, PHILIP.....177th Street and Southern Boulevard
PRYER, CHARLES.....New Rochelle, N. Y.
PUTNAM, R. M. S.....318 West 84th Street
PUTNAM, WILLIAM A.....2 Wall Street
PYLE, JAMES TOLMAN.....673 Fifth Avenue
PYNE, M. TAYLOR.....52 Wall Street
PYNE, MRS. M. TAYLOR.....263 Madison Avenue
RAND, GEORGE C.....Lawrence, L. I.
RANDOLPH, L. V. F.....49 William Street
RANDOLPH, WILLIAM W.....31 Nassau Street
RATHBORNE, RICHARD C.....care Spratts Patent (Ltd.), Newark, N. J.
RAUCH, WILLIAM.....Union Club
READ, WILLIAM A.....4 East 62d Street
REDMOND, HENRY S.....41 Wall Street
REDMOND, GOOLD H.....6 North Washington Square
REIMER, OTTO E.....15 Broad Street
REINHARDT, GEORGE N.....1346 Franklin Avenue
REYNOLDS, E. B.....281 Decatur Street, Brooklyn
REYNOLDS, JAMES BRONSON.....184 Eldridge Street
RHINELANDER, CHARLES E.....6 West 32d Street
RHOADES, JOHN HARSEN.....559 Madison Avenue
RICHARD, AUGUSTE.....12 East 69th Street
RICHARDS, E. O.....105 East 19th Street
RIKER, JOHN L.....19 West 57th Street
RIKER, SAMUEL.....27 East 69th Street
RIPLEY, H. DILLON.....Racquet Club
RIPLEY, SIDNEY DILLON.....Hempstead, L. I.
RIVES, GEORGE L.....32 Nassau Street
ROBBINS, CHANDLER.....64 West 47th Street
ROBISON, WILLIAM.....18 Wall Street
ROCKWOOD, WILLIAM H.....513 West End Avenue
ROE, FRANK O.....29 Wall Street
ROE, IRVING L.....174 West 72d Street

ROELKER, ALFRED.....53 West 47th Street
ROGGENKAMP, AUGUST.....567 East 176th Street
ROGERS, E. L.....71 Broadway
ROGERS, JAMES H.....1 Wall Street
ROKENBAUGH, HENRY S.....100 Broadway
ROOSEVELT, W. EMLEN.....804 Fifth Avenue
ROOT, ELIHU.....1626 Rhode Island Avenue, Washington, D. C.
ROPES, ALBERT G.....17 State Street
ROSE, JOHN J.....Jerome Street, Williamsbridge, N. Y.
ROSS, P. SANFORD.....29 Maiden Lane
ROSSITER, E. V. W.....Sanford Avenue, Flushing, L. I.
ROTH, F. R. G.....571 Fifth Avenue
ROWLEY, JOHN.....American Museum of Natural History
RUNGIUS, CARL.....107 Kent Street, Brooklyn
RUNYON, CHARLES.....25 Fifth Avenue
RUPPERT, JACOB.....1116 Fifth Avenue
RUSS, WILLIAM V.....209 North 6th Street, Roseville, Newark, N. J.
RUSSELL, ROBERT HOWARD.....Union Club
RYAN, J. D.....825 Third Avenue
SACKETT, MISS.....196 Madison Avenue
SACKETT, CLARENCE.....196 Madison Avenue
SACKETT, MRS. S. E.....196 Madison Avenue
*SAGE, DEAN.
SAGE, JOHN H.....Portland, Conn.
SAGE, MRS. RUSSELL.....509 Fifth Avenue
SALTUS, LLOYD.....146 Remsen Street, Brooklyn, N. Y.
SAMPSON, ALDEN.....Haverford, Pa.
SANDERSON, LLOYD BOWEN.....21 State Street
SAUSE, RICHARD E.....725 Sixth Avenue
SAUTER, FREDERICK.....3 North William Street
SCHARMANN, H. B.....170 West 59th Street
SCHEFER, CARL.....40 West 37th Street
SCHIEFFELIN, WILLIAM J.....170 William Street
SCHILLING, R. H.....28 Cooper Square
SCHIRMER, GUSTAV.....117 East 35th Street
SCHIRMER, RUDOLPH E.....243 East 17th Street
SCHLATTER, CHAS. F.....129 West 120th Street
SCHMIDT, GEORGE.....341 West 56th Street
SCHNEIDER, G. E.....961 East 184th Street
SCHOLLE, A. H.....30 Broad Street
SCHUCHARD, E. W.....Manhasset, L. I.
SCHULTZE, JOHN S.....59 Wall Street
SCHULZE, GEORGE T.....2815 Chestnut Street, Milwaukee, Wis.
SCHUMACHER, C.....31 East 81st Street
SCHUYLER, MISS LOUISA LEE.....135 East 21st Street
SCHWAB, MRS. GUSTAV.....Morris Heights
SCHWEIZER, J.....2151 Prospect Avenue
SCOTT, WILLIAM.....33 West 63d Street
SEARS, ROBERT B.....7 Taulmier Place, Jersey City
SEIB, H.....85 West 118th Street
SEITZ, ARTHUR.....811 Hudson Street, Hoboken, N. J.
SELIGMAN, ALFRED L.....Mills Building
SHAPIRO, D.....4175 Third Avenue
SHAW, CHARLES HERBERT.....47 West 43d Street
SHAW, JAMES G.....130 William Street
SHAW, WALTER W.....11 West 52d Street
SHELDON, GEORGE R.....24 East 38th Street
SHELDON, MRS. ISAAC E.....46 East 82d Street
SHELDON, W. C.....95 Park Avenue

* Deceased.

SHERMAN, GARDINER.....Metropolitan Club
SHIPWAY, JOHN H.....2972 Hull Avenue, Bedford Park
SHOENBERG, I.....940 East 182d Street
SHRADY, HENRY M.....305 West 80th Street
SHURTLEFF, R. M.....44 West 22d Street
SIEGEL, JACOB.....169th Street and Third Avenue
SIMMONS, JOSEPH F.....28 West 52d Street
SIMONS, JAMES D.....44 Broad Street
SIMPSON, JOHN BOULTON, JR.....988 Fifth Avenue
SIMPSON, WILLIAM.....757 Sixth Avenue
SKEEL, FRANK D.....361 Mott Avenue
SKIDMORE, WILLIAM L.....39 West 52d Street
SMILEY, DANIEL.....Mohonk Lake, N. Y.
SMILLIE, CHARLES F.....50 Wall Street
SMITH, AUGUSTINE J.....329 Lexington Avenue
SMITH, F. M.....101 Sansome Street, San Francisco, Cal.
SMITH, FRANK SULLIVAN.....54 Wall Street
SMITH, GEORGE WARREN.....Metropolitan Club
SMITH, LUCIUS H.....19 East 34th Street
SMITH, PHILIP S.....46 Johnson Park, Buffalo, N. Y.
SMITH, ROBERT W.....201 East 12th Street
SMITH, WILLIAM ALEXANDER.....412 Madison Avenue
SMITHERS, CHARLES.....507 Madison Avenue
SMITHERS, F. S.....180 West 59th Street
SMYTH, PHILIP A.....57 East 127th Street
SNEAD, C. S.....Room 115, 21 State Street
SOLTMANN, G. E.....Bedford Park
SOTSCHECK, CARL.....1773 Clay Avenue
SOUTHACK, FREDERICK.....48 West 53d Street
SOUTHARD, GEORGE H.....164 Montague Street, Brooklyn
SPENCER, SAMUEL.....80 Broadway
SPIEGELBERG, F.....44 Broad Street
SPITZNER, GEORGE W.....12 East 74th Street
SPOFFORD, MRS. J. L.....Hunts Point, N. Y.
SPRING, MISS ANNA RIKER.....434 Madison Avenue
SPRINGMEYER, ALBERT A.....120 Broadway
SPURR, E. W.....110 Worth Street
SQUIBB, CHARLES F.....Benardsville, N. J.
SQUIBB, DR. E. H.....148 Columbia Heights, Brooklyn
STANTON, JOHN.....13 William Street
STANTON, JOHN R.....256 West 70th Street
STARR, LOUIS MORRIS.....3 West 53d Street
STEBBINS, JAMES H.....80 Madison Avenue
STEEVES, JOHN F.....138th Street and Fourth Avenue
STEINBECK, EDWARD.....4378 Third Avenue
STEMPEL, J. H. T.....1071 East 176th Street
STEPHENS, OLIN J.....146th Street and Gerard Avenue
STERN, ISAAC.....Care of Stern Brothers, West 23d Street
STERNBACH, CHARLES.....129 East 69th Street
STEVENS, FREDERIC W.....33 West 35th Street
STEWART, WILLIAM R.....31 Nassau Street
STILLMAN, JAMES A.....7 East 40th Street
STIMSON, DR. DANIEL M.....11 West 17th Street
STOKES, H. B.....New Rochelle, N. Y.
STOKES, J. G. PHELPS.....229 Madison Avenue
STONE, MASON A.....244 Central Park West
STONEBRIDGE, CHARLES H.....2656 Third Avenue
STONEBRIDGE, G. E.....4143 Park Avenue
STOW, GEORGE G.....Oyster Bay, L. I.

STRANGE, A. B.....Woodmere, L. I.
STRATFORD, PROF. WILLIAM.....263 West 52d Street
STREAT, JAMES.....62 Leonard Street
STREETER, D. D., JR.....113 Hooper Street, Brooklyn
STUART, INGLIS.....3 Broad Street
STURGES, HENRY C.....56 East 34th Street
STUYVESANT, RUTHERFURD.....18 Exchange Place
SULLIVAN, MRS. JAMES.....36 Park Avenue
SULLIVAN, MARK S.....1 Brewers Block, Cambridge, Mass.
SUSSER, JOHN M.....183d Street and Third Avenue
SUTPHEN, JOHN S., JR.....9 Desbrosses Street
SUYDAM, HARRY L.....530 Broadway
SWAYNE, FRANCIS B.....Riverside Avenue and 90th Street
SYMS, DR. PARKER.....50 West 47th Street
TABER, MISS MARY.....9 East 10th Street
TAFT, HENRY W.....40 Wall Street
TAIT, A. F.....15 Fairfield Place, Yonkers, N. Y.
TALCOTT, JAMES.....7 West 57th Street
TATHAM, CHARLES.....465 West 23d Street
TAYLOR, DWIGHT W.....500 Madison Avenue
TAYLOR, GEORGE.....8 West 126th Street
TAYLOR, HENRY B.....40 Wall Street
TAYLOR, HERBERT C.....52 Broadway
TAYLOR, JAMES B.....30 East 50th Street
TAYLOR, KNOX.....Highbridge, N. J.
TAYLOR, LLOYD.....29 Broadway
TAYLOR, MOSES.....100 Broadway
TEBBS, RICHARD.....7 West 102d Street
TEFFT, WILLIAM E.....22 East 64th Street
TENNEY, C. H.....Metropolitan Club
TERRY, JNO. T.....Tarrytown, N. Y.
TERRY, REV. RODERICK.....169 Madison Avenue
TESLA, NIKOLA.....46 East Houston Street
THACHER, MRS. GEORGE W.....Care Charles A. Peabody, 2 Wall Street
THACHER, THOMAS.....25 Broad Street
THAYER, HARRY BATES.....463 West Street
THOMAS, DR. ALLEN M.....45 West 54th Street
*THOMAS, SAMUEL.
THOMAS, SETH E.....8 West 20th Street
THOMPSON, PROF. W. GILMAN.....34 East 31st Street
THOMSON, DAVID.....14 East 73d Street
THOMSON, GIRAUD F.....141 Broadway
THORNE, NEWBERRY D.....New Rochelle, N. Y.
THORNE, W. V. S.....43 Cedar Street
TIBBITS, LE GRAND C.....Hoosac, N. Y.
TIFFANY, LOUIS C.....27 East 72d Street
TILFORD, HENRY M.....24 West 52d Street
TILLINGHAST, WILLIAM H.....26 East 64th Street
TILTON, JOSEPH W.....11 Broadway
TOD, J. KENNEDY.....45 Wall Street
TODD, H. H.....New Rochelle, N. Y.
TOEL, WILLIAM.....20 East 67th Street
TONNELE, WALTER.....12 East 15th Street
TOOTHE, WILLIAM.....Madison, N. J.
TOUSEY, WILLIAM.....14 East 46th Street
TOWNSEND, CHARLES H.....Aquarium, Battery Park
TOWNSEND, ISAAC.....Union Club
TOWNSHEND, JOHN.....302 West 73d Street
TOWS, COE DOWNING.....34 West 52d Street

* Deceased.

TRABER, A. P.....2151 Prospect Avenue
TRASK, SPENCER.....27 Pine Street
TROWBRIDGE, EDWIN D.....16 Nassau Street
TROWBRIDGE, FREDERICK K.....115 East 37th Street
TRUAX, CHARLES H.....12 East 65th Street
TUCKERMAN, ALFRED.....342 West 57th Street
TURNBULL, ROBERT J.....6 West 47th Street
TURNURE, GEO. E.....115 East 36th Street
UNDERWOOD, WILLIAM LYMAN.....Belmont, Mass.
UPMANN, CARL.....406 East 59th Street
UPP, THOMAS M.....Perry Avenue and Holt Place
VALENTINE, DR. WILLIAM A.....34 West 38th Street
VAN BRUNT, C. H.....10 East 46th Street
VAN CORTLANDT, AUGUSTUS.....Tuxedo Park, N. Y.
VANDERPOEL, MRS. JOHN A.....224 Madison Avenue
VAN DER SMISSEN, DR. G. J.....2081 Bathgate Avenue
VAN DER SMISSEN, GILBERT.....758 Tremont Avenue
VAN EMBURGH, D. B.....30 East 38th Street
VAN NEST, MRS. ALEXANDER T.....31 West 37th Street
VAN NEST, G. WILLETT.....14 East 60th Street
VAN NORDEN, WARNER.....751 Fifth Avenue
VAN PELT, GILBERT S.....123 East 69th Street
VAN WINKLE, EDGAR B.....115 East 70th Street
VAN WINKLE, GEORGE S.....115 East 70th Street
VERDI, MISS MARY.....14 Fifth Avenue
VICKER, H. MONTAGUE.....7 Wall Street
VIELE, HERMAN K.....146 East 35th Street
VIVANTI, FERRUCCIO ANSELMOL.....995 Madison Avenue
VOGEL, HERMAN.....106 East 37th Street
VOGEL, JOHN.....1195 East 178th Street
VON DUERING, DR. ADOLPH.....552 East 155th Street
VON KADICK, DR. HANNS M.....Maspeth, L. I.
VORCE, A. D.....353 Fifth Avenue
WADSWORTH, CLARENCE S.....Middletown, Conn.
WADSWORTH, W. P.....25 East 30th Street
WAGNER, OTTO.....Washington Avenue and 185th Street
WAGSTAFF, C. DU BOIS.....Babylon, L. I.
WALLER, ROBERT, JR.....66 Broadway
WALTON, WILLIAM.....360 West 22d Street
WANNINGER, CHARLES.....114 East 95th Street
WARD, CHAS. H.....159 West 73d Street
WARD, HENRY C.....431 Fifth Avenue
WARD, J. Q. A.....119 West 52d Street
WARDWELL, WILLIAM T.....21 West 58th Street
WATERBURY, JOHN I.....20 Wall Street
WATSON, CHARLES F.....South Orange, N. J.
WEATHERBEE, EDWIN H.....240 Madison Avenue
WEBB, G. CREIGHTON.....47 East 44th Street
WEBB, DR. W. SEWARD.....Shelburne, Vt.
WEBER, LOUIS.....9 East 93d Street
WELLING, R. W. G.....2 Wall Street
WELLINGS, JOSEPH G.....628 West 147th Street
WELLS, OLIVER J.....Waldorf-Astoria
WENDELL, EVERT JANSEN.....8 East 38th Street
WENDELL, MRS. JACOB.....8 East 38th Street
WENZEL, LOUIS H.....133 West 83d Street
WERTHEIM, H. P.....27 William Street
WESTERGREN, M. F.....380 Mott Avenue
WESTOVER, M. F.....Schenectady, N. Y.

WHITAKER, H. P.....Hotel Netherlands
WHITE, JOHN JAY, JR.....103 East 57th Street
WHITE, LEONARD D.....39 East 74th Street
WHITE, STANFORD.....160 Fifth Avenue
WHITE, S. V.....7 Wall Street
WHITE, WILLIAM W.....49 Broad Street
WHITEHOUSE, J. HENRY.....Irvington-on-Hudson
WHITEHOUSE, WILLIAM F.....Knickerbocker Club
WHITFIELD, HENRY D.....14 East 11th Street
WHITIN, LOUIS F.....9 West 56th Street
WHITING, GILES.....898 Broadway
WHITMAN, CLARENCE.....P. O. Box 1805, New York City
WHITNEY, CASPAR.....3 Washington Square North
WHITNEY, MISS E. C.....11 Madison Square
WHITRIDGE, F. W.....59 Wall Street
WICKERSHAM, GEORGE W .....40 Wall Street
WIEGMANN, DR. WILLIAM H.....416 Sixth Street
WIGGIN, FREDERICK HOLME.....55 West 36th Street
WILLARD, E. A.....21 State Street
WILLETS, ROBERT R.....303 Pearl Street
WILLIAMS, G. G.....270 Broadway
WILLS, CHARLES T.....156 Fifth Avenue
WILMERDING, GUSTAV L.....38 Nassau Street
WILMSEN, WILLIAM.....414 Lenox Avenue
WILSON, HENRY R.....208 Fifth Avenue
WILSON, WILLIAM.....Briggs Avenue, near 201st Street
WINCKELBACH, L. O.....854 West End Avenue
WINTHROP, EGERTON L.....23 East 33d Street
WINTHROP, ROBERT D.....P. O. Box 17, New York City
WITHERBEE, FRANK S.....40 Wall Street
WITTE, C. W.....747 Tremont Avenue
WOLFF, EMIL.....115 West 70th Street
WOOD, GILBERT CONGDON.....51 Fifth Avenue
WOOD, J. WALTER, JR.....Short Hills, N. J.
WOOD, WILLIAM C.....51 Fifth Avenue
WOOD, WILLIAM H. S.....51 Fifth Avenue
WOODCOCK, R. C.....636 West 55th Street
WOODHOUSE, J. S.....341 West 87th Street
WOOLF, JAMES A.....1821 Trane Place
WOOSTER, NOYES C.....38 West 35th Street
WORTHINGTON, CHARLES C.....214 Broadway
WRIGHT, J. DUNBAR.....346 Lexington Avenue
WRIGHT, J. HOWARD.....2 Wall Street
WRIGHT, MRS. J. HOOD.....Kingsbridge Road and 174th Street
WRIGHT, MRS. MABEL OSGOOD.....118 West 11th Street
YOUMANS, EPHRAIM M.....2020 Broadway
YOUNG, FREDERICK STAFFORD.....11 West 19th Street
YOUNG, JOHN ALVIN.....49 William Street
YOUNG, RICHARD N.....11 West 19th Street
ZABRISKIE, ANDREW C.....716 Fifth Avenue

Corresponding Members.

BAKER, HERBERT.....Yuma, Arizona
BARBOUR, MRS. S. E.....Eau Gallie, Florida
BROWN, WILLIAM HARVEY.....Salisbury, Rhodesia, South Africa
CORNISH, C. J.....Oxford House, Chiswick Hall, London, W., England
EATON, HOWARD.....Medora, North Dakota
ELROD, M. J.....Missoula, Montana

GOLDING, CAPT. THOS. . Care R. L. Golding, 21 Birchin Lane, London, Eng.
GRAHAM, W. H. H. . . . . Winnipeg, Manitoba
GRIFFITH, WILLIAM A. . . . . Quebec, Canada
HAGENBECK, CARL. . . . . Thierpark, Hamburg, Germany
HUFFMAN, L. A. . . . . Miles City, Montana
MCCARTY, JOHN. . . . . Phœnix, Arizona
MARE, R. L. . . . . St. Johns, Newfoundland
MEYENBERG, E. . . . . Pecos City, Texas
SHELDON, CHARLES. . . . . Chihuahua, Mexico
STONE, ANDREW J. . . . . New York City
WILSON, T E. . . . . Banff, Alberta
WILTSEE, E. A. . . . . Denver Club, Denver, Col.

Summary of Membership.

Benefactors		1
Total number of	Founders	22
" "	Associate Founders	12
" "	Patrons	49
" "	Life Members	154
" "	Annual Members	1,091
Total of all classes		1,329

Form of Bequest.

I do hereby give and bequeath to the "NEW YORK ZOOLOGICAL SOCIETY," *of the City of New York,*.....

.....

.....

BURRHEL OR BLUE MOUNTAIN SHEEP.

DETAIL OF DECORATION OF LION HOUSE.

REPORT
OF THE EXECUTIVE COMMITTEE.

THE year 1902, the fourth in the development of the Zoological Park and of the serious work of the Society, was marked by most satisfactory progress. The event of chief importance was the transfer of the New York Aquarium to the management of the Society. This came without suggestion on our part, and is gratifying evidence of the confidence in our administration of the Zoological Park felt by the municipal authorities. The completion of the Lion House and the awarding of the contract for the Antelope House bring us two steps nearer the completion of our scheme of buildings. We also have to record the erection of several most attractive small installations, and the receipt of important gifts.

THE NEW YORK AQUARIUM

One of the first acts of the Hon. William R. Willcox, when he assumed the presidency of the Park Board, was to send for the officers of the Society and suggest the transfer of the Aquarium to our management, in order that it might be placed on a permanent and scientific basis and be brought into closer touch with the educational system of the city. The committee was at first reluctant to assume this additional responsibility; but finally consented

to do so, when it was learned that not only the Commissioner but also the Mayor and other officers of the city government were warmly interested in the plan of transfer.

A bill empowering the Society to take the Aquarium was introduced in the New York Assembly by the Hon. J. Mayhew Wainwright, and in the Senate by the Hon. Joseph P. Hennessey. This measure became a law and is known as Chapter 146 of the Laws of 1902. A second bill was introduced by Hon. Julius H. Seymour in the Assembly, and Hon. Nevada N. Stranahan in the Senate, authorizing the Board of Estimate and Apportionment to enter into a contract with the Society for the transfer of the Aquarium. This measure became a law April 10, 1902, and is known as Chapter 441 of the Laws of 1902. The Executive Committee desire to take this opportunity to express their thanks to the above named gentlemen for their services in this connection.

A contract between the Society and the City providing for the transfer of the Aquarium was signed on the 13th of October, 1902. By this contract the City provides a maintenance fund of not less than $45,000. The actual amount appropriated for the year 1903 was $46,500. The method of administration is as follows: the Society pays all the Aquarium bills in the first instance, and these, after approval by the Park Department and in the Comptroller's office, are repaid by the City.

The Society has organized the administration of the Aquarium on practically the same basis as that of the Zoological Park, with a scientific director and staff of practical assistants and a scientific council, which secures the best professional expert advice which can be found in the city. After consulting the best authorities, the Society invited Mr. Charles H. Townsend, of the United States Fish Commission, to assume the directorship, and he accepted the appointment. Mr. Townsend has been connected with the United States Fish Commission since 1883. He was the naturalist on the Arctic explorations of the U. S. S. "Corwin" in 1886, and for the deep-sea explorations of the "Albatross;" and many of his writings relate to the discoveries made on that trip. In 1887 he was made a member of the National Behring Fur Seal Commission, and later in the same year became chief of the Fisheries Commission of the United States Fish Commission. In the summer of 1902 Mr. Townsend was selected by Secretary Hay to represent the United States at the Hague in the arbitration of the fur seal question between the United States and Russia. Taking advantage of this trip abroad, Mr. Townsend, at the conclusion of the arbitration conference, which was decided in favor

of the United States, gave the remainder of the summer to a tour of the aquariums of Europe, in England and various parts of the Continent, familiarizing himself with the latest developments in the methods of stocking and the care of aquariums. He thus enters upon his position thoroughly equipped for his duties. For the scientific council of the Aquarium, the Society invited the co-operation of the following specialists: Professor Charles L. Bristol, of the University of New York, who has been directly interested in the Aquarium for several years; Professor Bashford Dean, of Columbia University, well known for his contributions to ichthyology; Dr. Alfred G. Mayer, of the Brooklyn Institute of Arts and Sciences, a graduate of Harvard, and formerly associated with Professor Alexander Agassiz; Mr. William E. Damon, and Mr. R. M. Shurtleff, both of whom have not only shown a warm interest in the Aquarium, but have considerable practical knowledge of the management of aquaria. All of these gentlemen accepted the invitation, and are now advising with Mr. Townsend in regard to various questions of administration.

The actual legal transfer of the Aquarium took place on the 31st of October, 1902. The presentation speech on that occasion was made by Hon. William R. Willcox, as follows:

Professor Osborn, and Members of the Executive Committee of the New York Zoological Society:

When in 1891 the United States Government decided to remove the Emigrant Station to Ellis Island, the question arose, what shall be done with Castle Garden? For fully forty years it had been used by the general government for the reception of emigrants, and for many years before that time as a place of amusement and a gathering hall for large assemblages. Here it was that Lafayette was received on his visit to this country in 1824. Here also the patriot, Louis Kossuth, was welcomed on the occasion of his visit in 1851. Originally built upon the rocks and connected with the shore by a bridge, this structure has been successively used as a battery in the early days, as a place of amusement, and as a landing place for emigrants. It was finally opened to the public as an Aquarium by the Department of Parks in the year 1896. For six years, therefore, the people of the City have had the advantages of this Aquarium, and that this privilege has been appreciated is attested by the fact that the yearly attendance during the past three years has been between one and a half and two millions of people.

But it is not enough that an institution of this magnitude, con-

ducted at such large expense to the City, should be used for exhibition purposes alone. There are educational advantages which can only be secured and maintained by a fixed policy and scientific management. The splendid position attained by the New York Zoological Park, by the Metropolitan Museum of Art, by the American Museum of Natural History, and by the Botanical Gardens furnished sufficient evidence of the truth of this proposition.

Accordingly, early in the present year a bill was drawn and sent to the Legislature, by the terms of which the Board of Estimate and Apportionment were empowered to enter into a contract with the New York Zoological Society for the care and maintenance of the Aquarium. In April of this year the measure became law. It was expected that the transfer would be made early in the summer, but unforeseen circumstances prevented the consummation of this plan until the present time.

It has not been the policy of the present Commissioner of Parks to make any radical departure from the general method of conducting the Aquarium during the past few months, inasmuch as the control was soon to pass into other hands.

The contracts having been signed and all arrangements made, we have met to-day to witness the formal transfer of this Aquarium to the New York Zoological Society. It is an event of peculiar significance to this institution, and will be far-reaching in its results. The splendid work already done by the Zoological Society is an earnest of what it can and will do with the facilities afforded here. Not only will the exhibition feature of the Aquarium be made prominent, but its educational value will be developed, and it will be brought in direct contact with the schools and educational system of the City. It is particularly appropriate that there should be in this great maritime city an institution devoted to the study of fishes and marine life generally. To provide a great variety of life from the sea, both from the tropics and from our own shores, and furnish facilities for observation of the living habits of marine and fresh-water animals, and to give the benefit of these researches to the scientific world, to the pupils in our public schools, and to the public generally, these are some of the results to which we can confidently look forward.

Gentlemen of the Committee, it gives me great pleasure to formally transfer the control of the Aquarium to the New York Zoological Society, and to assure you it will be the constant aim of the Department of Parks to co-operate with you in bringing this institution to the highest place of efficiency and usefulness.

The acceptance of the trust on behalf of the Zoological Society was made by Professor Henry Fairfield Osborn, Chairman of the Executive Committee and Vice-President of the Society, as follows:

Commissioner Willcox and Gentlemen:

The Aquarium has always been a very popular institution with the people of this city. It will be the chief aim of the Zoological Society to make it even more so. We have chosen as director Mr. Charles H. Townsend, widely known for his services in the United States Fish Commission; and the fact that a man of his character and scientific reputation accepts this position signalizes our determination to increase not only the attractiveness but the educational value of the Aquarium to the masses of the people who visit it. It is a legitimate use of municipal funds to bring the beauties and adaptations of nature within reach of those who have not the means or opportunity of going to nature. Mr. Townsend will have full authority here; but we are fortunate in associating with him as an advisory board a number of experts in marine life, including Professor Charles L. Bristol, of the New York University; Dr. Alfred G. Mayer, of the Brooklyn Institute of Arts and Sciences; Professor Bashford Dean, of Columbia University; R. M. Shurtleff, and William E. Damon. These are men who have, like the Director, traveled far and wide, and whose knowledge of the sea life has been by direct experience and observation. The Society did not seek the care of this Aquarium; Park Commissioner Willcox was the first to suggest it. But we appreciate this transfer as a sign of approval on the part of the City of our management of the Zoological Park. We consider it a public trust and will endeavor in every way to promote the best interests of the City. Mr. Willcox and Mr. Madison Grant, our Secretary, are to be chiefly credited with the preparation of the formal details of agreement. What is needed for the future success of this institution is the spirit of good citizenship, in the co-operation of the Society with the City, and of pride in giving this great City of New York the same eminence in science and education as that which it now enjoys in commerce.

A very careful agreement was drawn up between the City and the Society, defining the relations and providing for the absolute control and management of the Aquarium by the Society, and for the adequate support of the institution itself and for the extension of the collections by the City.

By the terms of this agreement the Zoological Society has the right to close the Aquarium on the forenoons of Mondays and Thursdays for administrative purposes. At such times the members of the Society, all persons definitely engaged in scientific work, and teachers from the colleges and public and private schools accompanied by their pupils are particularly welcome. The Committee trust that members of the Society will take advantage of this opportunity to visit the Aquarium and interest themselves both in the administration and in the extension of the collections. The Committee will also welcome from members of the Society or friends additions to the library of the Aquarium, or donations of living specimens for exhibition.

On taking over the Aquarium building, several serious defects were found to exist. First, additional light was needed in the Central Hall and in the rear of the wall tanks, the illumination being very inadequate. Second, the attendance at the Aquarium is very large, the daily average during the year being about five thousand visitors; the ventilation necessary for such crowds is entirely inadequate, and a mechanical system for constant change of air in the building is absolutely needed. Third, the steam and water supply piping system is in many places nearly worn out and requires renewal. These and various other improvements have been very carefully studied by the Director, the Secretary of the Society, and the Aquarium Committee, and the Society has asked for a special appropriation of $30,000 from the City for general improvements of this character.

The accompanying report of the Director of the Aquarium gives an interesting summary of the results already accomplished, and interesting plans for the further development of the institution and the extension of its scientific and educational work.

THE ZOOLOGICAL PARK

NEW BUILDINGS AND INSTALLATIONS

On the 1st of January the new Lion House was practically completed and some of the animals were installed. It will not be thrown open to the public, however, until February 1, 1903, owing to unavoidable delays in the completion of minor details of the building. It is much the largest building which we have thus far constructed, and is believed to be the most perfect and admirable in design. The ground plans were prepared by Director Hornaday and the architectural designs were by Messrs. Heins & La Farge. Mr. Eli Harvey modeled four sentinel lions for

the sides of the entrances, two pediments to be placed within the entrances, and a large number of heads of various felines for the decoration of the cornice and of the sides of the building. The details of the sculptured panels are also his work. The Society is indebted to the contractors, Thomas Cockerill & Son, for the enterprising and satisfactory manner in which they have completed the construction of this building. Many unique features embodied in this building are pointed out in the Director's report, especially the use of steel wire instead of bars for cage fronts, the provision of opalite tiling for the interior linings of the cages, and the studio for artists.

The large collection of felines needed for this building was presented by various members of the Board of Managers and other friends of the Society, a special subscription being made for this purpose; and in order to secure the finest types, the Director, accompanied by Mr. W. W. Niles, took a special trip abroad to examine anew the Zoological gardens of Europe, and to give the necessary orders to various dealers.

The Antelope House is well on the way to completion and should be finished during the spring of 1903. The contract was awarded to Thomas Dyer, for $54,900. The building will be used in winter for the housing of tropical deer, which are now crowded during the winter into the lower portion of the Buffalo House and elsewhere. We have been seriously embarrassed at the outset by our inability to house tropical animals during winter, and the purchase of many specimens has been deferred for this reason. The rapid destruction of many of the species of African antelopes also renders the completion of this building very timely, as every year of delay will increase the cost of these animals. Our next duty will be to procure a representative series of antelopes and other tropical ruminants for this building. It is planned in such a manner as to accommodate also elephants, hippopotami, zebras, and other African types, pending the future construction of the Elephant House and of a special installation for horses, asses, and zebras.

The plans for the Ostrich House were advertised in March, 1902. The lowest bid was $37,000, which far exceeded the amount the Society had planned to appropriate for this purpose. So the plans were withdrawn, and are now being re-studied; and it is hoped that a contract for this building will be advertised in the course of a month or so.

The erection of this building and of the house for small mammals necessitated the development of the area between the Ante-

lope and Reptile Houses as an informal court, somewhat similar to Baird Court. There is provision for a number of buildings of considerable size, but not drawn on formal lines, either as to location of buildings or as to planting of trees. It was decided to name this part of the Park after the great French-American naturalist, Audubon, so it can hereafter be known as Audubon Court.

Plans for the large Bird House have required an exceptional amount of study on the part of the Director, and Curator of Birds Beebe, and of several members of the Executive Committee. As a result, the ground plan and elevation, details of which are now nearly complete, are published in this report. These plans are in the hands of the Park Department, and bids are being advertised for. This imposing building, which provides for a great variety of bird life, especially during the winter months, will be located, as originally designed, on the northwest corner of Baird Court, and will afford cage room for a very large number of specimens. Provision is made for two interior and several outside flying cages. This necessitates the completion of the southern half of Baird Court up to the Central Sea Lion Pool; and we must look forward in the near future to the building of the concourse or main carriage road between Baird Court and Pelham Avenue, as soon as the necessary funds are provided by the City. The Park Department of the Borough of the Bronx is planning to construct a new single-arch stone bridge over the river at the northern boundary of the Park, which will greatly add to the beauty of Lake Agassiz.

The City is indebted to Mr. William Rockefeller for the gift of a magnificent antique Italian fountain from Como, Italy. After long consideration and the best advice, it was decided to place this fountain directly opposite the Sea Lion Pool and nearly north of the Primate House, in order to give the lines of the fountain the background of the trees on the east side of the court. The grading and planting of this section of the court will complete the setting for this beautiful monument.

In another part of the Park is being erected a gateway in memory of the late Philip Mesier Lydig, presented to the Park by his daughter, Mrs. Frank K. Sturgis. After considerable delay, the gateway has been located at the top of the steps overlooking Beaver Valley. The City acquired this land directly from the Lydig estate in 1888, and it was owing to this fortunate circumstance that the forests were in such a superb state of preservation. The gateway is Renaissance in design, covered by an iron grill,

and represents the taste of Messrs. Heins & La Farge. The Committee takes this opportunity of thanking Mrs. Sturgis for this very welcome memorial gift.

The chief changes of the year in this wilder portion of the Park are in the further provision for our collection of bears, and for our rapidly growing collection of wild sheep and goats. The Bear Dens have been extended to the south by the addition of four new dens, admirably designed by Mr. Beerbower, the rock work executed under the direction of Mr. Merkel. These dens will enable us to increase the number of bears on exhibition, and provide for a more scientific grouping and arrangement than has heretofore been possible. The completion of the Mountain Sheep Hill is a notably successful installation in this portion of the Park. It is after the original design of Mr. Hornaday, about which the Committee felt some hesitation, owing to the large amount of artificial rock-work involved. The idea has been carried out under the direction of Mr. Merkel and has proved to be not only practical but beautiful; the rocky sky-line afforded by these installations is admirably natural and beautiful. We have already installed a number of extremely interesting specimens of wild sheep and goats, chiefly from the Himalayan region.

The service of the Rocking Stone Restaurant has been greatly improved during the year by throwing open the south pavilion to the public, which is now used as an open air restaurant.

According to our original intention, the eastern end of the Reptile House has been fitted up for the reception of tortoises, and will be used for this purpose during the summer of 1903.

DEVELOPMENT OF THE PARK EAST OF THE BOSTON ROAD

One of the special grounds upon which the application of the new bond issue was based was the desire of the Society to protect and develop that beautiful portion of the Park lying east of the Bronx River, not heretofore enclosed. The first feature of the improvement was the construction of a walk along the east side of the Bronx Lake, it being the intention of the Society to utilize the whole area at present simply as a pleasure resort. Adequate protection for this beautiful forest is afforded by a new line of fencing completely enclosing our eastern boundary.

The condition of the Bronx River requires immediate attention on the part of the City authorities, and the expenditure of a very considerable sum of money if it is to be preserved and made healthful. The condition of the Serpentine River in London in Hyde Park shows that it is practicable to preserve an ancient

water course even in the heart of a large city. It need hardly be said that the Bronx is in the centre of the most beautiful natural portion of the entire park system of the City, and its preservation is a matter of vital importance. At present, this stream during low water period of summer is a menace to public health, and radical measures must be taken to prevent its further pollution along the upper stretches beyond the limits of the Botanical Garden. With the rapidly increasing population of the valley to the north, this question becomes one of increased importance.

A second matter of great moment is the extension of the eastern boundary of the Zoological Park. The present line is a purely artificial one, being the former boundary of the Lydig estate and not conforming in any way to the very abrupt changes of the surface. The border line runs along the crest of a ridge of very beautiful forest which covers nearly all the space between it and the Bear Swamp Road; in fact, the best portion of the forest is included in sixty acres immediately outlying the present Park boundary. The trees, chiefly pin-oaks, are perhaps the finest in the neighborhood of New York. This land, owing to its great irregularity, is of very little immediate value for building purposes, and it is of very great importance that the City should purchase this forest tract and add it to the Bronx Park. The cost is estimated at about $300,000. Commissioner Eustis, at the head of the Park Department of the Borough of the Bronx, has taken the initiative and is about to apply for the necessary funds for the purchase of this land, thoroughly appreciating the importance of securing it before the trees are destroyed.

If this forest is secured, the third improvement, equally vital to the natural development of the northern park system, will follow as a natural consequence, namely: the construction of the boulevard through the natural valley which traverses the middle of this forest, starting from West Farms on the south and joining the Pelham Parkway at Bronxdale on the north. This is a direct route which can be utilized for heavy traffic, thus relieving the present Boston Post Road, and enabling the Society and Park Commissioner to convert it into a road purely for Park service. Thus the acquisition of this land will bring about three public park improvements of the greatest importance, when we consider what vast crowds of pleasure-seekers will naturally enter this Park as the northern terminus of the rapid transit system. Still a fourth improvement, more or less directly connected with the above, is necessitated by the fact that the southern entrance of the Zoological Park at West Farms has been selected as one of

the termini of the rapid transit system, and for many years to come will constitute one of the most important, if not the chief entrance to the northern park system. The Rapid Transit Commissioners have been requested to keep their terminal station on the south side of 180th Street, and it is the intention of the Society and the Park Department of the Borough of the Bronx to ask the City to purchase sufficient land—in all about two and one-half acres—for the purpose of forming a plaza of approach somewhat similar to the Plaza approach to Central Park at Fifth Avenue, between Fifty-eighth and Fifty-ninth Streets. The Park Department of the Borough of the Bronx has applied to the Rapid Transit Commission to modify its plans in accordance with the above design, and is about to apply to the proper authorities for the funds necessary to complete this purchase. This plaza is greatly needed, as this will be the approach from the south to the entire park system of the Bronx. From this point will radiate boulevards and park roads through Bronx Park on the north, to Pelham Park on the east, and Van Courtlandt Park on the northwest; and this plaza, if properly treated, will offer a magnificent vista northward along Bronx Lake.

It is the purpose of the Committee, as soon as the plans for this plaza have been prepared, to build a boat-house close to the entrance and within the present boundaries of the Park. This boat-house will provide for a restaurant, for public comfort, for boating and skating facilities, and possibly for music and other entertainment for the public. It is estimated that these facilities would produce $1,000 income a year, which would be devoted to the maintenance and extension of the animal collection of the Park. The boat-house plans are under consideration, and the structure will be located as soon as the site can be definitely determined on.

The application for both these proposed extensions to Bronx Park have been initiated by Commissioner Eustis, of the Park Department of the Bronx, and not by the Society, but they will greatly benefit the Zoological Park by protecting and beautifying its boundaries, and will be earnestly supported by the Society.

Improved Service. The electric surface roads will in the near future extend along the Southern Boulevard, which forms the west boundary of the Park, and ultimately will extend from the Northwest Entrance, along Pelham Avenue to Fordham, and connect there with the Elevated and Harlem Railroads. When these systems are completed, a visitor entering from the south can make

the tour of the collections, and leave the Park at the Northwest Gate, without retracing his steps. In this connection it may be well to state that the service on the Third Avenue Elevated Railroad has been greatly improved by the electric trains, which have decreased appreciably the running time from the Borough of Manhattan to Fordham, affording one of the pleasantest means of reaching the Park.

FINANCIAL ADMINISTRATION

Maintenance. The Maintenance Fund for the year 1902 shows a deficit of about $3,000, which will be made good by the Society. In view of the completion of the Lion House early in the year, and the prospective completion of the Antelope House and large Bird Houses, the Society has made an application for increased maintenance, and for the year 1903 the Board of Estimate and Apportionment has provided $104,965 as the Maintenance Fund. It is important to remember in this connection that the Society has not only the care of the collection of animals, numbering on the 1st of January, 1903, about two thousand specimens, but that this Maintenance Fund includes the protection and care of the Park area, fully one-third as large as that of Central Park, and visited by very large crowds of people, probably larger crowds in proportion to area than any park in the city. With the increase in number of visitors, the increase in our collections, and in the cost of supplies, the most rigid economy has to be exercised to avoid running behind the funds provided by the City.

BUILDING AND PARK IMPROVEMENT FUND PROVIDED BY THE CITY

The Society made application to the Board of Estimate and Apportionment for a bond issue of $500,000, for the development of the Park, and on the 19th day of April, the Board of Estimate and Apportionment provided bonds to the amount of $250,000 for this purpose; this bond issue received the approval of the Board of Aldermen on May 13, 1902. A large portion of the bond issue has been spent for the improvement of the Park, chiefly for the development of Baird Court, building the Antelope House, the Bird House (now under contract), and the protection of the Park east of Bronx River. More detailed statement of the expenditure of this fund, and the balance available, will be found in the Treasurer's report. At the time of granting this amount it was understood that the balance, $250,000, would be provided during 1903, and application has been made to the

Board of Estimate and Apportionment to secure this amount. If granted, the Society will be in a position to prepare the Park sufficiently to meet the requirements of the large influx of visitors to be expected at West Farms upon the completion of the Rapid Transit system.

ATTENDANCE

The attendance of the year 1902 was 38¾ per cent. over that of the year 1901; in other words, there were 731,515 visitors, as against 527,145 during 1901, an increase of 200,000. During the month of August alone nearly 127,000 persons visited the Park. The care of these visitors on crowded days, and the proper protection of the collections against mischievous and malicious people will become increasingly difficult as time goes on.

The relations between the Society and the Mayor, the individual members of the Board of Estimate and Apportionment, and above all with the Hon. John E. Eustis, Commissioner of Parks for the Borough of the Bronx, and his staff, have been of the most cordial and satisfactory character. Mr. Eustis has been at all times a zealous advocate of the Society's work, and has done everything in his power to advance the development of the Zoological Park. The Executive Committee desire to take this opportunity of expressing their appreciation of the cordial co-operation of the municipal authorities with its work. The business arrangements with the Comptroller's office have been greatly simplified, so that the delay in repayment of money advanced by the Society has been reduced to a minimum. The present method of the Society is to pay all its bills in the first instance, and to send them to the Park Department and Comptroller's office for approval and repayment. This, however, as in the case of the Aquarium, necessitates an overdraft of considerable amount. This has been met by an agreement with the Knickerbocker Trust Company under a bond of indemnity signed by all the individual members of the Executive Committee.

FUNDS FOR THE PURCHASE OF ANIMALS

Animals are purchased from three sources, namely: the franchises of the Park, the balances of the General or Membership Fund, and gifts of special animals and collections.

Franchises. Franchises of the Park have yielded during the past year about $7,000, the proceeds of which have been devoted to increasing the collections, according to our agreement with the City.

General Fund. The Society must look forward in the future to the income from this General Fund as the principal source for the supply of new animals. All the balance derived from membership fees, over and above the necessary running expenses of the Society, is devoted to this purpose. This fund can only be increased by additions to the membership, and the Committee urges upon the Society the importance of sending in the names of such of their friends as will be interested in joining, and supporting our work. Such a city as ours could easily provide 3,000 members; but these can only be secured through individual efforts. The membership on January 1, 1903, was 1,210, representing an increase of 117 during the past year. This increase of the General Fund is needed, not only for the purchase of animals, but for the extension of our scientific work.

Gifts of Animals. The chief gifts of the year are those connected with the stocking of the Lion House, for which the Society is indebted chiefly to the following of its friends:

Nelson Robinson, one pair Barbary Lions.
Col. O. H. Payne, one pair Corean Tigers.
Charles T. Barney, one pair Bengal Tigers.
Andrew Carnegie, one Barbary Lion.
Emma B. Auchincloss, one pair Snow Leopards.
Cleveland H. Dodge, one Nubian Lion.
Philip Schuyler, one Senegal Lioness and one Manchurian Leopard.
William D. Sloane, one Jaguar and one pair Black Leopards.
Jacob H. Schiff, one Cheetah or Hunting Leopard.
Frederick L. Eldridge, one African Leopard.
Charles E. Whitehead, one pair Ocelots.
Henry Fairfield Osborn, Jr., one Malay Tiger.

We are also indebted to Mr. William Rockefeller for the gift of a herd of European Red Deer of the best Russian stock, as well as a valuable Fallow Deer from the same source. Hon. William C. Whitney has presented the Park with a Musk Ox, the first animal of its kind received in this country. The same friend, by exchange of a portion of his Buffalo herd, has secured for us, with the aid of three or four other subscriptions, a pair of the very rare Prejewalsky Horses from Siberia. We are indebted to Mrs. Julia Armour Ferguson and Mrs. Mary Armour Nichols for the gift of $1,000 to our fund, as a memorial to their father, the late H. O. Armour.

SCIENTIFIC WORK AND PUBLICATIONS

Of chief scientific interest is the establishment on a permanent basis, we trust, of our Medical Department. The object of this service is by systematic observation and record, and by experimental treatment, to extend our knowledge of the care and health of wild animals in captivity, the causes of various diseases, and the means which should be taken for their prevention. This is both humane and part of an economic administration. An animal properly housed and well cared for, as it may be by our admirable curatorial service, also needs scientific medical attention, because all animals in confinement are peculiarly liable to certain kinds of diseases. We feel that very substantial progress has already been made by our Medical Department. We are fortunate in having enlisted the enthusiasm and interest of Dr. Harlow Brooks, a well-known medical pathologist. Dr. Miller, a trained veterinarian, has been in charge of the surgical and medicinal treatment of the animals, while the laboratory for the microscopic investigation and preparation of various pathological cultures has been ably conducted by Dr. W. Reid Blair. The results of their work are summarized in reports of the Medical Department in this volume.

The Chairman has proposed to collect all the observations of our curators and keepers, as well as the observations made by the members of our medical staff, and to issue from time to time papers on the care of certain kinds of animals in the Park. These will be collected and finally published in book form, as a comprehensive work on the care and treatment of animals in captivity, a work which is very much needed. The Society in doing this will take the initiative, as in many other directions. It is a surprising fact that no such work showing the experience gained from zoological park management has ever been published.

Publications. During the year 1902 the Sixth Annual Report of the Society has been published; also an official guide, chiefly prepared by Director Hornaday, and Bulletin No. 7. Bulletin No. 8 was published during January, 1903, and was widely distributed throughout the city, with the object of increasing interest in the work of the Society and enlisting new members. A special investigation has been made by Mr. Madison Grant of the geographical distribution of the various races and species of caribou in different parts of the northern hemisphere. The results of this investigation constitute the special scientific feature of our Annual Report this year. Of the very valuable series of illustrations appearing with this paper, many have been furnished by the

American Museum of Natural History, from specimens collected in Alaska and British Columbia by the Stone expeditions, which were supported by funds contributed jointly by friends of the Museum and of the Zoological Society. This is an interesting example of the value of co-operative scientific work.

Gifts to the American Museum of Natural History. It is a fortunate circumstance that every loss to the Society in the Zoological Park is not a real loss to the City; it is instead a gain, because all rare and valuable animals are immediately transferred for taxidermic and scientific purposes to the American Museum of Natural History and become a part of the exhibitions in that institution. Our losses during the past year have also enriched the museum of the Brooklyn Institute of Arts and Sciences, by gifts of specimens which would have merely duplicated the collections in the American Museum.

Photography. The photographic department, under the direction of Mr. Sanborn, has been systematized and rapidly developed during the past year. It has now become truly a part of the scientific work of the Society. These photographs have not only been published in our Bulletins, in the public press, as a means of arousing interest, but they have been sought by a number of publishers for the illustration of works of permanent value and influence in natural history. By writing to the Park, members may obtain a series of very artistic pictures of many of the animals in their natural surroundings.

Game Protection. This should rank first among the scientific services rendered by the Society during the past year. Chiefly through the activity of our Secretary, Mr. Grant, the Society has either initiated or encouraged measures, such as the Act by Congressman John F. Lacey, for the preservation of game in Alaska, and by the Canadian Government for the preservation of game in northwest British Columbia. We have also been able to exert, through our Secretary, considerable influence in drafting a measure providing for the preservation of game in Newfoundland.

GENERAL ADMINISTRATION

The Committee desire to extend to the members of the Society their cordial acknowledgment of the support received during the past year in the form of prompt and generous response to various requests for donations and gifts.

We are indebted to our architects, Messrs. Heins & La Farge, for the successful completion of the designs of the newer build-

ings. Also to Mr. H. A. Caparn, our landscape architect, for his valued advice on many difficult questions of park treatment.

We especially desire to express our appreciation of the work of Director Hornaday during the past year, and of the efficient services rendered by the members of his scientific and administrative staff. In view, especially, of the work of Messrs. R. L. Ditmars and C. William Beebe, in charge of reptiles and birds, respectively, the Committee has recommended their promotion to curatorships. Other acknowledgments of the efficiency and *esprit de corps* of the staff will be found in the report of our Director.

We desire to make special acknowledgment of the co-operation of the Hon. John E. Eustis, Commissioner of Parks for the Borough of the Bronx, and his staff. The Committee desire to take this opportunity to express also their appreciation of the cordial co-operation of other municipal authorities in this work, but chiefly the Mayor, Hon. Seth Low, Comptroller Edward M. Grout, and Park Commissioner of Manhattan, Hon. William E. Willcox.

CONCLUSION

The formative or projection period of the Zoological Park has practically come to a close; but we have by no means reached the point of execution of all the plans and ideals which have been forming in our minds for the beautifying of the Park, for increasing the effectiveness of the collections of animals as a part of the educational system of the City, and for increasing our installations and exhibits. From this standpoint it appears as if our work were only beginning. We need the intelligent co-operation of the younger citizens of New York, of men who can devote some of their time and brains, who by first joining the Society and gradually familiarizing themselves with its purposes, can prepare for taking part in the interesting but very responsible work of administration.

Respectfully submitted,

HENRY FAIRFIELD OSBORN, *Chairman.*

JOHN S. BARNES, MADISON GRANT,
WILLIAM WHITE NILES, PHILIP SCHUYLER,
SAMUEL THORNE, CHARLES T. BARNEY,
LEVI P. MORTON, *Ex-officio.*

NEW YORK, January 1, 1903.

Treasurer's Reports.

YEAR ENDING DECEMBER 31, 1902.

The annual expenditure of the various funds is shown in appended statements.

Park Improvement Fund.

RECEIPTS.

Cash in Treasury, January 1, 1902			$18,791 72
Reimbursement by City of amounts advanced prior to January 1, 1902			9,752 76
Subscriptions:			
Hugh J. Chisholm	$1,000 00		
W. G. Nichols's Executor	1,500 00	$2,500 00	
For Account Animals for Lion House:			
Oliver H. Payne	$2,500 00		
Nelson Robinson	2,000 00		
Charles T. Barney	1,500 00		
Andrew Carnegie	1,500 00		
Mary Clarke Thompson	1,000 00		
Emma B. Auchincloss	800 00		
Cleveland H. Dodge	750 00		
Philip Schuyler	500 00		
William D. Sloane	500 00		
Jacob H. Schiff	250 00		
Frederick L. Eldridge	100 00		
Charles E. Whitehead	50 00	11,450 00	13,950 00
			$42,494 48

EXPENDITURES.

Mountain Sheep Hill		$781 88	
Antelope House		665 00	
Landscape Architecture		160 00	
Engineering		807 66	
Live Animals		7,913 00	
Express Charges on Animals		1,200 96	
Buffalo Shed and Corral		968 34	
General Expenses		175 32	
Bird and Reptile House Railings		1,529 75	
Maintenance Shortage for 1901		3,714 37	
Adee House		245 74	
Ostrich House		575 00	
Animals for Lion House	$10,626 59		
Expenses of European trip	668 70	11,295 29	$30,032 31
Cash in Treasury, December 31, 1902			12,462 17
			$42,494 48

H. R. MITCHELL,
Chief Clerk.

CHARLES T. BARNEY,
Treasurer.

January 1, 1903.

General Fund.

RECEIPTS.

Cash balance in Treasury, January 1, 1902		$4,163 08
Annual dues from members	$8,880 00	
Life membership fees	3,200 00	
Interest Stokes Bird Fund	125 01	12,205 01
		$16,368 09

EXPENDITURES.

General office expenses	$1,853 73	
Salary of Secretary	2,500 00	
Photographs and slides	1,823 68	
Stationery, printing, and office supplies (general office)	299 23	
Treasurer's office expenses	267 04	
Advertising matter	66 85	
Miscellaneous expenses and supplies	631 54	
Library	224 73	
Guide Books	27 81	
Rocking Stone Restaurant	1,042 63	
Zoological Park Relief Association	120 00	
Live animals	1,260 00	
Employers' insurance	264 62	
Annual Report and Bulletin	1,161 41	
Pathological equipment	307 13	
Interest	216 02	
European trip, for account Aquarium	200 00	
Geographical Distribution of Animals	287 00	$12,553 42
Cash balance in Treasury, December 31, 1902		3,814 67
		$16,368 09

H. R. Mitchell,
Chief Clerk.

Charles T. Barney,
Treasurer.

January 1, 1903.

Animal Fund.

RECEIPTS.

Cash in Treasury, January 1, 1902		$1,857 38
Receipts at Park:		
Admissions	$4,256 50	
Checking	268 95	
Soda Water	1,025 22	
Rents	530 00	
Sale of Animals	5,193 00	
Miscellaneous receipts	313 12	
Boating	300 00	11,886 79
		$13,744 17

EXPENDITURES.

For the purchase of animals during the year	$4,924 65	
Traveling and other expenses	100 00	
Express and other charges	415 33	$5,439 98
Cash balance in the Treasury, December 31, 1902		8,304 19
		$13,744 17

H. R. Mitchell,
Chief Clerk.

Charles T. Barney,
Treasurer.

January 1, 1903

Maintenance Fund.

RECEIPTS.

Received from City on account of Maintenance appropriation of $85,000 for the year	$84,593 13		
Balance due from City on account of Maintenance	406 87	—$85,000 00	
Shortage for the year		2,757 57	
		$87,757 57	

EXPENDITURES.

General administration	$9,905 75	
Maintenance of buildings and care of animals	23,046 68	
Maintenance and care of grounds	22,922 20	
Tools and hardware	2,159 04	
Paints and oils	803 64	
Nursery supplies	109 61	
Nursery stock and seeds	111 39	
Office furniture and fixtures	217 55	
Office supplies and printing	596 37	
Uniforms and badges	1,197 00	
Sanitation	232 73	
Horses and vehicles	1,101 84	
Repairs	345 14	
Telephone service and tolls	386 09	
Postage, telegraph, and express	746 91	
Food for animals	14,036 60	
Fuel	4,065 44	
Signs and labels	292 00	
Engineering supplies	35 87	
Drugs and medicines	524 49	
Lumber	1,309 06	
Cement	374 95	
Plumbing supplies	346 56	
Stone and screenings	247 50	
Miscellaneous supplies and sundries	754 00	
Telephone and electrical supplies	102 48	
Insurance	101 25	
Fencing and netting	215 45	
Medical attendance (employés)	301 00	
Medical attendance (animals)	850 00	
Ice	318 98	
		$87,757 57

H. R. Mitchell,
Chief Clerk.

Charles T. Barney,
Treasurer.

January 1, 1903.

Ground Improvement Fund Balance Sheet.

(Showing status of Appropriation of $250,000.)

RECEIPTS.

Appropriation of Board of Estimate and Apportionment....		$250,000 00

EXPENDITURES.

Through Park Department:		
Contract, Thomas Dwyer, Antelope House....	$54,900 00	
Contract, William H. Wright & Son, Bear Dens	5,327 00	
Contract for improving West Farms Road....	5,495 00	
Over expenditure last appropriation.....	99 58	
Miscellaneous expenditures	2,508 33	—$68,329 91
By the Zoological Society: Bill to reimburse Park Improvement Fund, account advanced to complete buildings on Baird Court—		
Monkey House	$5,374 77	
Lion House	9,262 16	
Antelope House	1,189 00	— 15,825 93
Guard rails	858 40	
Seeds and plants	962 20	
Public Comfort Building No. 1.....	210 50	
Bear Dens, addition	7,725 96	
Mountain Sheep Hill	3,035 31	
Buffalo Range drainage	740 39	
Beaver Valley Walk	4,191 71	
Grading and seeding	932 12	
Drainage Elephant House site.....	256 31	
Baird Court retaining wall.....	155 80	
Baird Court walks	1,166 05	
Buffalo and Restaurant main.....	549 87	
Beaver Pond	38 25	
Machinery, tools, and hardware.....	787 01	
Photograph Gallery	95 54	
Crematory	257 58	
Grading and seeding borders of Auto Road...	192 38	
Bronx River Walk	5,177 70	
Antelope House	649 20	
Lion House	1,994 64	
Miscellaneous fencing and netting.....	126 18	
Pavilion No. 3	90 00	
Improvements East of Bronx River.....	1,875 24	
Corrals and walks	122 38	
Miscellaneous ground improvement items.....	3,404 39	
Mountain Sheep Walk	875 62	
Breeding House	935 84	
Reptile House improvements	183 44	
Park benches	595 00	
Grading and seeding Beaver Valley Walk.....	666 42	
Tortoise Enclosure	1,373 82	
Electric lighting	794 07	
Boundary fence	2,466 22	
Italian Fountain	282 03	
Bird Enclosure	380 40	
Red Deer Range	442 52	
Trimming and pruning	41 00	
Foundations for Ducker Portable Houses.....	19 50	
Miscellaneous materials and supplies.....	1,130 35	— 45,781 34
Balance available for expenditure.....		120,062 82
		$250,000 00

H. R. Mitchell,
Chief Clerk.

Charles T. Barney,
Treasurer.

January 1, 1903.

Aquarium Fund.

RECEIPTS.

Received from City on account of Aquarium appropriation of $5,968.64 for November and December		$2,990 24
Balance due from City		2,969 73
Unexpended balance		8 67
		$5,968 64

EXPENDITURES.

Salaries	$4,031 07	
Coal	1,024 04	
Office supplies and printing	38 65	
Office furniture and fixtures	236 00	
Repairs	19 34	
Engineering supplies	96 81	
Ice	9 54	
Fish food	284 87	
Freight and express charges	17 90	
Fish Hatchery	77 13	
Turtle	10 00	
Photo work	4 00	
Carting ashes	7 20	
Painting sign	11 00	
Hardware	14 00	
Incidentals	50 00	
Miscellaneous supplies	28 42	
Unexpended balance	8 67	
		$5,968 64

E. R. Sampson,
Disbursing Clerk.

Charles T. Barney,
Treasurer.

January 1, 1903.

REPORT OF THE DIRECTOR
OF THE
ZOOLOGICAL PARK
TO THE BOARD OF MANAGERS.

EVEN with a sincere desire to be grateful for the support which has been granted to it, and for the results that have been accomplished, the New York Zoological Society realizes that to-day the Zoological Park is only half complete. The spacious, solid, and elegant character of the improvements demanded by the people of New York renders the progress of upbuilding somewhat slower than was originally intended. These conditions, taken in connection with the great increase in the cost of building materials and labor, are accountable for the fact that four and one-half years after the inauguration of the work of development, the Park is still in an unfinished condition.

A recent inspection of the best zoological gardens of Europe, made last autumn by two representatives of the Society, rather painfully emphasized our lack of accommodations for many groups of animals that are highly desirable. In the Berlin Garden was found the most liberal number of enclosures for animals, not only for groups, but for individuals. As a natural sequence of a great number of places in which to exhibit specimens, the collections of that garden were found to be rich beyond compare. For example, the Crane and Stork House provides 32 enclosures in the open air, and a like number under shelter. For the cassowaries and ostriches there are 26 enclosures. The new Antelope House contains 18 compartments and 18 outdoor yards, and the three houses for wild swine provide 12 enclosures. In the average zoological garden about 20 wire-covered yards with shrubbery, grass, and water are considered sufficient for the pheasants, but in Berlin the new Pheasant Aviary—a plain and simple, but very effective installation—provides 60 enclosures without, and a like number within. This wealth of accommodations is made possible by a wise subordination of the architectural features of the building. The visitor sees only wire netting, the front of a modest shelter house, the birds, and the shrubbery in which they live.

The new deer houses, of which there are four, have made it possible for the Berlin Zoological Society to possess and exhibit

AOUDAD OR BARBARY WILD SHEEP: FAMILY.
Two lambs born in spring of 1903.

about 50 species and varieties of deer, which constitute the finest collection in existence in a zoological garden.

The collections mentioned above, and those of wild cattle, buffaloes, bison, wild sheep, goats, ibex, wild horses, and zebras, must excite in every American feelings of profound admiration and envy. In the most positive manner, the Berlin Zoological Garden and its collections indicate to the people of New York, regardless of what has already been accomplished, that a mountain of work yet remains to be done before the New York Zoological Park can even equal its great pacemaker in Berlin.

The lesson to be drawn to-day from the zoological gardens of Berlin, London, Hamburg, Amsterdam, and Antwerp is unmistakably plain and pointed. Hereafter we must build more extensively, and more rapidly, or we will never equal our greatest rivals, and never make a finish.

In several respects, the year 1902 has shown the usual rate of progress. The attendance of visitors increased nearly 40 per cent., and the gain for the year in new installations for animals, walks and maintenance equipment has been on the whole fairly satisfactory. The delay in the completion of the Lion House and additional Bear Dens has been a disappointment, but ultimately it will be forgotten in the enjoyment of these important features.

ATTENDANCE.

Notwithstanding the fact that the street railway facilities for reaching the entrances to the Zoological Park are as far away as ever, the attendance of visitors has shown a large increase. The monthly record is as follows:

	1901.	1902.
January	12,483	12,958
February	16,167	12,155
March	24,544	54,742
April	25,822	56,081
May	50,381	105,519
June	70,770	89,691
July	48,375	87,164
August	74,264	126,874
September	103,503	63,370
October	48,995	45,262
November	32,687	68,268
December	19,154	9,431
	527,145	731,515

Total increase for the year, 204,370.

ANIMAL COLLECTIONS.

During the past year the efforts of the Society have been directed toward procuring additional species of special educational value rather than toward the mere increase of the number of individuals. In all three of the zoological classes—Mammals, Birds, and Reptiles—an unusual number of important additions have been made. Unfortunately, however, the collections have now reached a point beyond which any noteworthy growth is a practical impossibility until more accommodations have been provided.

DEPARTMENT OF MAMMALS.—*W. T. Hornaday, Curator; R. L. Ditmars, Assistant.*

The most noteworthy event in this department was the acquisition of a fine collection of lions, tigers, leopards, jaguars, and pumas, for exhibition in the Lion House. All these animals were inspected and selected by the Director, and each animal in the collection was acquired as an individual gift, as set forth in detail in the report of the Executive Committee.

Of the animals mentioned above, 10 were purchased in Hamburg, of Carl Hagenbeck, 1 of the Berlin Zoological Gardens, 1 of the Antwerp Zoological Gardens, 4 were imported direct from their habitat, and 4 have been ordered of Mr. Hagenbeck, to be delivered as soon as they can be procured.

The animals purchased in Europe arrived on October 16th, and for about two months were quartered temporarily in the Elk House. On December 1st, the lioness called "Bedouin Maid," of the pair presented by Mr. Robinson, gave birth to 5 cubs, 3 males and 2 females, all of which have been well cared for by the mother, and are doing well.

As fast as the interior cages of the Lion House were finished, the lions and tigers were transferred to them, and made comfortable; but the long delay on the last six cages of the series rendered it impossible to open the building to the public during 1902.

During the past year, important additions have been made to the collection of wild sheep, goats, and ibex. The additions consisted of 1 Siberian Ibex *(Capra sibirica)*, imported from Central Asia; 3 Punjab Wild Sheep *(Ovis vignei)*; 1 Burrhel *(Ovis burrhel)*, 1 Chamois *(Rupicapra tragus)*, 2 female Himalayan Tahr *(Hemitragus jemlaicus)*, 1 female Mouflon *(Ovis musimon)*, and 2 female Aoudad *(Ovis tragelaphus)*. In this collection there were 3 additions by birth, and at present the collection contains 18 specimens, representing 8 species.

Early in the spring of 1902 the Society received by gift from Mr. William H. Harriman, a young male specimen of Nelson's Mountain Sheep, secured by him in Lower California. The little animal was much weakened by its long and tedious journey, and only survived about three months. This was believed to be the first specimen of that species to reach a zoological park for public exhibition.

Among the mammals of special rarity and zoological importance which reached the Zoological Park during 1902 mention must be made of the female Musk-Ox, eighteen months old, from the Barren Grounds north of Great Bear Lake, purchased by Hon. William C. Whitney, and presented to the Zoological Society in March, 1902. This was the first specimen of *Ovibos moschatus* ever exhibited in America, and it attracted great attention, both from visitors and from the press. In October, a second specimen—one year younger than the first—which was captured by Commander Robert E. Peary in Northeastern Greenland, was presented to the Zoological Park by the Peary Arctic Club. Strenuous efforts were made to induce both these animals to survive in this latitude, but without success. The first specimen died on August 17th, of pneumonia, the disease to which most Eskimo and sea-lions succumb in New York. The second expired suddenly from an affection of the spinal cord, which produced complete paralysis. Thus far, fifteen specimens of the Musk-Ox have been brought out to civilization; but of this number all save three have died within a very few months after reaching warm latitudes. Of the three which survived, one is now exhibited in the Berlin Zoological Garden, one in the Zoological Garden at Copenhagen, and the other is in the collection of the Duke of Bedford, at Woburn Park, England.

The Peary Arctic Club also presented to the Society a young Atlantic Walrus, which was received in September in very weak condition, and survived only about three weeeks. Its death was due to hemorrhage of the lungs. Of all these rare animals the Society's photographer secured excellent photographs, which eventually will be published.

From Carl Hagenbeck the Society received by purchase a fine male specimen of the now rare Zebra Wolf, or Thylacine, of Tasmania. This animal is the largest living carnivorous marsupial, and is so rare that only two specimens are on exhibition in Europe, and four in America. Although our specimen arrived in weak condition it has greatly improved in health and strength, and seems likely to become acclimatized. A fine specimen of the

Cape Hunting Dog, or Hyena Dog, of South Africa was also acquired by purchase, and is in excellent condition.

Captain Thomas Golding, a Corresponding Member of the Zoological Society, who has brought from the far East many rare and valuable animals for the Zoological Park, procured in Singapore and brought safely to New York a fine specimen of the Sumatran Rhinoceros. This animal was kept during the summer in one of the ape cages in the Primates' House, in very small quarters. In view of the period which must elapse before the Antelope House is completed, and the extreme difficulty of keeping such an animal in temporary quarters, it was decided to dispose of this specimen, and accordingly it was sold in December to Ringling Brothers for exhibition in their menagerie.

Captain Golding procured in Shanghai a fine specimen of the Manchurian Leopard, which forms a particularly interesting link in the chain of spotted cats now in the Society's possession, which reaches from Paraguay, in South America, to North Africa. The Manchurian Leopard is particularly interesting by reason of the fact that its body is marked by rosettes of a size midway between the large rosettes of the jaguar and the small rosettes or spots of the Indian and African leopards.

On December 26th the Society had the great good fortune to receive from Hagenbeck, by purchase, two specimens of the newly discovered Prejevalski Horse, from Western Mongolia. This animal is particularly interesting by reason of the fact that it is the nearest approach, among wild horses and zebras, to the domestic horse of civilization. The two specimens in question are about ten months old, and were born in Hamburg of parents captured in Mongolia by the expedition sent out by Mr. Hagenbeck four years ago. That the Society's future collection of zebras and wild horses should begin with a pair of animals as rare and scientifically interesting as the Prejevalski Horse may surely be regarded as a good omen. The fund for the purchase of these specimens was contributed by Professor Osborn and Messrs. William C. Whitney, Philip Schuyler, and Charles T. Barney.

Another animal deserving special mention among recently acquired rarities is a fine specimen of the Siberian Ibex from Western Mongolia, now three years of age, and in good condition. A young female specimen of this species, born in the Berlin Zoological Garden, has been engaged, and its arrival here is expected some time during the coming spring. Beside the Siberian Ibex is exhibited a beautiful male Burrhel *(Ovis burrhel)*, from the Himalayas, which came to the Park from the London Zoo-

logical Society's Gardens, in exchange. This animal is one of the most beautiful of the wild sheep, and an effort will be made to establish on Mountain Sheep Hill a herd of this species.

During the coming spring a collection of animals must be provided for the Antelope House. With a sufficient fund available it will be possible to purchase during the next six months a sufficient number of tropical antelopes, bovines, equines, elephants, giraffes and hippopotami, to completely stock the new building.

The following is a statement of the species and specimens of mammals on hand on December 31, 1902:

Primates	39	Species.	91	Specimens.
Chiroptera	1	"	11	"
Carnivora	41	"	143	"
Pinnipedia	1	"	4	"
Rodentia	23	"	122	"
Ungulata	33	"	117	"
Edentata	1	"	1	"
Marsupialia	2	"	14	"
	141		503	

Received by gift	95
Purchased	204
Born	43

DEPARTMENT OF BIRDS.—*C. William Beebe, Curator.*

Owing to the fact that during the year 1902 no additional bird buildings or aviaries could be provided, the bird collections could not be sensibly increased. During winter weather the resources at the command of the Curator have been taxed to the very utmost to provide proper housing for the many migratory or tropical species now on hand. The temptation to admit song birds to the Aquatic Birds' House had proven so far irresistible that the building referred to is now crowded full of birds, both of land and water. In summer, when the aquatic birds are in the Flying Cage, the song birds and other land birds have full sway in the Bird House, and in a number of temporary but comfortable outside cages.

The unexpectedly high prices bid for the construction of the proposed Ostrich House led to the rejection of all the bids, and a revision of the plans through which a considerable reduction in cost might be secured. The failure of the plan to erect that building in 1902 made necessary a postponement of the Society's

intention to form a fine collection of Ostriches, Rheas, Cassowaries and Emus, and have it on exhibition at this date.

Among the new species added to the collection of birds during 1902 the most important were the Paradise Crane, Crowned Crane, Sarus Crane, Vulturine Guinea Fowl, Upland Goose, Caracara Eagle and Griffon Vulture. The greatest rarity of all is a large bird called the Seriema, from South America, which, in its long crane-like legs, bustard-like body, and hawk-like beak bears some resemblance to the far-distant and equally rare Secretary Bird of Africa. This bird has for years been an ornithological puzzle, and has been variously classified, but the latest decision is that it shall be accorded a Family all its own, near the cranes and bustards.

The usual careful attention was paid by Curator Beebe and his assistants to the breeding of birds, with very satisfactory results. In addition to the successful breeding of all the species which bred last year, young were reared by the Indian Peacock, Wood Duck, English Pheasant, and Mongolian Pheasant.

Several rare species deposited eggs, and under better conditions would no doubt have reared young. These were the Cassowary, Rock Dove, Chinese Goose, Sparrow Hawk, Trumpeter Swan, and Bald Eagle; and their efforts point out the possibilities of the future, when all species of birds will be properly installed, both for exhibition purposes and for rearing young.

A determined effort was made to colonize several Ospreys in a state of freedom in the Park, and induce them to regard this preserve in the same light as their very popular homes on Plum Island and Gardiner's Island. Curator Beebe visited Gardiner's Island by invitation of its owner, Mr. Gardiner, and there collected 7 young birds almost ready to fly, and an osprey nest weighing about 400 pounds. With great labor, nest and nestlings were transported to the Park, the former was erected at the western end of Cope Lake and provided with a descriptive label. Various schemes were devised to fix the home idea in the minds of the growing Ospreys, but as soon as they were able to fly strongly, those that were fed in a state of freedom, with unclipped wings, finally flew away and failed to return.

Similar efforts have been made with Gulls, but thus far without success. These experiments will be continued, however, in the hope that finally several large and interesting species of birds may be induced to nest in the Park every year.

An interesting development has been the increase in the number of wild birds which have made the Park their home. Four

species of ducks—Wood Duck, Widgeon, Mallard, and Red-Head —were in the Park all the fall, frequently flying from pond to pond, and several wild Wood Ducks are spending the winter on the Aquatic Mammals Pond.

Green, Black-Crowned, Night, and Great Blue Herons are very often found in the Park, generally near their relatives in the great Flying Cage. Thus the Park is rapidly becoming an unexcelled place for studying many of our rarer native birds, large and small, at close range in addition to the advantages which a bird-lover may derive from the birds in the collections.

The erection in 1903 of the large house for perching birds, the plans for which are now nearly complete, will not only afford great relief to the congested condition of the bird collections but will afford an opportunity to bring together a great number of forms now quite unrepresented in the Park.

The following is a full statement of the bird collections on hand on December 31st:

Order.	Species.	Specimens.	
Ratitæ	1	1	
Longipennes	2	13	
Steganopodes	5	24	
Anseres	29	199	
Odontoglossæ	2	6	
Herodiones	12	38	
Paludicolæ	9	15	
Gallinæ	22	133	
Columbæ	6	12	
Raptores	20	65	
Psittaci	25	39	
Coccyges	1	1	
Passeres	59	134	
13 Orders	193	680	
Received by gift			115
Purchased			215
Exchanged			40
Deposited			1
Collected			18
Hatched and Raised			88

DEPARTMENT OF REPTILES.—*Raymond L. Ditmars, Curator.*

The most important accessions to the reptile collection during the year consisted of two specimens of the Florida Crocodile, each nearly ten feet in length. The first was captured near Cape Sable by Mr. Julian A. Dimock, and presented by him. The other was presented by Mr. C. B. Cory from his collection of living animals at Palm Beach. These specimens represent the only species of true crocodile found in the United States. It is sharply distinguished from the Alligator by its olive-green color, its sharp-pointed snout, and exposed lower canine teeth.

To accommodate these very interesting specimens one end of the Alligator Pool in the Reptile House was cut off by a wire partition. Soon after Mr. Dimock's specimen was placed in this enclosure it proved itself to be a female by depositing 28 eggs. These were quickly taken in hand and placed in an incubator, but unluckily they proved infertile.

Noteworthy additions to the collection of venomous serpents consisted in three large Cobra-da-Capellos from India, the first specimens to be imported since the opening of the Reptile House. Although in poor condition on arrival, they were treated with such care and skill that their old skins were finally removed successfully, since which they have thriven. They are very active and vicious, and attract much attention. The addition of 2 more species of Rattlesnakes brought the number of that genus up to eight. A female Fer-de-Lance procured from Trinidad gave birth to 24 young, which are being reared by hand with especial care.

On December 31st, 1902, the reptile collection contained the following representatives:

Chelonia	32	Species.	134	Specimens.
Crocodilia	3	"	33	"
Lacertilia	16	"	112	"
Ophidia { Venomous	12	"	80	"
Ophidia { Non-Venomous	35	"	301	"
Batrachia	16	"	112	"
	114		772	

Received by gift	442
Purchased	518
Born	46
Used for food, for snake-eating snakes	310

SUMMARY OF LIVE ANIMALS ON HAND ON JANUARY 1, 1902.

	Species.	Specimens.
Mammals	141	503
Birds	193	680
Reptiles	114	772
Total	448	1,955

DEPARTMENT OF ADMINISTRATION.—*H. R. Mitchell, Chief Clerk.*

The additional room afforded this department by its new quarters in the Service Building has been fully appreciated during the past year. The centralization of several departments under one roof, and the placing of all buildings in direct communication by telephone with the Chief Clerk's office, has greatly aided the thorough systematizing of the many details connected with the purchase, receipt, and distribution of the great bulk of materials and supplies required annually in the maintenance and development of the Park.

The Rocking Stone Restaurant.—Early in the past season the patronage of the Restaurant increased to such an extent as to warrant the engagement of a competent steward and head waiter to take immediate charge of its operation. Mr. Leo Fradkin, an experienced caterer, was employed for this position, and took charge the latter part of June, thus relieving this department of the details of the Restaurant service. A careful supervision, however, was maintained, and full daily reports, with remittances, made to the Chief Clerk's office, where a complete set of books are kept covering the operation of this privilege. Under this arrangement good service was maintained. Special care was given to the purchase of food supplies, and as far as possible all supplies were of the best quality obtainable.

Early in May the dining-room was found to be inadequate to accommodate the increasing patronage on Sundays and holidays, and it became necessary to equip the South Pavilion as a dining-room annex. In order to supply service to this annex, doors were cut in the south end of the kitchen, and a passageway constructed leading thereto. The expense of additional equipment for the enlarged dining-room, coupled with a long period of bad weather in the latter part of the season, converted the early gains to a net loss for the year. In one respect, however, we may count the year a successful one, since the first object

of the Zoological Society in the operation of the Restaurant is to furnish satisfactory service for its patrons.

Soda Fountains.—The season of 1902 has been one of marked progress and success in the handling of this privilege. During the previous year a number of complaints reached us regarding the quality of the soda-water served in the Park. It was decided that we could most effectually improve it by manufacturing our own syrups from the best grades of fruits and purest extracts obtainable. Accordingly a man thoroughly skilled in the preparation of soda-water and syrups was employed to take charge of this work, and a laboratory for his use was fitted up in the basement of the Service Building. The results were highly satisfactory, both as regards the quality of product and cost of production.

A new soda-water pavilion was erected near the Bird House beside the walk leading through Birds' Valley to the Flying Cage. This has proven very acceptable to the public, and is well patronized by visitors entering the Park at the Northwest Entrance.

The erection of four new bear-dens rendered it necessary to remove the candy pavilion built the previous season near the south end of the bear-dens. It was removed to a well-shaded spot on the new Beaver Valley Walk, near the Polar Bears' Den. These two new stands added to those already in use near the Reptile House and Wolf and Fox Dens, four in all, were sufficiently distributed throughout the Park to afford visitors an opportunity to obtain cool drinks whenever they were desired. A limited supply of confections were handled at each of these stands without additional expense for services. As in the case of the Restaurant, this business is under the supervision of the Chief Clerk's office, and reports and remittances are made daily. The total net profit realized for the season was $2,634.69. A considerable portion of this amount, however, was expended for equipment made necessary by the extension of the business, notwithstanding which $1,025.22 was placed to the credit of the Animal Fund, to be expended for the purchase of animals.

Gate Receipts, and Other Privileges.—The attendance on pay-days has shown a very encouraging increase during the year just past, and is evidence of the increasing popularity of the Park. Although it was not expected that any considerable revenue would be derived from this source the gate receipts have steadily increased. The net amount in 1902 was $4,256.50, an

increase of $1,257.70 over the previous year. Wheeled chairs have been provided, and although up to the present time but little revenue has been derived therefrom, they are a great comfort to elderly and invalid visitors.

When the boating privilege was leased for 1902 it was hoped that before the expiration of the lease plans would have been perfected and a contract let for the erection of a boat-house and public comfort rooms in connection with the West Farms Entrance at the terminus of the Rapid Transit System. Unfortunately this has been delayed for another year by other and more important buildings. We believe this privilege when developed will be an especially profitable one, and hope to see it established in the near future. We also hope for the early development of all other Park privileges, believing that eventually they can be made to net annually a handsome sum for the increase of the animal collections.

New Members.—Whenever possible, without neglecting other duties, this department has made continuous efforts to increase the membership of the Society, and with some degree of success. During the past year 128 Annual Members and 3 Life Members qualified, whose applications had been obtained through the Chief Clerk and other members of the Zoological Park staff.

Leasing of Adee House.—In the early part of the year the Society obtained from Park Commissioner Eustis a five-year lease of the property known as the "Adee Farm," in Pelham Bay Park, at a nominal rental. The house on the property was put in repair and sub-leased at a satisfactory rental. The farm, barns, and coachman's house were put in charge of the forestry and gardening department, to be utilized to the utmost in producing hay and vegetables for the Park animals.

Books and Accounts.—The books kept in the Chief Clerk's office, from which the Treasurer's annual statements are made, consist of a separate set for each of the following accounts: Park Improvement Fund, General Fund, Animal Fund, and City Fund—the latter containing separate ledgers for the Maintenance and Ground Improvement Funds. Separate books are also kept both for the Privilege Accounts and Rocking Stone Restaurant. Trial balances for the year have been taken from all of the above books, and all accounts properly balanced on December 31st, 1902. In addition to items already mentioned the work of this department included all work in connection with the preparation of bills for payment, disbursement of pay-rolls, and preparation of

Treasurer's orders and checks. The amount covered by the various accounts and disbursements named above aggregated more than $175,000.00.

But one important change was made in the Chief Clerk's force during the year—that of Assistant. Mr. Charles F. Dickinson, who had satisfactorily filled the position for eighteen months, resigned on November first to go into business for himself. Mr. William Mitchell, Jr., was engaged to fill the vacancy, and assumed the duties on the first of November. Mr. Mitchell is well fitted for the position, and comes to us with a number of years of active experience in office work.

Several important changes have been made during the year in the manner of rendering bills to the City for reimbursement, which have resulted in greatly facilitating their payment.

DEPARTMENT OF PHOTOGRAPHY.—*Elwin R. Sanborn, Photographer and Assistant Editor of Publications.*

The Zoological Society has entered seriously upon the work of collecting photographic records of its animals, both for present and future use. It is now a fixed policy that whenever a rare animal arrives, especially one which is new to the Zoological Park, it is the duty of the Photographer, and also the curators and keepers, to secure good photographs of it at the earliest moment practicable.

In pursuance of this policy the Society has provided Mr. Sanborn with two workrooms, a modest outfit of cameras and lenses, and has also equipped a special studio for indoor work. Already several hundred negatives of mammals, birds, and reptiles have been taken, a set of index albums has been made, and prints are on sale at a small profit above the cost of making them.

In order to control this valuable material the photographs are copyrighted, and the choicest pictures are reserved for first appearance in the publications that are issued for the benefit of the members of the Society. The Society shares with the public the right to reproduce its photographs, but is obliged to make a small charge, according to the material used, as a partial return of the cost involved. Already many publishers of books, magazines, and newspapers have availed themselves of the Society's photographic materials.

Those who are unacquainted by personal experience with the difficulties to be surmounted in obtaining a good photograph of a wild animal have not the faintest conception of the cost of

success in this line of work. It is my belief that no other line of photography presents difficulties equal to this. To "make a snapshot" of an animal through its bars, at long range and without choice of position, is easy enough; but such results are of so little value they are not worthy of serious consideration. A bunch of fur, sans feet and tail, and with poor facial details, is not a portrait fit to represent a species. To secure animal photographs which are of value, Mr. Sanborn finds it absolutely necessary to choose a period of good light, secure the assistance of keepers to drive animals into position, enter the enclosures of all save the large felines, and work until good pictures are secured. With some very difficult subjects a dozen negatives are exposed behind the finest lenses in order to secure one that fairly represents the species.

Although the Society's Photographic Department was established but recently, it has secured fine negatives of 9 species of bears, 17 species of deer and other hoofed animals, about 30 species of carnivorous animals, about 60 species of apes, monkeys, lemurs, rodents, marsupials, and edentates, about 30 species of birds, nests, etc., and 25 species of reptiles. As soon as the accumulation of pictures has progressed to a proper point the Society will begin the issue of publications which will place the best of these results in the hands of its members.

In addition to his photographic work Mr. Sanborn constantly renders very valuable editorial service in connection with the production of the Annual Report, Bulletin, and Guide Book.

It should be noted at this point that all expenses connected with the production of photographs, including Mr. Sanborn's salary, are paid from the general fund of the Society.

ENGINEERING DEPARTMENT.—*George M. Beerbower, Civil Engineer.*

During the past year the work of this department has been unusually varied and important. Mr. Beerbower furnished all the plans, details, and specifications for the four new bear-dens, superintended the iron construction, and took entire charge of the construction of the Beaver Valley and Mountain Sheep Walks. He made a detailed map of the water supply, sewers, and drains of the entire park, and laid out an adequate system of drains for the Buffalo Range, one-half of which has been constructed. In co-operation with the Real Estate Title Guarantee Company's engineer, Mr. Beerbower surveyed the eastern boundary of the

Zoological Park, and marked it by stone monuments. He also did all the engineering work on the Riverside Walk, east of the Bronx River, prepared preliminary plans for the boat-house and public comfort building, and for an extension of the buildings of the Service Yard.

Beaver Valley Walk.—The completion in 1901 of the trunk sewer in Beaver Valley made it possible to construct the long-delayed walk leading through the forest in Beaver Valley, from Baird Court past the Beaver Pond and Bear Dens to the West Farms Entrance. With the consent of the Park Commissioner this entire work was performed by day labor under the superintendence of Mr. Beerbower. At the same time the main walk leading from the Buffalo Entrance to the steps near the Buffalo House was entirely rebuilt on scientific principles, and connected with a branch along the base of the hill to Beaver Valley Walk. As a whole, this improvement is of great value and comfort to visitors, for it provides a direct route from the entrance to Baird Court through a very beautiful portion of the forest.

Mountain Sheep Walk.—Mr. Beerbower also superintended the construction of a first-class walk along the western side of the Wild Sheep enclosures, from the Sea Lion Pool to the Antelope Walk.

Bear-Dens.—The most important plans prepared by the Engineer were for the four new Bear-dens. Owing to the very irregular nature of the rock and ground, this task was the most difficult piece of construction that has yet been performed in the Park, and when fully completed it will reflect decided credit upon Mr. Beerbower, and also upon Mr. Merkel, who superintended the rustic-rock construction. The iron doors and fittings generally of the sleeping dens are much superior to those in the first series of dens, and the guard rail also is a great improvement on the old design.

DEPARTMENT OF FORESTRY AND GARDENING.—*Hermann W. Merkel, Chief Forester.*

General Maintenance.—As the collections of animals and the number of visitors to the Park both increase, the amount of labor involved in caring for the Park also increases. Each year calls for additional service in the cleaning of the walks and grounds, sprinkling walks, the removal of refuse from buildings and yards, the hauling of food supplies, and also of live animals. The four

horses purchased early in 1902 have been of great service in park work generally.

An important item of extra work was the destruction of tent caterpillars, which threatened to inflict great damage upon our trees. This pest was successfully combated by the destruction of about 10,000 of its tents. Two vegetable pests, the poison ivy and ailanthus, were also attacked, and a sufficient number of the plants were dug up and destroyed that an equal amount of work in 1903 will free the Park from both.

About 300 tons of ice were cut, stored, and afterward distributed.

The Nursery.—During the year an important addition to the propagating plant at the Nursery took shape in the Breeding House, which is described elsewhere in this report. It is believed that in less than two years the products of this building will repay its entire cost. The following is a list of the live-animal food bred and reared in the Nursery during the past year:

1,207 chickens,	380 pigeons,
254 rabbits,	576 guinea-pigs,
268 rats,	578 mice,
157 sparrows (trapped),	8,400 eggs.

Of vegetables, the Nursery produced the following, all of which were consumed in the Park:

20 bbls. of potatoes,	14 bu. of hard corn,
10 " of onions,	3 bu. of peas,
6 " of parsnips,	25 bu. of asparagus,
9,000 roots of celery,	157 bu. of parsley,
1,500 heads of cabbage,	49 egg plant,
125 bu. of carrots,	150 summer squash,
32 bu. of turnips,	109 musk-melons,
34 bu. of beets,	6 bu. of string beans,
9,500 heads of lettuce,	24 bu. of spinach,
100 bu. of tomatoes,	43 bu. of leeks,
3,700 ears of corn (green),	4 bu. of lima beans,
1 bu. of peppers,	48 cucumbers,
28 bu. of rhubarb,	24 bu. mint.

The Adee Farm.—The small farm in Pelham Bay Park which was leased of the Park Department in March was utilized to the utmost. In view of the fact that the land was in poor condition and no money was available by which it could be fertilized,

the crops obtained were quite as abundant as could fairly be expected. The total results were as follows:

60 tons hay,	5,500 heads cabbage,
100 bbls. potatoes,	900 pumpkins,
175 bu. sweet corn,	80 bbls. turnips.

Wood for Fuel.—During the coal famine all the dead wood that had been cut out of the forests and accumulated during the past two years, to the extent of about 50 cords, was sawed, split, and consumed in the furnaces of the animal buildings, thus saving several hundred dollars' worth of coal.

Grading and Seeding.—The borders of the new sections of the motor road, the borders of all new walks, and the lines of the trunk sewers and water lines, about 42,000 square feet in all, were graded and seeded.

PERMANENT GROUND IMPROVEMENTS.—*Hermann W. Merkel, Chief Constructor.*

By the consent of Park Commissioner John E. Eustis, the miscellaneous ground improvements provided for in the bond issue authorized on May 19th, 1902, were carried out under the direction of the Zoological Society and officers of the Park staff. The results previously achieved on this plan have demonstrated that for many kinds of work it is more economical, and far more satisfactory in results than would be possible under the contract system.

Addition to the Bear-dens.—The growth of the bear collection rendered it imperatively necessary to increase the accommodations for those animals, and the success of the original series of bear-dens justified the completion of the series by the erection of four new dens, as originally planned. As previously stated, the plans and specifications for this improvement were prepared by the Society's Engineer, Mr. Beerbower, and the masonry construction was performed by the Zoological Park force, working under the direction of Mr. Merkel.

The presence on the site of these dens of several valuable trees —some of them standing on sloping banks of earth—rendered it necessary to build for two cages an elevated concrete floor, to provide for the roots of the trees a proper air space, and to avoid disturbing their roots. The presence of a number of immense granite blocks which had broken away from the main ledge suggested their utilization in the construction of the sleeping-dens.

VIEW OF MO
Total length,

N SHEEP HILL.
Width, 130 feet.

Accordingly these large blocks of weathered granite were left as Nature placed them, and the space behind them was blasted out and roofed over for use as sleeping-dens. In view of all these circumstances the construction of the four new bear-dens involved the most difficult rock and concrete construction that has yet been undertaken in the Park. The result, however, has admirably justified the effort and expenditure. The sleeping-dens are commodious, dry, and very practical in the arrangement and working of their doors. Having been constructed with air spaces around their walls they will be much drier than the dens of the first series, which were built close against the face of the cliff.

A contract for the iron work for the Bear-dens was made on June 26th, 1902, with William H. Wright & Son, which required the completion and erection of the iron work within sixty working days. For various reasons these conditions were not met, nor will it be possible to secure the use of the Bear-dens until about the end of March, 1903. The lack of the new dens has been severely felt during the winter, partly for the reason that on account of the growth of the bears it was no longer possible to vacate dens in order to make repairs by placing the occupants of two dens together.

Mountain Sheep Hill.—The growth of the collection of wild sheep, goats, and ibex rendered it necessary to subdivide two of the large enclosures by running new fences transversely across the hill and making two new shelter-dens. At the same time the crest of the hill, which up to that date had consisted entirely of earth, was taken in hand and finished with rock, in accordance with the original plan. Large slabs of weathered stone were blasted and wedged off from several out-croppings of rock near the eastern side of the Zoological Park, with great labor dragged to the Bear Swamp Road and loaded on stone-trucks. They were then hauled to Mountain Sheep Hill, where they were carefully cut to fit their spaces, and by means of a derrick laid in position. The position of all the exposed rock laid on Mountain Sheep Hill was carefully studied in order to make the new work conform to the natural lines of the mother ledge. All this work was carried out by Mr. Merkel, and the successful result reflects credit upon both his mechanical judgment and artistic conception. This piece of work and the new dens for bears forcibly illustrate the great desirability that in the future all such work should be executed by day labor under the personal supervision of Park officers.

Riverside Walk.—Having received from the Board of Estimate a sum of money to be devoted to the protection of the Zoological Park east of the Bronx River, and the making of certain necessary improvements therein, the Society hastened to improve the opportunity to provide a Telford macadam walk throughout the whole length of the Park along the eastern bank of Bronx River and Lake. This walk was laid out by Mr. H. A. Caparn, landscape architect, and the work of construction was performed under the direction of the Chief Forester, Mr. Merkel. In addition to the construction of 4,500 lineal feet of Telford macadam walk 10 feet wide, following the contour of the ground, two bridges were constructed—one 30 feet in length, the other 50 feet.

For very nearly its entire length this walk follows steep hillsides. The difficult character of the surface involved a great deal of costly rock filling and also blasting through rock. The curves of the river bank were followed as closely as practicable, and the contour of the ground was adhered to as nearly as was consistent with the construction of easy grades.

The bridges were built of oak logs and finished with rustic guard-rails. About 3,300 feet of this walk was made ready for its top-dressing of trap-rock screenings, when work had to be suspended on account of winter weather. The entire walk will be finished early in the spring, and when completed will undoubtedly be much appreciated by the large number of visitors who find enjoyment in the beautiful forest and water-view in that portion of the Park.

Eastern Boundary Fence.—For many months past the depredations which have been committed upon the forest growth of the eastern portion of the Park, and the practical impossibility of preventing such depredations by means of watchmen, have emphasized the absolute necessity of a boundary fence which will form a genuine barrier to timber thieves. Accordingly the first step taken in the development of the eastern portion of the Park was the erection of a high boundary fence of extra heavy Page wire topped with a double overhang of barbed wire supported on iron arms. To meet the demands of the situation 5,000 feet of boundary fence was erected, and it is reasonably certain that from this time on those who wish to cut fire-wood in that portion of the Zoological Park will find it extremely difficult, if not impossible, to do so.

Removal of Old Houses.—A very important improvement during the past year was the demolition and removal of five old

and dilapidated dwellings which stood in the northeastern portion of the Zoological Park. These buildings were very old, and had fallen into so serious a state of disrepair that it was out of the question for them to be longer occupied as residences. With but one exception they were serious disfigurements to the Park grounds, and with the concurrence of the Commissioner of Parks for the Borough of the Bronx and his Chief Engineer, these buildings were removed and their sites properly covered with top-soil, graded, and set in grass. The improvement thus made was particularly noticeable at the intersection of the Zoological Park boundary with the Boston Road, where the appearance of the Park was very greatly improved.

Breeding House.—The great number of live animals required for food purposes in the Park—particularly by the reptiles—and the success of the nursery force in breeding and rearing of rabbits, guinea-pigs, chickens, pigeons, mice, and rats, pointed out the advisability of increasing the facilities of the Nursery for the breeding and rearing of such animals. With the concurrence of the Commissioner of Parks, the Zoological Park force erected at the Nursery a wooden building 16 x 20 feet, and 2½ stories in height, with a good basement, heated by the furnace in the Conservatory. In the basement were placed the incubators and brooders; on the second floor the rabbit hutches, and on the third the nest-boxes for guinea-pigs, rats, and mice. The attic is devoted to pigeons. With this equipment the Chief Forester hopes to be able, in a short time, to supply all the small-animal food that is required by the animals in the Park.

Crematory.—The difficulty in disposing very promptly of the dead bodies of animals not desired for scientific purposes rendered necessary the erection of a small crematory, consisting of a conical furnace 8 feet high and 8 feet in diameter, with brick walls 12 inches thick, lined with 4 inches of fire-brick. In this furnace, the fires of which are suppplied with waste wood, are consumed not only animal remains but also the garbage which accumulates in the Park.

Tortoise House.—The removal of the lunch-room from the glass-roofed hall at the eastern end of the Reptile House rendered it possible to complete the construction and equipment of that hall as originally planned for the accommodation of the collection of tortoises. Additional heating pipes were installed, a concrete floor laid, and the spaces between the limestone pillars on the eastern front were properly filled in with buff brick and

adequately provided with windows. It now remains only to construct the outside yards for summer use, which will be done during the early spring of 1903.

Drainage of Deer and Buffalo Ranges.—During particularly wet seasons it was found that certain portions of the Buffalo Range and three of the Deer Ranges drained off with considerable difficulty, and in places remained in a soft state for so long a period as to constitute a menace to the health of the animals. The Buffalo Range in particular heretofore contained three natural basins that were practically undrainable without a sewer in 182d Street. With the completion of the long-delayed sewer in 182d Street it became possible to drain the Buffalo Range as had so long been desired. Work began in the lower range early in the spring of 1902, and a large section of its area was very thoroughly drained. At the same time the range formerly occupied by the moose was well drained. The drainage of the upper portion of the Buffalo Range—a matter of considerable time and expenditure—was undertaken in the autumn and prosecuted as far as possible up to the beginning of winter. This range can now be drained into the 182d Street sewer—connections with which were made early last year for the stagnant pond in the north end of the Range, and from which the herd has constantly been fenced off. Early in the spring this task will be completed so thoroughly that there will remain in this range neither stagnant water nor areas of boggy ground.

MISCELLANEOUS WORK.

The following miscellaneous items of work were accomplished:

A soda pavilion was erected at the lower end of Birds' Valley, near the Bird House.

Two strong guard fences, 700 feet in length, were erected at dangerous points on roadways near West Farms.

In the course of planting operations, 400 pines, hemlocks, and cedars were set out in various portions of the forest.

An extensive series of ladders, horizontal bars, and trapezes were put up in the cages of the Primates' House.

In the Lion House six patent folding doors were constructed for sleeping cages, and large stumps and shelves of hard wood were provided for the use of the animals in the interior cages.

The four-inch water-main in Baird Court was tapped, and a four-inch pipe laid to the Italian Fountain.

A small pool was excavated in Beaver Valley, and a rustic dam

built below it as a reservoir and water-head for the water supply of the Beaver Pond, which runs through an underground conduit. The retaining wall of the Burrowing Rodents' Quarters was pointed up with Portland cement mortar, and the drainage system was improved.

The soda pavilion which formerly stood at the south end of the Bear-dens was removed previous to the construction of the new dens.

An additional water line of two-inch pipe was laid from the main in 182d Street to supply the Bear-dens and Mountain Sheep Ranges, involving in all about 800 feet of pipe.

The site of the Elephant House and the entire line of the main sewer from the Lion House to West Farms, which was left in a very unsightly condition by the sewer work, was carefully graded, top-soiled, and seeded down.

About 4,000 feet of the newly adopted guard wire of T-iron posts and Frost steel wire were erected in various portions of the Park where most necessary, and a stock of posts and wire accumulated for further work in this direction.

The borders of the newly built service road were given the usual treatment of grading, top-soiling, and seeding, as were also the several panels near the Rocking Stone Restaurant and Beaver Valley Walk, amounting in all to about 42,000 square feet.

CONTRACTS UNDER THE DIRECTION OF THE PARK DEPARTMENT.

The Antelope House.—On June 26, 1902, a contract was made by the Park Department with Thomas Dwyer, who erected the new wing of the Metropolitan Museum of Art, in the sum of $54,900, for the erection of a large and finely appointed building for tropical hoofed animals, such as giraffes, African antelopes of every description, zebras and wild horses, and wild cattle of the equatorial zone.

The Antelope House is an elliptical building, 142 feet long by 78 feet wide, and is being constructed of buff brick, gray limestone, and terra-cotta, in the same general style as the other large buildings of the Park. Around its interior walls it will provide a series of 24 stalls for animals, 4 of which are very large (19 x 24 feet) and the remainder are of various smaller sizes. From the exterior of the building will radiate a series of open-air yards, adequately shaded by trees, and properly macadamized.

Work on this building began on August 1st, and there is no good reason why it should not be completed by May 1, 1903.

A sum of money has been held in reserve in the Ground Im-

provement Fund for the erection of the necessary iron fences and macadamizing what will provide a series of 24 open-air enclosures, well shaded by trees. The average total depth of these enclosures will be about 100 feet, with an extreme width of 50 feet, gradually narrowing as they approach the building. Already a large amount of stone has been accumulated on the ground for the macadamizing of these yards, and a contract for the iron work will be let immediately.

West Farms Road.—In view of the numerous complaints that were made by the residents of the territory lying east of the Zoological Park it was found necessary to improve the condition of the road known as the West Farms Road, which leads eastward through the southeast corner of the Zoological Park grounds. Hitherto the road referred to had consisted of a track over a high ledge of rock, ending in a swampy situation near the Park boundary. Through the initiative of Park Commissioner Eustis, and under the direction of Mr. Martin Schenck, Chief Engineer of the Park Department, a contract for the improvement of this road was let to the John P. Devlin Company, in the sum of $5,495.00. This contract provided for the blasting out of a proper roadway through the obstructing ledge of rock, and the construction of a proper road and sidewalk of Telford macadam. The walk bordering the road on the north side was planned to connect properly with the Riverside Walk, and furnish a good footway for pedestrians down to the bridge across Bronx River. This work is now nearly complete.

A special footway attached to the iron frame-work of the Bronx River bridge should now be constructed for the further accommodation of visitors to the Park and residents eastward thereof who traverse this route to West Farms. It is hoped by the Park Department that it will be possible to induce the Department of Highways to construct the footway that is imperatively needed to enable pedestrians to cross the bridge without the danger of being run down by vehicles on the roadway.

WORK DURING THE COMING YEAR.

It is believed that the year 1903 probably will witness the greatest amount of progress of any year since the opening of the Park in 1899. As already stated, the Antelope House will be completed in the spring and immediately filled with animals specially purchased for it. A contract for the Large Bird House (for perching birds), to be erected on the northwestern corner of Baird Court, will be awarded and actual work begun probably

in the month of April. The plans for a spacious Ostrich House, and for a Small Mammals' House of equal size, are now rapidly nearing completion, and funds for the construction of both these buildings are available in the Finance Department of the City. Both these buildings should be erected, completed, and stocked with animals by December 1st of the present year.

The Society intends that very important additions shall be made within the next few months to the collection of deer, which will have the effect of making it not only extensive but of high scientific value.

ACKNOWLEDGMENTS.

In looking back upon the past year's work the Director feels profoundly grateful to the Executive Committee and Board of Managers of the Zoological Society for the satisfaction which he has derived from serving them. He feels grateful also to the Park Commissioner of the Borough of the Bronx, Honorable John E. Eustis, and to the Chief Engineer of the Park Department, Mr. Martin Schenck, for the prompt and effective co-operation which both those officers have rendered the Zoological Society in connection with the development of its plans in general, and its contract work in particular. Mr. Schenck's attention to all details connected with the construction of the Lion House has been of great value to the Society. The original designs called for in the construction of the Lion House cages and service appliances presented many perplexing problems. In this connection it would be ungrateful to omit an acknowledgment of the consideration which has been shown the Society by Thomas Cockerill & Son, in sparing no pains to finish all details of the Lion House in strict accordance with the desires of the Society, even at the expense of troublesome experiments necessary to secure the most perfect results. From the beginning of his work in the Zoological Park, Mr. Cockerill has been animated by a desire to produce buildings which would be completely satisfactory to the Society, and a credit to him, regardless of all other considerations.

To the Officers of the Zoological Park staff, and also to the members of their respective forces, the Director desires to record here an expression of the great pleasure he has derived from their intelligent, industrious, and capable service, and their devotion to their own work in particular, and the objects of the Zoological Society in general.

Respectfully submitted,

WILLIAM T. HORNADAY,

December 30, 1902. Director.

REPORT OF THE DIRECTOR OF THE AQUARIUM.

TO THE BOARD OF MANAGERS.

THE Aquarium was placed under the management of the Zoological Society on the 31st day of October, 1902, the Hon. William R. Willcox representing the city of New York, and Professor Henry F. Osborn representing the New York Zoological Society. The Director was present at the transfer, and was immediately placed in charge.

The Aquarium has been under the control of the Society for two months. Two-thirds of the Aquarium force remain, including the regular aquarists and the clerk, and have rendered efficient service to the Society. Three employees of the U. S. Fish Commission were among those secured to fill vacancies, one of them acting as foreman of the entire laboring force. A stenographer was secured and the office immediately fitted for the proper conducting of its correspondence and the preservation of its records.

Progress has been somewhat hampered for three reasons: the considerable amount of pioneer work that was necessary in establishing a working routine; the defects in the building itself; and the limited amount of funds available during the balance of the year 1902.

The Director has devoted most of his time to studying the needs of the Aquarium, and to preparing plans for its development.

CONDITION OF THE BUILDING.

The building has been thoroughly examined by architects, who are now preparing estimates relative to the enlarging of skylights, the renewal of iron piping, the decoration of the walls, and other permanent improvements.

Openings for transparent labels above the exhibition tanks have been cut, and the preparation of labels is under way. The insufficiency of light in the building is one of its serious defects,

and the introduction of transparent labels will add much to the satisfaction of visitors in examining the collections.

A number of minor repairs have been inaugurated and are being carried on with the Aquarium force without extra expense. It is hoped that additional funds from the bond issue which has been asked for will be provided for the extensive improvements contemplated, especially in the machinery, which is dangerously out of repair. The extremely high price of coal precluded the possibility of making any extensive improvements from the balance of the maintenance fund for 1902.

There has been much trouble with rusted-out pipes, but so far repairs have been made with the Aquarium force.

Suitable arrangements have been made in the attic under a large skylight for the raising of aquatic plants to be placed in the exhibition tanks among the fishes. Store-rooms have also been constructed in the attic, which has resulted in a gain of space on the main floor for office purposes.

It is proposed to line the exhibition tanks with rockwork, but this improvement has been delayed owing to the difficulty in procuring the proper kind of rock for that purpose. Work of this kind is much needed, as the present lining of white tiles in the tanks is altogether unnatural, and a scheme of furnishing the tanks with more natural backgrounds is being worked out in detail.

The Salt-Water Collections.—The large and valuable collection of tropical fishes from the Bermudas is maintained in the Aquarium under rather unfavorable conditions, the salt-water supply, pumped constantly from New York Bay, being subject to daily fluctuations in density. A set of Hilgard's Ocean Salinometers has been purchased and a record of the changes in density is now being kept on forms prepared for the purpose. This is being done in conformity with the records kept by the U. S. Coast Survey and the Fish Commission, and will be interesting as showing the varying conditions under which these fishes live. The observations already made show that these fishes, from the pure sea water of the Bermudas, are living in water which at some conditions of the tide is quite fresh, varying from 8 to 12 by the salinometer when it should be nominally 28. While fishes and crustaceans appear to flourish in this brackish water, it is not adapted to many forms of invertebrates, and important collections of the latter received in December from the coast of Massachusetts have been lost on this account, none of

the species living more than ten days. An ideal collection of native fishes and invertebrates cannot be maintained under existing conditions. The construction of large reservoirs for the storage of pure sea water seems to be a necessity if additional forms of life are to be added to the salt-water collections.

The Fresh-Water Collections.—The Croton water used for the fresh-water collections is not clear enough to permit of the fishes being viewed satisfactorily. A reservoir for the storage of filtered water must be supplied before there can be much improvement in the fresh-water tanks.

The system of closed circulation for both fresh- and salt-water tanks is employed with the best results in the public aquariums of Europe, and also in the aquarium of the U. S. Fish Commission at Washington.

The collection of native fresh-water fishes needing some additions, arrangements were made with the U. S. Fish Commission, the New York State Fish Commission, and the South Side Sportsmen's Club for certain food and game species. The fishes have been received as donations from the sources mentioned.

A moderate number of salt-water fishes has been procured from local fishing grounds. The following list shows the gifts to the Aquarium during November and December:

Forty gold fish, 7 varieties; 4 snapping turtles, and 8 painted turtles, from Henry Bishop, Baltimore, Md.

Thirty brook trout, 29 rainbow trout, 3 hybrid trout, and 2 brown trout, from the South Side Sportsmen's Club, George P. Slade, President.

Four whitefish, 4 pickerel, 3 pike, 1 rock bass, and 9 suckers from the New York Fish, Game, and Forest Commission.

Fresh-water plants, 100 landlocked salmon fingerlings, and 100 Atlantic salmon fingerlings from the U. S. Fish Commission.

Fish Hatchery.—A fish hatchery has been installed in one of the floor pools of the Aquarium, which will prove an addition to its attractions, not only to visitors in general, but to students from the schools. This pool, oval in shape and 28 feet long, is well adapted to the purpose. Four troughs are placed at the sides and fitted with wire-bottomed trays for the eggs of trout, salmon, and other species hatched in this manner. The north end is supplied with a battery of jars for the eggs of whitefish, shad, and other kinds which require to be kept in motion during the hatching process. The opposite end is fitted with curved

rearing boxes in which young fish are kept while the yolk-sac is being absorbed. All these devices rest upon the broad stone coping of the pool, the pool itself being a receptacle for the young fish after the absorption of the yolk-sac, when they begin to feed freely.

This hatchery, with its troughs and jars, has a capacity of about two million eggs at one time, and is fitted for the hatching of both fresh- and salt-water species. Through the co-operation of the U. S. Fish Commission it is to be at once supplied with eggs of the brook trout and the whitefish, and arrangements have been made with the Fish Commission for supplies of eggs of various species of fishes in season. It is expected that the hatching of some of the most interesting of our native food fishes will be carried on here during about 8 months of the year.

EDUCATIONAL WORK.

In order to bring the Aquarium into closer relations with the educational system of New York the forenoons of Monday and Thursday were set aside for the use of teachers from the public schools with their classes. The Director proposed to the City Superintendent that the biology teachers in the schools be supplied with aquarium jars, and offered the services of a competent aquarist to assist in establishing them in the school buildings. This proposition was accepted, and several schools have already been supplied with small fresh- and salt-water collections. It is expected to continue this work, which is very highly appreciated by the teachers. The cost of the necessary apparatus and the transportation of the collections will be assumed by the Board of Education.

A field collector will be appointed on January 1st in order that the Aquarium may have a constant supply of local fresh- and salt-water fishes and invertebrates, not only for the purpose of improving and varying the collections in the building, but for furnishing biological material for the use of natural history classes throughout the City.

The fine collection of balanced aquaria, containing both fresh- and salt-water forms of life, has been enlarged, and it is proposed to increase this interesting series to the full capacity of the laboratory room on the second floor. This collection is visited weekly by classes from the schools, and furnishes to the pupils many valuable object lessons.

The Aquarium has considerable correspondence, and it has

been necessary to begin the collecting of a small working library on fishes and aquatic life in general.

The preparation of a new guide-book for the Aquarium will be commenced at an early date.

IMPROVEMENTS.

The improvements needed may be considered in the following order of their importance:

Lighting.—The skylights in the service gallery require to be fully trebled in size all the way around the building, and no less an amount of light that can be secured in this way will be sufficient to exhibit the collections properly and to permit the growing of plants in the exhibition tanks.

The large central floor pool is more or less of a failure on account of lack of light, and the opening in the dome should be greatly enlarged. The collections in this pool can scarcely be seen, even on the brightest days. Certain modifications of the skylights above the other floor pools are very desirable.

Stored Sea Water.—The improvement of the water supply seems to be next in importance, and no amount of light that may be admitted to the exhibition tanks will overcome the defects of the present water supply. There should be reservoirs constructed, not only for the purpose of securing clear water, but in order to lessen the present cost of maintaining salt-water collections. At the present time the water pumped in daily from New York Bay at a temperature of 34° requires to be heated to a temperature of 70° before being supplied to the tanks containing the tropical species. With stored water less than half this amount of heating would be necessary, as the water would soon acquire, in part, the temperature of the building and greatly relieve the strain upon the boilers in furnishing steam for heating.

Painting and Decoration.—The improvement of the main exhibition hall is most desirable, and some tinting of the walls will be practicable after additional light has been let into the building.

Supply Pipes.—The supply pipes to the floor pools being worn out these pools are now supplied by unsightly over-head pipes which should be removed as soon as possible. New pipes to the radiators will be required before the commencement of another winter.

Ventilation.—The introduction of electric fans into the embrasures would probably be sufficient for the ventilation of the

building during the summer. In winter, when the attendance is smaller, the matter of ventilation is not serious.

For these improvements it will be necessary to secure an additional appropriation, as the maintenance fund will only be sufficient for the decoration of the exhibition tanks already referred to.

The balance of the appropriation for the year 1902, turned over to the Society on November 1st, was $5,968.64. This sum, with the exception of $8.67, was expended, the expenditures being as follows:

November.		
Pay-rolls	$1,988.16	
General maintenance	451.92	$2,440.08
December.		
Pay-rolls	$2,042.91	
General maintenance	1,476.98	3,519.89
Total		$5,959.97
Balance maintenance for 1902	$5,968.64	
Expended	5,959.97	
Credit balance	$8.67	

The New York Aquarium has always been an institution of great popularity, its attendance throughout the year averaging 5,000 persons daily, being somewhat larger in summer than in winter. The number of visitors for November and December was 97,052 and 54,294 respectively. The total number of visitors during the year 1902 was 1,700,453.

The building is open every day in the year, including Sundays and holidays, from 10 A.M. to 4 P.M., except on the forenoons of Monday and Thursday as previously stated.

The Society should proceed as rapidly as possible with the improvement of the Aquarium as a place of recreation for the public and with the development of its possibilities along new lines.

The building itself is an interesting landmark, and was built in 1807 as a fort. In 1822 it became a place of amusement, and was known as Castle Garden. Jenny Lind began singing there in 1850. From 1855 to 1891 it was a landing station for immigrants, and finally in 1896 was opened to the public as an aquarium.

It contains nearly a hundred wall tanks and seven large floor pools. The collections embrace both fresh- and salt-water species, and constitute the largest single collection of living fishes.

Its extensive steam plant maintains warm water for tropical fishes in winter, and operates a refrigerator for northern species in summer. There are usually over 150 species of native and tropical fishes on exhibition.

An institution so popular should be adequately maintained, and there is no reason why it should not become the most attractive, as it is already the largest public aquarium in the world.

NEW YORK AQUARIUM.
Under the management of the New York Zoological Society.

STRIPED GRUNT.

NOTES ON THE PUBLIC AQUARIUMS OF EUROPE.

By C. H. TOWNSEND.

IN accordance with instructions received from the Executive Committee of the New York Zoological Society I visited the larger public aquariums of Europe for the purpose of studying their methods, especially those relating to the storage and circulation of salt water, and the exhibition of collections. I left The Hague on July 12th, where I had been in the service of the State Department in connection with the arbitration of whaling and sealing claims against Russia. A month was spent in visiting the public aquariums at Amsterdam, Berlin, Naples, Paris, Brighton, and Plymouth. Most of these aquariums have been in existence for many years, and all are more or less satisfactory in their results, although controlled and operated in different ways. The aquariums at Naples and Plymouth are adjuncts to biological stations controlled by scientific bodies, while the aquarium at Paris is controlled by the municipality and is to some extent a fish-cultural station. The aquarium at Amsterdam is an adjunct to the Zoological Garden; those of Berlin and Brighton are managed by private companies.

The Naples and Plymouth aquariums exhibit salt-water collections only. Amsterdam, Berlin, and Brighton have both fresh-

and salt-water collections; while the Paris aquarium is limited to fresh-water species. At Berlin the salt water in use is manufactured in the establishment. It has been used since 1869, being much cheaper than natural sea water; at the other aquariums it is pure sea water stored in underground reservoirs or cisterns. As a rule salt water is pumped from the reservoirs to the exhibition tanks, whence it flows through sand filters back to the reservoirs. Although supplied with filters the aquariums at Naples and Plymouth get good results without filtering the water. The former has three reservoirs and the latter two. The supply of sea water is secured at the most favorable times, that is, when the adjacent bays are clearest and freest from impurities, and as seen in the exhibition tanks is always clear and permits very satisfactory viewing of the collections.

In most cases the exhibition tanks are fed by jets, the water striking the surface with considerable force and carrying air down with it.

The use of pure sea water permits of the exhibition of many kinds of invertebrates that would not live in brackish water. At Naples there are specimens of anemones that have lived in the tanks for years.

The reservoirs are constructed in series of two or three, water being pumped from them in turn after a period of settling. The reservoirs are emptied and cleaned once or twice a year. At the Naples aquarium an abundance of minute life—copepods, etc.—lives and propagates in the water supply, furnishing more or less food for the smaller forms of invertebrates in the exhibition tanks, and perhaps freeing the water to some extent of refuse. In all cases the reservoirs are kept in total darkness, and are located below the exhibition tanks, so that considerable aeration is secured by the falling of the water back into them.

Among the officials of European aquariums the consensus of opinion is that the best results are secured with closed circulation, that is, with a permanent stored supply of sea water. Varying conditions of temperature and density, and practically all sediment are thus avoided.

In European aquariums generally the collections consist of local species, or at least of such forms as are adapted to the customary temperatures of the cisterns, and they are maintained without either heating or cooling devices. The salt water is, therefore, warmer in winter and cooler in summer than the fresh water taken from city pipes. Some of the institutions were supplied with aerating machinery, but it was nowhere found in use,

and artificial aeration has been practically discontinued. The feed pipes supplying water in jets are usually so constructed that more force, and consequently greater aeration, can be secured by increased pressure. The jets are applied either to the open surface of the tank, or are received in large glass tubes in the corners of the tanks leading to the bottom, the latter serving to make the circulation more effective. In some cases they were supplied with jets at each end.

The cisterns and exhibition tanks everywhere are of masonry and cement. In some cases the water-flow is continuous from tank to tank throughout the exhibition series, while in others each tank has its separate outlet.

A noticeable feature of the exhibition tanks in European aquariums is their large size, fishes especially being given considerable room for movement. In some cases two or three tanks are connected, giving a good range for the more active species.

At Plymouth the largest tanks are 15 feet long, 8 feet wide, and 5 feet deep. Two of these are connected, giving the fishes a swimming range of 30 feet. At Amsterdam the larger tanks are 7 feet long with single glass front plates 4½ feet high, having apparently a width of about 5 feet. The largest of three connected tanks was 8½ feet long. The largest glass plates in use are two inches thick, the others being somewhat lighter.

Some of the grotto-like exhibition tanks at Berlin extend back apparently 10 feet from the glass front. Three tanks at the Naples aquarium are connected, giving a swimming range for large fishes of about 30 feet, the width being about 12 feet.

There are 26 tanks in this aquarium, the glass fronts of the tanks being 6 feet high.

The Brighton aquarium has 41 exhibition tanks. These are mostly 11 feet long by 10 feet wide. Two of the tanks here are of exceptional size, one being 130 feet long and 40 feet wide, and the other 50 by 30 feet.

At Paris the central tanks are 12 feet deep, although not of great dimensions otherwise. This aquarium is underground, occupying the site of an old quarry. Its exhibition tanks, 23 in number, extend to the park above, where their surfaces appear as open ponds, the collections being viewed from the wide underground corridors. The tanks—open to the air and sun—permit a good growth of fresh-water plants. There is nothing in the park to indicate the presence of the aquarium beneath, which has cave-like entrances leading down from the adjoining street.

The Berlin aquarium, with 50 exhibition tanks of varying sizes, is constructed in the grotto style. The tanks have a water capacity of 100,000 litres.

As a rule the exhibition tanks of these aquariums are lined with rock-work on both sides and back, the rock-work frequently commencing well forward and being piled to the surface in receding tiers, the different ledges of rock being especially effective in the exhibition of anemones. In some cases pillars of rock are constructed with good effect. Rock-work being reflected from the still surface often produces excellent grotto-like effects. The bottoms of the tanks are of rock, gravel, or sand, according to the species exhibited.

At Berlin the collection of medusæ is well exhibited in a tank lined entirely with black basaltic columns.

The introduction of rock-work permits of varying the appearance of the different tanks perhaps more than could be secured by the collections exhibited. Cobble-stones and volcanic rock are often used.

In most European aquariums the pumps are operated by small electric or gas engines, the machinery being reduced to a minimum. At Naples no boilers are in use, the electric engines being connected by wires with distant power stations. Elsewhere the power is chiefly derived from gas engines. In the engine-rooms machinery is usually found in duplicate, one set being held in reserve.

Three kinds of tubing are in use: hard rubber, or vulcanite; iron pipes, porcelain-lined; and soft lead pipes. The last is reported as satisfactory for sea water, although from its soft nature it is available only in the smaller sizes.

The labeling of the collections in public aquariums is done in various ways, the labels usually resting on the ledges in front of and below the glass. They are often placed under glass frames, and where several species are exhibited in one tank they are identified by means of colored plates and paintings. In some cases the labels are painted on white tiles, the different species being shown in colors on separate tiles. Where several species are kept permanently in one tank their identity is sometimes shown by paintings on ground glass hung near the top of the tank.

At the Naples aquarium labels are not used, the tanks being numbered to correspond with descriptions in the guide book.

Owing to the fact that European aquariums are either adjuncts to biological stations, or have other attractions than their purely aquarium collections, it was somewhat difficult to ascer-

tain the number of employees required to operate them. While there are about 40 employees at the Naples establishment perhaps not more than 8 are directly connected with the aquarium exhibit, most of them being attendants in the laboratories of the biological department. The station has collectors on its force, providing material for both aquarium and laboratories, but perhaps the bulk of the material placed on exhibition is purchased from the local fishermen. At Brighton, where there is a concert hall and a restaurant, the aquarium attendants probably constitute the smallest part of the force. This may also be true of the aquarium at Berlin, which maintains an aviary and other exhibits. The simple but attractive collection at Plymouth is apparently cared for entirely by the custodian, who lives in the building. A natural-history museum occupies a portion of the building of the Amsterdam aquarium. Six persons were found in attendance at this aquarium, but doubtless others were available among the employees of the Zoological Garden, of which it forms a part. Perhaps the simplest of all these aquariums is that of the fresh-water aquarium of the Trocadero at Paris, where a single caretaker seemed to be sufficient.

Although the corridors of European aquariums are usually rather dark, the tanks are well lighted, and as the water is usually clear the collections, with their attractive backgrounds, can be viewed satisfactorily.

All these aquariums, while attractive and popular, have small collections as compared with those of the New York Aquarium, which, with its hundred tanks and pools, could probably carry the collections of any two of them with safety. Their combined attendance probably does not equal that of the New York Aquarium, which averages 5,000 visitors a day throughout the year. Doubtless the fact that the New York Aquarium, with its very large collection of native and tropical fishes, is maintained free to the public accounts for its very large attendance. An admission fee is charged at all the European aquariums except that of Paris.

Respectfully submitted,

CHARLES H. TOWNSEND,

Director.

December 31, 1902.

PUNJAB SHEEP.

List of Gifts
TO THE ZOOLOGICAL SOCIETY.

(Complete to March, 1903.)

ALDEN, JOHN V., Woodmere, L. I.:
Red Coati Mundi (2 specimens).

ANTHONY, J. D., Waubeek, Ia.:
Pintail Duck.

BARBOUR, MRS. S. E., Eau Gallie, Fla.:
Ground Swift, Hog-Nosed Snake, Red Racer, Whip Scorpion (4 specimens), Centipede, Salamander, Gopher Tortoise (20 specimens), Yellow-Bellied Terrapin (2 specimens), Musk Turtle, Diamond-Backed Rattlesnake, Snapping Turtle, Scarlet King Snake, Toads (81 specimens).

BARBOUR, THOMAS, New York City:
West Indian Boa (3 specimens), Diamond-Backed Terrapin (4 specimens), King Snake (2 specimens), Indian Sand Boa, African Mud Turtle, Green Snake, Corn Snake (3 specimens), Florida Swift, Hog-Nosed Snake (2 specimens), Chicken Snake (3 specimens), Coachwhip Snake, Chicken Turtle, Blossom-Headed Parrakeet, Davis' Mountain Coluber, Blainsville's Horned Toad (7 specimens), Brown Horned Toad (6 specimens), Bull Snake, Jaguar Cub.

BARBOUR, WILLIAM, New York City:
Black-Tailed Python.

BARNEY, CHARLES T., New York City:
Bengal Tiger (2 specimens).

BARRON, GEORGE D., Rye, N. Y.:
American Osprey.

BEEKMAN, MRS. WILLIAM S., New York City:
White-Fronted Amazon Parrot.

BELL, MISS MAE A., New York City:
Red Fox.

Benedict, C. E., New York City:
Dipsas Snake.
Bischof, Dr. Albert, New York City:
Green Monkey.
Bjorksten, Miss Grete, New York City:
Red Fox.
Bollenbach, A. W., Bloomfield, N. J.:
English Ring-Necked Pheasant.
Britton, Mrs. N. L., New York City:
Great Horned Owl (2 specimens).
Brown, Herbert, Yuma, Ariz.:
Lynx, Elf Owl (4 specimens), Boyle's King Snake.
Butler, William Mill, Philadelphia, Pa.:
Jaguar.
Buxton, Mrs. Thomas, North Branch, N. J.:
Raccoon.
Caldwell, H. M., Red Bank, N. J.:
Coati Mundi.
Campbell, Mrs. John, New York City:
Blue-Fronted Amazon Parrot.
Carnegie, Andrew, New York City:
Barbary Lion.
Chapman, Frank M., New York City:
American Osprey.
Coe, Miss Miriam S., New York City:
European Blackbird.
Correa, E. H. A., Hoboken, N. J.:
Chinese Pheasant.
Cory, Charles B., Boston, Mass.:
Crocodile, Deer (3 specimens).
Cuilty, Sr. D. Carlos, Chihuahua, Mexico:
Wolf Pups (2 specimens).
Custom House, New York City (*through John Quackenbush, Deputy Collector*):
Song Thrush, Jackdaw, English Starling.
Davis, William Harper, New York City:
Chicken Snake (2 specimens), Black Hog-Nosed Snake, Glass Snake, Banded Water Snake, Pilot Black Snake.
Dean, A. H., Lake Mahopac, N. Y.:
Virginia Deer (2 specimens).
De Hart, Mr., New York City:
Herring Gull.
Dimock, Julian A., New York City:
Florida Crocodile.
Dodge, Cleveland H., New York City:
Nubian Lion.
Doering, Richard, Brooklyn, N. Y.:
Raccoon.
Dove, Adam, New York:
The following specimens were collected by Mr. Dove and Mr. Pearsall at Bethel, Sullivan County, N. Y.: Banded Water Snake (20 specimens), Banded Rattlesnake (6 specimens), Ribbon Snake (35 specimens), Garter Snake (128 specimens), Ring-Necked Snake (13 specimens), Storer's Snake (27 specimens), Green Snake (17 specimens), Black Hog-Nosed Snake (2 specimens), Black Snake (3 specimens), Milk Snake (22 specimens).
Durbin, Thomas, New York City:
Sparrow Hawk.

Dutcher, William, New York City:
Chaffinch (3 specimens), Yellowhammer (3 specimens), Hemipodes (2 specimens).
Eggeling, O., New York City:
Song Thrush.
Eldridge, Frederick L., New York City:
African Leopard.
Ellsworth, D. E., New York City:
Silver Pheasant (2 specimens).
Emerson, W. M., Chelan, Wash.:
Rattlesnake (4 specimens), Bull Snake, Horned Toad, Tree Toad.
Eustis, John E., New York City:
Alligator.
Fleet, S. J., New York City:
Eagle.
Forsythe, Samuel, New York City:
Screech Owl.
Germaine, Mrs. Katherine, Newark, N. J.:
White-Faced Sapajou.
Getchell, Elmer E., New York City:
Cockatoo.
Gilsey, Mrs. John, New York City:
Marmoset.
Goldamer, Miss E., New York City:
Common Marmoset.
Golding, Captain Thomas, S. S. *Afridi:*
Monitor Lizard, Indian Leopard.
Gosling, Goodwin, Hamilton, Bermuda:
Young Tropic-Bird.
Haase, Captain H., S. S. *Alleghany:*
Peccary.
Hagenbeck, Carl, Hamburg, Germany:
Reindeer (2 specimens), Entellus Monkey, Semnopithecus Monkey.
Hall, Robert A., Gabriels, N. Y.:
Flying Squirrel.
Halm, Anton, Kingsbridge, N. Y.:
Red-and-Blue Macaw.
Hamlin, Marston L., South Dartmouth, Mass.:
Garter Snake (21 specimens).
Harper, Peter, Corona, N. Y.:
Virginia Rail.
Harriman, W. M., New York City:
Californian Mountain Sheep.
Hart, W. W., New York City:
Peacock.
Henis, Fred. A., New York City:
White-Faced Sapajou.
Horstmann, H. W., New York City:
Screech Owl.
Huemmer, Henry J., New York City:
Saw-Whet Owl.
Jackson, Mrs. R. G., Yonkers, N. Y.:
Festive Amazon Parrot.
Kaegebehn, Ferdinand, Hoboken, N. J.:
Golden Herpestes.
Kahn, Hermann, New York City:
Flying Squirrel (2 specimens).
Kent, Edwin C., New York City:
Gray Fox.

Kuoof, Mrs., New York City:
Ring Dove.
Landi, S., New York City:
Ring Dove (2 specimens).
Langner, Charles, New York City:
Saw-Whet Owl.
Lawrence, H. R., Pine Island, N. Y.:
Great Blue Heron.
Ledogar, Miss W., New York City:
Acadian or Saw-Whet Owl.
Letkemann, Hermann V., New York City:
Snake-Necked Turtle, African Turtle (2 specimens).
Levy, Master Walter Scott, New York City:
Nine-Banded Armadillo (2 specimens), Marmoset.
Little, Dr., Glens Falls, N. Y.:
Barred Owl, Great Horned Owl.
Little, F. D., Lakeside, Wash.:
Rattlesnake (4 specimens), Bull Snake, Horned Toad, Tree Toad.
Loewy, Mrs. Benno, New York City:
Western Slender-Billed Cockatoo.
Loring, J. Alden, Owego, N. Y.:
Red Newt (16 specimens), Milk Snake (2 specimens), Screech Owl, Pied-Billed Grebe, Red-Tailed Hawk.
McGrath, Miss Edna, New York City:
Alligator.
McGuire, Captain, New York City:
American Egret.
McIntosh, Mrs. S., New York City:
Blue-Fronted Amazon Parrot.
Marthing, D., Congers, N. Y.:
Young Alligator (3 specimens).
Martin, G. C., New York City:
German Glass Snake (3 specimens), European Glass Snake (2 specimens).
Max, Reuben, Yonkers, N. Y.:
Coyote Pup.
May, George, New York City:
Canary.
Merriam, Walter H., New York City:
Horned Toad.
Meyenberg, E., Pecos City, Tex.:
Bats (6 specimens).
Miller, Sidney R., Newark, N. J.:
Double Yellow-Headed Parrot.
Morgan, H. Carey and Camilla, New York City:
Raccoon.
Naef, Mrs. Paul, New York City:
Chameleon (3 specimens).
Noska, Elliot, New York City:
Mocking-bird.
Oestreicher, Henry, New York City:
Virginia Rail.
Osborn, Henry Fairfield, Jr., New York City:
Malay Tiger.
Payne, O. H., New York City:
Barbary Lioness.
Pearsall, Morris, New York City:
Garter Snake (10 specimens), Water Snake (3 specimens), The following specimens were collected by Mr. Pearsall and Mr. Dove

at Bethel, Sullivan County, N. Y.: Banded Water Snake (20 specimens), Banded Rattlesnake (6 specimens), Ribbon Snake (35 specimens), Garter Snake (128 specimens), Ring-Necked Snake (13 specimens), Storer's Snake (27 specimens), Green Snake (17 specimens), Black Hog-Nosed Snake (2 specimens), Black Snake (3 specimens), Milk Snake (22 specimens).

PEARY ARCTIC CLUB, Brooklyn, N. Y. (*through H. L. Bridgeman, Secretary*):
Walrus, Musk-Ox, Eskimo Dog (4 specimens).

PETERS, MR., New York City:
Peafowl (2 specimens).

PHILLIPS, C. M., Morristown, N. J.:
Raccoon.

PIERMAN, MRS. F. E., New York City:
Levaillant's Amazon Parrot.

PODHAJSKI, CHARLES L., New York City:
Screech Owl.

RABADAN, SYLVESTER, Bedford Park, New York City:
Marmoset (3 specimens).

RACZEWSKI, G. A., New York City:
Green Heron.

RICE, MRS. T G., Brooklyn, N. Y.:
Pig-Tailed Monkey.

RICHTER, WILLIAM J., New York City:
Sea Gull (2 specimens).

ROBINSON, NELSON, New York City:
Barbary Lion (2 specimens).

ROCKEFELLER, WILLIAM, New York City:
English Red Deer (3 specimens), English Fallow Deer (3 specimens), Russian Fallow Deer (6 specimens).

ROSE, GEORGE, New York City:
Screech Owl.

ROTHANG, HENRY, New York City:
Kinkajou.

RUDDOCK, MRS. J., New York City:
Canary (2 specimens).

SCHIFF, JACOB H., New York City:
Cheetah, or Hunting Leopard.

SCHUYLER, PHILIP, New York:
Senegal Lioness, Manchurian Leopard.

SETON, ERNEST THOMPSON, New York City:
Turtle (7 specimens).

SHAEF, FRANK, New York City:
Screech Owl.

SHELDON, CHARLES, Chihuahua, Mexico:
Puma.

SHERER, L. J., New York City:
American Coot.

SHILDROTH, CHARLES, New York City:
Black Snake (2 specimens). Hog-Nosed Snake, Ribbon Snake, Garter Snake (15 specimens), Water Snake, Bull Frog (15 specimens), Green Frog.

SIEGEL-COOPER COMPANY, New York City:
Cuban Dove.

SLOANE, WILLIAM D., New York City:
Jaguar, Black Leopard (2 specimens).

SMITH, MRS. WARREN E., Nyack, N. Y.:
Flying Squirrel.

Spaeth, Reynold A., Cape May Point, N. J.:
Young American Osprey (2 specimens).
Spinning, E. S., Jersey City, N. J.:
Golden Eagle.
Squires, Hubert, New York City:
Box Turtle (2 specimens), Painted Turtle.
Stadtmueller, Dr. Norbert, New York City:
Thunder Snake, or Cook's Ground Boa.
Stanton, Miss Jeannie T., New York City:
European Goldfinch.
Stedman, Mrs. Arthur W., West Roxbury, Mass.:
Bonneted Sapajou.
Stewart, W. H., Geneva, N. Y.:
Horned Toad (3 specimens).
Streeter, D. D., Jr., Guernsey, Neb.:
Large Garter Snake.
Thompson, C. D., Bernardsville, N. J.:
Golden Eagle.
Tilley, G. D., Darien, Conn.:
Gadwall Duck.
Tower, Charles P., New York City:
Magpie.
Tranis, A., Brewster, N. Y.:
Brünnich's Murre.
Trimble, G., New York City:
Barred Owl.
Underhill, Mrs. C. F., Newburgh, N. Y.:
Red Newt (2 specimens).
Van Winkle, Howard, New York City:
Red-Tailed Hawk.
Von Briesen, Arthur, New York City:
Marmoset.
Vought, Chauncey, Williamsbridge, N. Y.:
Flying Squirrel (4 specimens).
Wagener, H. A., Penn Yan, N. Y.:
Alligator.
Wait, Mrs. F. S., New York City:
Fire Salamander (2 specimens).
Wallace, William, Jr., Highbridge, N. Y.:
Garter Snake (57 specimens), Dekay's Snake (14 specimens).
Walter, Mrs. W., New York City:
Purple Finch.
Ward, R. J., New York City:
Indian Sand Boa, Cuban Boa.
Whitehead, Charles E., New York City:
Ferret (2 specimens), Ocelot (2 specimens).
Whitfield, Mrs. Henry D., New York City:
Jack Rabbits (4 specimens).
Whitman, Prof. C. O., Chicago, Ill.:
Green Heron (3 specimens).
Whitney, Hon. William C., New York City:
Musk-Ox.
Wiesendanger, N., Yonkers, N. Y.:
Screech Owl (adult female and 5 young).
Wilder, Dr. Burt G., Ithaca, N. Y.:
Mud Puppy (4 specimens).
Young, Richard, Jr., Brooklyn, N. Y.:
Cooper's Hawk.

Gifts to the Library.

American Museum of Natural History, New York City:
Bulletin of the American Museum of Natural History, Vols. XI., XIV., XV., and XVI.
The Huntington California Expedition.
Thomas Barbour, New York City:
Essays Relating to Indo-China, four vols.
British Museum:
A Hand-List of the Genera and Species of Birds.
A Guide to the Shell and Starfish Galleries.
Morton J. Elrod, Missoula, Mont.:
Summer Birds of Flathead Lake.
Fisheries, Game and Forest Commission:
Reports, 1897 and 1899.
Geological Survey of Canada:
Report on the Country Between Athabasca Lake and Churchill River.
Report on the Doobaunt, Kazan, and Ferguson Rivers.
Geological Survey of Canada—Index to Reports.
Catalogue of Canadian Plants.
Prof. Dr. E. A. Goldi:
Album de Aves Amazonicas.
Carl Hagenbeck, Hamburg, Germany:
Zebra Hybrids, etc., on Exhibition at the Royal Agricultural Society's Show.
Horses, Asses, Zebras, and Mules. Tegetmeier and Sutherland.
J. A. Pettigrew, Jamaica Plain, Mass.:
The Antelope and Deer of America. J. D. Caton.
Philadelphia Academy of Sciences, Philadelphia, Pa.:
Proceedings of the Academy of Natural Sciences, 5 vols.
G. O. Shields, New York City:
Drawings of Birds and Animals by Carl Rungius, L. Gray, and E. Josephine Pitkin.
Smithsonian Institution, Washington, D. C.:
Annual Report of the Smithsonian Institution, 1900.
Inglis Stuart, New York City:
Adventures Among Lions. Jules Gerard.

Gifts of Plants.

Mrs. O. Eggeling, New York City:
One Large Rubber Tree.
Mrs. George L. Heins, Mohegan, N. Y.:
Five Large Rubber Trees.
Mr. John Hoffman, New York City:
Two Large Rubber Trees.

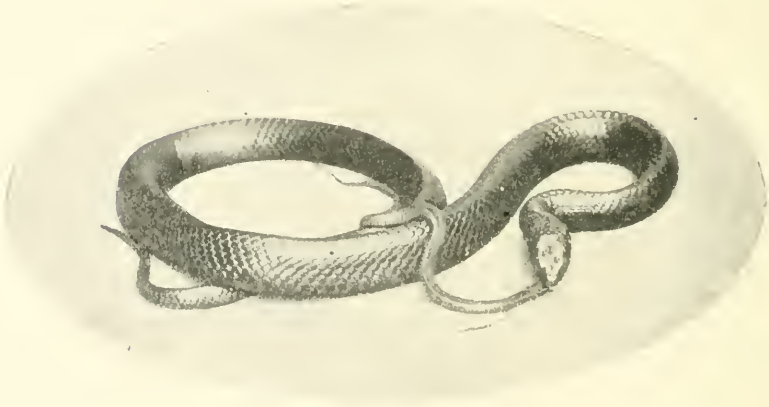
Gifts to the Aquarium.

AGUERO, C. A.:
Small alligator.
BISHOP, HENRY, Baltimore, Md.:
40 goldfish (7 varieties), 4 snapping turtles, and 8 painted turtles.
HANEMANN, MASTER BILLY:
Young alligator.
HARVEY, JOHN:
Crayfish.
JAMES, EDWARD A.:
Small alligator.
JESS, MISS BERTHA:
Small alligator.
LEARY, JOHN L., Supt. U. S. Fish Commission, San Marcos, Tex.:
4 specimens of the Blind Salamander (*Typhlomolge rathbuni*).
NASH, MISS LILLIAN E.:
2 young alligators.
NEW JERSEY FISH AND GAME COMMISSION:
3 pickerel, 4 crappie, 1 wall-eye pike, 3 scale carp, 4 yellow perch, 4 long-ear sunfish, 7 short-ear sunfish, 3 leopard frogs, 45 fresh-water fishes, representing 12 species, among them: pickerel, yellow perch, catfish, crappie, sunfish, roach, and minnow; 12 small-mouth black bass, 2 horned mullet.
NEW YORK FISH, GAME AND FOREST COMMISSION:
4 whitefish, 4 pickerel, 3 pike, 1 rock bass, and 9 suckers.
POUET, MASTER ARNOLD C.:
1 young Florida alligator.
REDFIELD, MASTER EDWARD T.:
Wood turtle, 2 bullfrogs, and 24 salamanders.
SEARING, GEORGE E., Towanda, Pa.:
60 tadpoles, 2 newts, 4 sunfish, and 4 water beetles.
SOUTH SIDE SPORTSMEN'S CLUB, GEORGE P. SLADE, President:
30 brook trout, 29 rainbow trout, 3 hybrid trout, and 2 brown trout.
UNITED STATES FISH COMMISSION:
Fresh-water plants; 100 land-locked salmon (fingerlings), 100 Atlantic salmon (fingerlings); 20,000 rainbow trout eggs; 20 yearling golden tench, 10 adult golden tench, 20 yearling green tench, 5 adult carp; study series of 50 species of fishes from Long Island, identified, 188 specimens; 275,000 eggs of whitefish, 6 adult Atlantic salmon, 6 adult paradise fish; 50,000 lake trout eggs.
WILLMENT, MRS. C. C.:
1 alligator.

Gifts to the Aquarium Library.

AMERICAN FISHERIES SOCIETY:
Transactions, 1902.
BARBOUR, THOMAS:
7 Pamphlets on Fishes, from Bulletin Museum Comparative Zoology, and Proceedings Boston Society of Natural History.
BOSTON FISH BUREAU:
Series of 12 Annual Reports.
DUGMORE, A. R.:
"Nature and the Camera."

MAYER, DR. A. G.:
Brooklyn Institute Science Bulletin, Nos. 1, 2, and 3.
SMITHSONIAN INSTITUTION:
Proceedings National Museum, 1878 to 1902; Smithsonian Institution Reports, 1886 to 1897; Miscellaneous Bulletins, 1 to 48, and 5 special Bulletins.
TOWNSEND, C. H.:
"Fishes Little Known or New to Science."



HIMALAYAN TAHR.

SARDINIAN MOUFLON

ANNUAL REPORT OF THE PATHOLOGIST.

By HARLOW BROOKS, M.D.

THE space of time covered by this report extends from January 1st, 1902, to January 1st, 1903. The records of the work done prior to April 10th, 1902, were not, however, as thoroughly kept as at present. On this date a system of records was adopted for the department which has since been closely followed. These data have formed the chief basis of the report. Previous to this time only the more important scientific observations were recorded, and many of them have meanwhile been presented in papers and studies before various scientific societies.

Our work during the early part of the year was somewhat retarded by the loss of Mr. Deaken, who had filled the position of assistant to the veterinary and pathological departments. Mr. Deaken left us to accept a similar position for the City Board of Health. His work at the Park was very satisfactory, and fully demonstrated the necessity for the position. We have since been very fortunate in securing the services of Dr. Blair, a graduate of the veterinary department of McGill University, and a gentleman of excellent attainments. I owe many of the data, the basis of my report, to the records carefully collected by him.

The more accurate observations and several brief researches which our increased facilities have rendered possible this year have, we believe, given us more valuable results than have heretofore been the case. We now feel that we are still better prepared to enter on a new year's work, since we begin with a more definite idea as to the lines which promise most for the future.

DEATH RATE.

It is impossible to give the percentage of deaths which have occurred, since the records were not sufficiently carefully kept with this end in view during the early months of the year. Even if they had, the figure would be misleading, since it would necessarily include many deaths which took place in animals but recently introduced to the Park, animals whose illness had been

contracted in transit, and which, not infrequently, arrive at the Park in a moribund condition. Suffice it to say that our mortality compares not unfavorably with the human records for the Bronx Borough. This is largely due to the fact that we are attempting to keep many animals which other parks have given up on account of the great difficulty of keeping them. The New York Zoological Society feels that with its superior facilities it owes science the attempt to devise methods for the keeping of these animals, some of which already threaten to become extinct. If we were to strike from our lists the deaths of the moose, caribou, and native deer, all of which have been practically given up by less ambitious institutions of like nature, our mortality rate would be greatly reduced. Nevertheless, we have learned from these sad experiences many facts, and we hope that in the near future we shall be able to demonstrate that it is possible to keep these animals when the necessary conditions shall be fully understood. Recent results with the antelope and caribou fully justify us in these conclusions. It must also be borne in mind that many of these animals are short-lived even in a state of nature.

Post-mortem examinations are now systematically made on all animals dying in the Park. We find that these necropsies can be made without injuring the carcass for the taxidermist, while at the same time facts of the greatest scientific importance are being discovered. I wish to particularly impress the importance of routine examinations, for it is well known that we often find the most valuable conditions where they are least expected. The records of these examinations are filed, and in the course of a few years we shall possess a collection of pathological data bearing on the diseases of wild animals in captivity of the greatest value, both practically and scientifically.

On January 1, 1903, there were nearly two thousand animals in the Park.

Deaths have been most frequent among the primates. Of the one hundred and seventy deaths recorded in the entire collection sixty-seven have been members of this group.

Of these sixty-seven deaths thirty have been from tuberculosis. This brings the death rate in our monkeys from this disease to within a small margin of the frequency of death from tuberculosis in the human.

TUBERCULOSIS.

Observations have been conducted with particular interest in regard to this disease, and we have apparently established certain

facts in relation to it. In the majority of cases the disease has been contracted before the animals reach the Park. Several animals have died from advanced tuberculosis almost immediately after their arrival. I am fully convinced that the average case of monkey tuberculosis is contracted under the unfavorable conditions usual in the quarters of the dealers, or under the still more unhygienic surroundings prevailing in transit. The primary infection takes place generally in the cervical and bronchial lymph nodes, and extension of the disease usually follows as metastases from these foci. This also is, no doubt, the most frequent story in the pulmonary tuberculosis of children, which, I think, simulates closely in nearly every particular the history of the disease as we find it among the monkeys. Pulmonary tuberculosis is by far the most frequent form of the disease as in man, but other types of the disease are also observed, for instance, two cases of typical primary intestinal tuberculosis have been discovered, both of which probably received their infection in our cages. Pure cases of lymphatic tuberculosis are even more frequent. In these instances the lymph nodes and the spleen are the most frequent sites of the disease, the liver becoming involved later. Generally cases of lymphatic tuberculosis terminate with pulmonary involvement, though sometimes otherwise, as by tubercular meningitis.

The general character of the lesions produced in simian tuberculosis correspond very closely to those of the human, and the bacilli found also simulate morphologically those of the human infection. No comparative biological tests have, however, yet been made by us. Chronic tubercular lesions are much more infrequent in the monkey, and the pronounced fibroid changes of pulmonary phthisis as seen in the man have never been observed by me in the monkey. Neither does one frequently find healed tubercular lesions in the tissues, particularly in the lungs of these animals, as in man. In man, dying of other than tubercular disease, healed tubercles are present in from 50 per cent. to 80 per cent. of cases. I infer from these facts that the disease is of a much more virulent form in the monkey, and that the rule is death in infected animals, while in man the average case recovers. This observation may be likened to the characteristics of the disease when it affects a primitive people, particularly one in which tubercular infections are infrequent in their natural habitat; we may thus compare the primate tuberculosis to that of the Indians, of the Esquimaux, or even to that of the negro, in his native land. From this line of reasoning it appears that

we shall eventually find that the offspring of monkeys in captivity are less liable to succumb to the infection than those direct from the jungle, that is, of course, assuming the conditions of infection and environment to be the same.

I wish to particularly commend to your attention the investigations and observations of Dr. Blair appended to this report, pertaining to the very important question of the manner of communication of tubercular infection among wild animals in captivity. From Dr. Blair's work we may safely conclude that the manner of infection is precisely like that in the human. Bearing this well in mind we should adopt for our guidance the same fundamental precautions which are now generally recognized for the prevention of the disease in the human. The key-note of these is that the disease is usually communicated through the agency of the secretions of the bronchial, tracheal, and nasal mucosæ, which becomes dried and mixed with the dust of the habitation to finally be drawn into the respiratory tracts of other animals. We must, therefore, most rigorously exclude all animals known or suspected to be tubercular from the cages of the uninfected, and at the first signs of the disease in any animals they must at once be separated from the healthy ones. As a corollary, cages occupied by tubercular animals must be efficiently washed and disinfected after the removal of animals sick with this disease, and before healthy beasts be placed in the compartments.

I realize that such precautions impose a very severe task on those caring for the primates, and doubtless "practical animal men" will make light of these suggestions, just as equally uninformed persons did of similar measures in regard to the human but a few years ago. I feel certain that if these measures be rigorously observed for a considerable space of time in any primate collection that the greatest problem in regard to the keeping of these animals will be solved, provided, of course, that originally uninfected animals can be obtained. Perhaps before this shall be possible much missionary work must be done among the animal dealers.

In regard to the prevalence of tubercular disease among animals other than primates we feel that we may congratulate ourselves. But one ruminant has been lost from the disease; this unfortunately was a valuable specimen, a musk-ox, which died with extensive lymphatic tuberculosis, terminating with a pneumonia which apparently was non-tubercular. It is somewhat interesting to consider the infection of this animal, recently from

the arctic regions where tuberculosis is unknown, with the similar fate of the Esquimaux who were brought to this country by Lieutenant Peary, all of whom contracted tuberculosis within a few days after landing. The great rapidity of these cases, which came under my observation, is most instructive in that it teaches us to especially guard against the possibility of infections for creatures coming from a widely altered habitat.

In my last report I mentioned the presence of a tubercular-like disease primarily affecting the gums of the reptiles and in bad cases producing metastases in the viscera. It was intended that a serious study of this disease be made during the past year, with special reference to the determination of its nature and cause. We have been very happily disappointed in not receiving enough material from our reptiles to make this study possible; this is most complimentary to the care which these animals have received, for I believe this disease is one of the most frequent causes of death among reptiles in captivity. I nevertheless very much regret to state that Chicago has decidedly beaten us in the investigation of this disease, for Dr. Evans has demonstrated the presence of tubercle bacilli in the lesions, and has succeeded in communicating the disease to other animals by inoculations with the tubercular matter. I have been, as yet, unable to substantiate Dr. Evans's work in the few cases of the disease which we have had in the past year, but the condition seems to be thoroughly established in his cases at least. I wish to acknowledge the kindness of Dr. Evans, who sent me specimens from his cases in which I have found numerous bacilli corresponding to the tubercle bacillus. The past year's work has taught all of us to modify our ideas considerably in regard to the possibility of tuberculosis in cold-blooded animals, for the disease has now undoubtedly been induced, either naturally or experimentally, in both frogs and fishes, and we are all, I believe, growing to consider the tubercle bacillus as either protean in its forms or capable of undergoing great modifications in its biological possibilities.

GASTRO-ENTERITIS.

Although our past experiences and observations have taught us much in regard to gastro-enteritis, nevertheless it still remains probably the most serious problem with which we have to deal.

Forty-three deaths have been caused by this disorder. Of these deaths eleven have been of the ruminants, the most valuable animals dying from this disease. Seven members of the canidæ died from the disorder, but two of these cases were caused

by the mechanical action of intestinal parasites, and should be properly excluded from the list, since I prefer to discuss the disease as we find it caused by dietetic factors. Gastro-enteritis has been second to tuberculosis the most frequent cause of death among the primates for the past year, but it has not been sufficiently frequent to be a serious factor, and the disease in these animals is more or less amenable to treatment as well as more easily prevented. It is primarily *the* cause of death among the ruminants, and I propose to discuss the disease as we have found it in this family, particularly since the more valuable animals prone to the complaint belong to this group.

It may be assumed as proven that the chief causes of gastro-enteritis in the ruminants are errors in diet. We may safely exclude all possibility of specific bacterial agency—though at the same time our observations have shown us that various intestinal bacteria serve as exciters of the disease whenever the intestinal mucosa becomes abnormally irritated by digestive disturbances of any character. The most serious outbreak of this disease has been that of the buffalo herd. Investigation of the epidemic —for it practically amounted to an epidemic—shows us beyond reasonable doubt that it was caused by the faulty hygienic conditions existing in the large buffalo pasture. This subject was treated in a special report, and I only desire to emphasize here that I believe it will be found impossible to so alter this range as to make it safe for these animals without a very considerable outlay. A review of the disease as it has affected the buffalo, caribou, moose, and native deer, I believe, definitely indicates the difficulty of keeping animals of this class in such natural ranges as we are able to provide in the Park. They must be placed where the food and water supply is absolutely under the control of the keepers. We could not expect domestic cattle to thrive under the conditions which we are able to provide in the way of pasturage.

The present condition of the caribou warrants our belief that the animals above referred to can be kept in asphalt or macadamized ranges, where all food and water are under the immediate control of competent men.

PNEUMONIA.

Thirty-three cases of pneumonia are reported. Of these three were caused by the presence of bronchial filaria. Dr. Miller will specially discuss this important condition in his report, hence I pass it by with mere mention. In four other cases the disease

was also of the broncho-pneumonic character, one of them being due to aspiration of food. The remaining cases are well-defined instances of lobar pneumonia. Lobar pneumonia has usually been found to present a terminal stage of some other condition, usually primary. In three cases among the canidæ the primary cause was distemper, among the ruminants it has usually been either the direct or remote result of gastro-enteritis. No bacterial investigations have been made of the disease, but I am fully convinced from its clinical aspects and from the pathological findings that the disease, as in the human, is by no means a specific one, always caused by the pneumococcus, but that many infective agents may alike produce it, the chief factors being those of predisposition. Probably as chief among these predisposing factors are to be considered those conditions or diseases tending to a general lowering of the resistance of the body forces, in other words we may well liken the usual case of the disease (lobar pneumonia) to the pneumonia of senile men. I propose to discuss later more fully the conditions which I believe specially predispose to this disease.

PARASITIC DISEASES.

In our last report we mentioned the prevalence of cysterci in the cadavers of the animals dying in the Park—they were found present in nearly all cases, involving alike reptilia, mammals, and even the amphibia, and being found in every viscus. During the past year they have been found with equal frequency, and in three cases have apparently caused death of the invaded animals. The condition therefore becomes of importance. Doubtless in many more cases it is at least a causative agent in the production of anæmia and malnutrition. Dr. Blair has made a special study of the condition as found in our animals and as described in the available literature, and his report will be found appended.

I have already mentioned the *bronchial filaria* and the fact that it has caused death through broncho-pneumonia; in last year's report I mentioned this fact as a possibility.

INTESTINAL PARASITES.

Are found very abundantly, and in very many cases they have been the cause of impaired food absorption and malnutrition, and have hence predisposed to gastro-enteritis. In two of the canidæ fatal enteritis was thus excited, and in three coyotes death was

caused by the abstraction of blood from the intestinal mucosa from the action of these parasites. One of the most frequent of these intestinal parasites found in the animals of the dog family is the *ankylostoma duodenale*, a worm chiefly found in the duodenum, where it attaches itself to the mucous membrane by hook-like spikes with which it is provided. These parasites often give rise to severe anæmias, "Egyptian Chlorosis" of man being caused by its presence. It has been shown that it may remain in the intestine for a long time after the primary infection. The eggs of the parasite are oval shaped, and enter the intestine through infected food or drink; here they undergo partial development, and leaving the gut develop still further in foul water. Entering the intestine again through this means they develop into sexually mature parasites, and the ovæ are then discharged in the fæces of the infected animals.

CESTODES

Of various types are frequent in the intestines of the animals at the Park; in several instances death has been caused by them. They are particularly frequent among the snakes, notwithstanding the care which is exercised in the selection of food for these animals. These parasites always enter in infected meat.

There can be no doubt but that the intestinal parasites frequently induce conditions at least predisposing to the development of fatal disease, hence care should be exercised in the prevention of this infection. This can in a measure be carried out by inspection of the stools of recently acquired animals before they are admitted to general enclosures. Frequently also when the parasites are found in the fæces, if the attention of the veterinarian be called to the fact, proper treatment may relieve the animal and prevent the extension of the disease to other animals. It is self-evident that all food should be inspected for parasites.

In last year's report I mentioned the finding of the *mischerschen schleuche* (Rainey's corpuscles) in the heart-muscle of one of the elk, where it created sufficient disturbance to cause the death of the animal. It was mentioned at this time that, according to the literature on the subject, invasion of the myocardium by the parasite is rare, and it is generally looked upon as innocent in most cases. This view of the parasite has been advanced by Ostertag, and is endorsed by such authorities as Pfeiffer and Ziegler. These investigators do not consider it as highly infectious, and Pfeiffer was unable to infect animals experimentally. Pfeiffer's conclusions have, however, been disproven by the re-

cent work of Theobald Smith, who has conclusively shown that the disease may be communicated through infected meat.

Since our attention was first drawn to this sarcosporidion we have systematically investigated the heart muscle of all the dead elk, and the result has been that we have been able to demonstrate the parasite in every case. Though the organism may exist in the heart muscle without strictly inflammatory changes in many cases, my studies have shown that in most cases where found in the heart, they give rise to a general parenchymatous degeneration of the muscle cells, this together with the destruction of the individual infected fibres greatly impairs the heart action and eventually causes death. Doubtless this is the cause of the unsatisfactory condition of the elk, and probably nearly all the members of the present herd will eventually die with the disease. This condition is serious enough in itself, but the parasite has also been found in the myocardium of several caribou, producing the same results in these animals as in the elk. Mere gross examination of suspected tissues is not sufficient to establish the absence of the parasite, for I have been able to find it in microscopic preparations where it was not seen macroscopically.

Unfortunately the life history of this organism is not known, notwithstanding the very considerable researches which have been conducted in regard to it. It is, however, generally admitted to be communicable, though the manner of infection is quite unknown, that is among the ruminants, for Smith has shown us that infected meat is capable of producing the disease in susceptible animals fed upon it. Reasoning from analogy we may probably safely infer that the disease is also communicated among the ruminants by the intestinal tract. The origin of the infection is obviously a matter of considerable importance to us. It is highly improbable that the parasite exists in the muscle of the wild animal. In my own somewhat limited observations of the musculature of dead wild animals of this class I have never seen it. Diligent inquiry among hunters and guides has also failed to give me any data of at all "probable" cases, so the disease is most likely acquired in captivity, and probably by intestinal infection with the dejecta of diseased animals. The parasite is very frequent in the common sheep, and Kuhne has found it in 98.5 per cent. of pigs examined (in Germany). It is more than probable that the present ranges of the Park have previously been utilized for pasturage for sheep and pigs. Granting, then, that the sporidion is communicable, we have a

plentiful source for the disease in the ranges for the elk and caribou. It seems to me advisable that if additions to the elk herd be made that the new animals should not be allowed to freely mingle with those of the present herd which are known to be diseased.

INFECTIOUS DISEASES.

Perhaps the most serious form of infectious disease which we have had to contend with during the past year has been *actinomycosis,* commonly called "lumpy jaw." We have lost four animals—four antelope and one deer—as a result of this disease. It is impossible to certainly trace the origin of this epidemic. It is thought to have been brought to the Park by one of the victims, an antelope; it may, however, be that it was brought by some other animal in which it did not develop far, and which in some way came in contact with the antelope. Not the least improbable theory for the origin of the disease is that it was contracted from germs remaining in the soil of the enclosure, and that some one of the animals became infected after the usual method through some wound or abrasion of the mucous membrane.

To my mind this presents a very probable source of the infection, for we know that the land now occupied by the Park has been utilized in past years largely for a pasture, and similar modes of infection in like circumstances are not infrequently reported. The remaining possible course of contagion is to be considered in the food, which may have been contaminated by some diseased animal. Once the disease is introduced the spread of it is of course perfectly clear.

In some respects the character of this disease has differed from the form usually seen in cattle or horses. The actinomycotic nodules have been noticeably smaller than is generally the case in cattle, and as might be expected, following the law laid down by Darwin, the disease being probably newly introduced, proved especially virulent. The pathological picture is further characterized by a greater than usual tendency to the formation of metastases. In this respect it has more resembled the disease as it is found in the human than in animals previously studied.

DISTEMPER.

Ten animals have been lost through distemper. The disease was introduced through a coyote which was brought to the Park probably while suffering from the disease. I have been unable

to find where this animal was secured. The prevention of this disease can only be brought about through a close attention to the inspection of animals subject to the disease when they are sent to the Park, and the immediate quarantining of sick animals if the disease breaks out. The disease is a particularly active contagion, and it is one in which medical treatment is often most unsatisfactory. I wish to particularly call your attention to the report of Dr. Miller on this subject. His conclusions are of the most vital importance.

RABIES.

There has been but one possible death from this disease. It is by no means certain that this animal, a Pallas cat, had rabies, as it died very shortly after it reached the Park, and before it had been removed from the case in which it was sent. It is, however, most essential that hydrophobia be excluded from the Park, as most disastrous results might follow, once it was introduced. In this consideration it is well for us to refer to the marvellous results which have followed the quarantine system as applied to animals susceptible to rabies, practiced by England and Australia. All pets imported to these countries are subjected to an examination, and are kept in quarantine for such time as is thought necessary before they are allowed to be turned loose. The result has been that, as stated in a recent number of the London *Lancet,* England and Australia are now free from rabies. It would certainly be a much more simple problem for us at the Park to prevent the development of the disease by following out similar methods than it has been to establish this national quarantine.

UNUSUAL DISEASES.

We have not been without a list of rare diseases, and most of them are of great interest to the student of comparative medicine.

One lemur died as the result of *acute hepatitis.* No jaundice was present. A walrus died from *pulmonary hæmorrhage,* the cause of which could not be ascertained. A baboon died from what appears to have been *epileptic convulsions.* A large anaconda met death from invagination of the colon, producing *intestinal obstruction.* A Cuban rat developed a *strangulated omental hernia* from which it died. A porcupine died from *puerperal sepsis* and *septic metritis.*

One of the most interesting of the rare diseases was a case of *aneurism of the heart,* which occurred in a Newfoundland caribou. The case is of such interest that I shall abstract quite extensively from the protocol and microscopical examination.

The animal had been ailing for some time, suffering from occasional attacks of diarrhœa and finally dying apparently from malnutrition. At the post-mortem the following cardiac condition was found:

"The heart as a whole is large and well formed. The epicardium shows no areas of thickening or of injection, except over the posterior portion of the apex, where a thick fibroid scar extends forward to a little beyond the anterior border. The entire scar measures 6 cm. vertically, and 4 cm. horizontally. The scar involves the left ventricle near its apex chiefly. On incising this tissue it is found to contain large blood clefts, many lymph spaces, and to be made up mostly of loosely arranged connective tissue, the external layers of which are much more compact. The average thickness of the scar which extends through the entire wall of the ventricle is 5 cm., and it has evidently bulged out from the regular contour of the heart to a considerable degree when under blood pressure.

"The myocardium, as a whole, is pale and abnormally soft. The auricles show general thickening of the endocardium, especially of the left auricle, and the mitral valves show a moderate degree of relative insufficiency. All the cavities of the heart contain a small amount of mixed clot.

"The arch of the aorta shows a slight degree of atheroma, which is not continued into the coronary trunks, the intima of which appears normal, though the vessels are of unusually wide calibre. The lower one-third of the left coronary artery which should supply the area involved by the scar is completely occluded, and from this point on is marked as a simple fibrous cord extending down, and finally blending with the fibrous wall of the aneurism.

"The muscle cells in sections remote from the gross lesion show a highly granular cytoplasm, and a few contain oil globules, some of large size. The fatty degeneration is much more pronounced in sections taken from near the aneurismal wall. There is a marked infiltration with small round cells in the immediate neighborhood of the fibroid area, the muscle fibres becoming more and more infrequent and more highly degenerated as the aneurism is approached, where muscular tissue is completely replaced by adult and embryonic connective tissue, the cells of which show a still active state of hyperplasia. The blood-vessels

of the diseased area are surrounded by a pronounced infiltration of small round and occasional plasma cells, and many of them are completely occluded by fibrous tissue which has developed about them, chiefly in the adventitia.

"Groups of the Mischerschen Schleuche are frequent in the muscle cells, and a few are found in the fibrous tissue, apparently remaining after absorption of the muscle cells in which they were originally lodged."

Apparently this aneurism of the heart was formed by degeneration of the muscle cells in this particular area, probably primarily due to the presence of the Mischerschen Schleuche, with fibroid replacement of the muscle tissue as degeneration progressed. It is also probable that the condition was favored by the inflammation which may accompany the encystment of the schleuche. It is possible, however, that the original lesion was thrombosis of the left coronary artery with consequent muscular degeneration and fibroid replacement. This is the more common cause of aneurism of the heart in the human. In so far as I am able to learn, this case is absolutely unique.

MUSCULAR ATROPHY.

One of the most remarkable specimens obtained during the past year was that of a beaver, which showed very pronounced atrophy of the muscles of the rear extremities. The character of the lesions in this case differs entirely from those of ordinary muscular atrophy, and its causation is a complete riddle to us. No history was, of course, obtainable, and unfortunately neither the spinal cord nor the peripheral nerves were secured for examination.

DEATH FROM INJURIES.

Fortunately, the number of deaths from injury has been very small. This is a most excellent showing, especially where so large groups of animals are kept together as is the practice with us. But eight deaths resulted from this cause.

CAUSE OF DEATH UNKNOWN.

We have been able to establish the cause of death in all recorded cases except four. In this regard I must especially commend the industry and thoroughness of Dr. Blair, to whom the major part of this work has been entrusted.

PATHOLOGICAL EFFECTS OF CAPTIVITY ON WILD ANIMALS.

A certain number of animals die while in captivity of conditions which might well be classed as *old age*. During the past year I have made a study of what I believe to be the conditions leading up to this state, and though as yet my observations are brief, I believe it is well to present them in an abstracted form at this time. It is well known that in most cases the organs of wild animals, even though of considerable age, if free from intercurrent disease, are practically normal. This is notably so inasmuch as we are obliged to resort to these animals to procure specimens of many normal tissues, particularly normal liver, kidney, and blood-vessels. We practically never find these tissues in normal condition in the human, even in young children. In examining the tissues of animals which have been in captivity for a considerable length of time I have been struck with the frequency with which we meet changes very like those with which we meet so constantly in the human.

The most common of these changes consists of a fatty degeneration of the parenchymatous tissues of the body, particularly of the cells of the liver, and to a slightly lesser degree of the kidney. This is accompanied by a parenchymatous degeneration of the heart muscle, which in the more pronounced cases is accompanied by fatty degeneration, and sometimes in the more sluggish animals by a fatty infiltration.

The changes in the blood-vessels are those of arterio-sclerosis of variable degree. In my observations I have rarely found this to extend to actual atheroma, but a fatty degeneration of the walls seems to represent more frequently the most extreme stage. Arterio-sclerosis is usually most manifested in the arterioles by a proliferation of the adventitia and of the perivascular connective tissue. This is probably associated with more or less marked interference with the functions of the vasa vasorum. It is very likely that these alterations in the blood-vessels are among the earliest changes, and that they are often the primary lesions which induce the latter parenchymatous alterations.

The cause of these tissue changes are probably multiple. In my opinion the most frequent and common etiological factors are two in number: over-nourishment; insufficient exercise. These factors go hand in hand, and one is probably always associated with the other. We therefore find these changes taking place to a most marked degree and earliest in animals with which the amount of food is not absolutely under control, and in those ani-

mals which take kindly to that provided. I may mention as animals of this group especially the ruminants, and particularly if these animals be allowed to feed at will on the natural foods of their range in addition to receiving prepared fodder. In the natural state these animals do not feed as undisturbed as in the Park, but must be constantly on the lookout, rendering constant feeding impossible. Coupled with this natural method is a large amount of exercise which the beasts must take in the securing of their food. During inclement weather their rations are doubtless often reduced to a minimum. Thus we find in nature that the amount of food is generally limited, and that the procuring of it requires the expenditure of a considerable amount of energy. At the same time the foods selected by the animals are naturally those designed for them by nature, varying according to natural requirements. In captivity almost opposite conditions obtain. The amount of food is generally too great, unless absolutely under the control of keepers, as with the carnivora or such omnivora as the bears. The amount of exercise necessarily expended in the securing of the food is reduced to a minimum, and finally the inclosures of the animals are generally so limited in extent that sufficient exercise is not encouraged. We may conclude more or less confidently that animals are very much like man and are not inclined to do more than the necessary amount of labor, sufficient to provide them with food and comfort. It is well known that the most healthy people are those who earn their food under proper hygienic conditions by abundant physical exercise. In captivity, in most cases, the foods cannot be selected with the strict adherence to the demands of each peculiar animal as in the open.

These factors, improper alimentation coupled with insufficient physical exercise, throw on the excretory and absorbtive structures of the body increased work, accompanied generally with a diminished oxidation. Digestive and other metabolic disturbances follow, and metabolic toxins are thrown into the circulatory fluids exciting parenchymatous and fatty degeneration of the parenchyma cells, accompanied by the arterio-sclerosis and interstitial hyperplasia. I believe that we may not inaptly compare these conditions to those of high living men, and the results on the body tissues are the same in both instances.

Resulting from these lesions we have a general lowering of the tone and resistance of the body. This condition predisposes to many infective diseases, of which doubtless pneumonia is the most frequent. The condition is well exemplified in the preva-

lence of pneumonia, particularly in the cases of the sea-lions at the Zoological Park, and is perhaps best shown in the case of the West Indian seal who died recently at the Aquarium. In such cases the pneumonia may be looked upon as a terminal disease, like the senile pneumonia of man, which Osler aptly says is a natural end of old age. The condition also predisposes to gastro-enteritis; note the frequency of this disease among our native ruminants, and it of course predisposes to acute nephritis, from which five of our cases died, while nephritis also almost always complicates gastro-enteritis.

The correction of these conditions among wild animals in captivity presents a problem more easily delineated than accomplished. In brief, the factors tending to do away with this "premature old age" would be careful selection of foods; limitation of the amount, and immediate control of both food and drink by competent men. Every means possible should be devised to make the animals exercise.

CAGE PARALYSIS.

One of the most serious results of captivity seems to be the development of the so-called "cage paralysis." In so far as I can learn no scientific descriptions of this disease have been published, and it is the hope of Dr. Miller and myself to eventually make a careful study of it. As yet sufficient material is wanting. The disease is characterized by partial sensory and motor paralysis of the hind extremities, accompanied by more or less muscular atrophy. In so far as I have examined cases the tendon reflexes seem to be present even in quite late stages of the disease, but the animal eventually loses control of the hind quarters, and moves about by dragging the extremities after it. The animals may live for a considerable time in this condition. The chief symptoms of the disease are but briefly outlined in this report, since Dr. Miller will later consider the clinical characteristics at some considerable length.

One case of paralysis came to autopsy. The case was that of a bear which arrived at the Park in this condition, and which exhibited several symptoms not characteristic of the disease, hence we are in doubt as to identity of this particular case with the ordinary cage paralysis. This bear exhibited most marked symptoms of most intense parasthesias for a considerable time before it was thought best to kill him. Indeed, the sensory disturbances in this particular case apparently exceeded the motor derangements, and in so far as we can learn muscular atrophy

was limited if present at all. The tissues from this case were not obtained in absolutely fresh condition, hence I have disregarded the cytoplasmic alterations of the ganglion cells, their nature indicating that they were probably entirely of post-mortem origin.

In brief, the lessons found in this doubtful case of cage paralysis consist of areas of neuroglial sclerosis, situated in the lower dorsal and lumbar cord, limited to the columns of Gall and Burdach, with irregularly degenerated fibers in the two posterior tracts, both above and below the sites of the chief areas of sclerosis. The fibers of the posterior nerve-roots and the posterior root-ganglia both showed degenerations, but apparently the chief descending tracts of the cord and the anterior nerve-roots were free from disease.

The blood-vessels, excepting in the sclerosed areas, were found to be normal.

The lesions in this spinal cord indicate that the disease was very like *tabes dorsalis*, and the symptoms of the case also resembled those of this disease. We do not look on this case as a typical one of cage paralysis, and simply report it as a most interesting observation.

RECOMMENDATIONS.

Although great improvements have been made in the Park during the past year there still remain many improvements which must be made, especially for stricter quarantine, and the sooner they are made the cheaper it will prove in the end. I believe that the most important change which can be made in the present management of the Park would be the establishment of a thorough quarantine system.

QUARANTINE.

The most important function to be considered under this head is designed to prevent the entrances of disease to the Park. Our greatest hopes in the control of the diseases in the Park must chiefly rest on the prevention of the introduction of disease from the outside. Eighteen valuable animals have been lost during the past year to our direct knowledge through the admission of but two diseased animals. We can form no idea as to how far our deaths from tuberculosis have been due to the importation of tubercular animals, particularly monkeys. Furthermore, unless more rigorous measures are introduced soon there is no telling when rabies, distemper, tuberculosis, anthrax, actinomycosis

and other infectious and contagious diseases may become disseminated throughout the entire collection. This can all be prevented by the introduction of measures which can be carried out without, I verily believe, more expense than the cost of the animals we may lose in any year from these diseases. I would strongly recommend, therefore, that *no animal be admitted to the common inclosures or cages until those animals have been kept isolated and under the observation of the veterinarian until he is fully satisfied that they are free from contagious disease.* It hardly seems necessary to defend this suggestion, but I would like to call your attention again to the remarkable results which have followed the enforcement of the similar rule which has resulted in the absolute eradication of rabies from England and Australia.

Undoubtedly such a rule would involve the construction of a suitable building in which this work could be carried out. This building would preferably be placed in an obscure part of the Park, and should not, of course, be open to the general public. It need not be an expensive building, but in any case I believe that it would be the most paying investment which the Zoological Society could make.

Such a building could be further utilized as a hospital to which animals under treatment for contagious diseases could be removed, so preventing infection of their fellows. I believe that under the supervision of the veterinarian such a hospital could be built for a very reasonable sum and yet possess all the necessary appliances. I do not wish to be understood that I advise that every monkey with lymphatic tuberculosis, for instance, be removed from exhibition, but I do most earnestly insist that all animals even so slightly infectious should be removed from the cages of healthy animals. For example, a cage could be reserved in the monkey house in which tubercular animals fit for exhibition might be placed, careful means being taken to prevent infection being carried from this cage to uninfected ones. Unless some such measure is introduced tuberculosis is practically sure to become diffused throughout the entire primate collection. The observations of Dr. Blair have clearly shown that the disease is communicated among the monkeys as in man, and these statements must appear self-evident to any thinking man.

DISINFECTION.

Should be generally practiced in cleansing the cages of dead or sick animals. This applies especially to the primate, lion, bird

and antelope houses. A new animal should never be placed in an empty cage until it has been thoroughly cleansed and disinfected. The results achieved during the past year by the earnest manner with which these rules have been observed demonstrates fully their necessity.

LIBRARY.

A library is greatly needed. The literature bearing on these subjects is meager enough, and we should certainly be provided with the little that does appear. The chief journals of veterinary and comparative medicine and pathology, and every worthy book bearing on the diseases of the animals kept in the Park, should be secured. It will be much cheaper to subscribe for the journals now than to attempt to buy up back editions later on, as we certainly shall have to do. The numerous valuable publications of the Government laboratories and research stations should be secured and provision should be made for the filing of all such matter, so that it may be found quickly whenever needed. Humanitarians interested in the "Prevention of cruelty to Animals" could make no more valuable contribution to this charity than to endow such a library.

LABORATORY.

The laboratory still needs more and better instruments and most of all more room. It is hoped during the next year to interest outside scientists in the problems with which we are contending, and we propose to furnish tissues and other material as desired, asking in return in each case that some contribution be made on their part as to the results of their investigations, and that they be published as in collaboration with the New York Zoological Society.

MUSEUM.

One of the most important advances planned is a museum in which interesting and important specimens may be prepared and preserved for the future benefit of the Park, and of all persons interested in the diseases of animals. A very proper location for such a museum would be next door to the pathological laboratories, which would be very properly situated in the reception and quarantine building, which we hope will be the next house erected by the Zoological Society.

In conclusion I wish to again thank the Board of Managers, and especially their immediate representatives, for the interest

which they have taken in our work, and for the encouragement which they have given us. I am very sure that Dr. Miller and I both agree that much of the success during the past year in our department has been due to the loyal co-operation and faithful work of Dr. W. Reid Blair.

Finally I wish to acknowledge the great benefit which I have derived in these studies of comparative medicine from my association with so thoroughly scientific and advanced a practitioner of this important science as the Zoological Society is fortunate in finding in the person of Dr. Frank Miller.

BARBARY LION, SULTAN.
Gift of Nelson Robinson.

ANNUAL REPORT OF THE VETERINARIAN.

By FRANK H. MILLER, V.S.

I RESPECTFULLY beg to submit this, my second annual veterinary report, relative to the animals of your Society under my immediate care at the New York Zoological Park; their health, diseases, injuries, treatment, feeding, and general hygienic conditions.

Owing to the greatly increased number now in the Park, and the orderly system of clinical and post-mortem reports of all cases, installed early in the past year by the Pathologist, Dr. Harlow Brooks, and myself, not only has our medical work among the animals been greatly facilitated, but much greater advantages have been attained than heretofore in point of accuracy of treatment and tabulating conditions of disease, both matters of the first importance if this work is to be continued.

After the brief space of two years in your service in this particular field of science, I am fully convinced that, owing to the modification of symptoms and results of diseases well known and thoroughly classified in the domestic animals when communicated to such animals as are kept in zoological installations collected from all parts of the globe, the only manner in which a scientific and really valuable knowledge of them will be attained must come from this system of observing, comparing, and reducing to permanent records our deductions, thereby gradually but surely arriving, more or less unconsciously perhaps, at a special system of pathology and therapeutics, peculiarly adapted to the animals of the wild state.

Notwithstanding the fact that the current year has been severely marked by the presence among the animals of not less than seven well-known contagious diseases, I am happy to report that our past experience and investigations into the internal Park conditions, and the manner of keeping certain species of animals, has resulted in great good and diminished loss, and as time allows further improvements to be made, to meet the demands plainly suggested by the success already achieved, it is not too much to

hope that the general status of animal health will be very materially added to both as regards contagious and non-contagious conditions.

Owing mainly to our incompleted system of observing and recording disease, we found it necessary to confine our first annual report more particularly to those conditions of a sporadic and non-contagious nature, as accidents and illness inseparable from ordinary life, enhanced by the nature of the animals and their changed surroundings. The present report, by reason of the number and importance of the contagious and infective diseases, will give those diseases entire precedence in this report; other conditions being treated in a purely cursory manner.

In treating of these various contagions it would be manifestly improper to assume or even directly infer that their numbers are unaccountably high, considering that the Park at the present time is in the evolutionary stage, practically doubling its exhibits year by year without more elaborate and costly safeguards against their introduction in purchased animals, the majority of which possess great susceptibility to, and low recuperative powers from, such diseases, animals which almost invariably come from dealers' collections, through channels both of which are known to be, in the great majority of cases, very constantly infected with animal diseases of this nature.

It is a fact worth bearing well in mind that even the introduction of an infected ferret may under unfavorable conditions be at any time the direct cause of the greatest mortality among lions. I must urgently suggest that even more thought be given to the matter, first of accepting or purchasing animals of all kinds without due consideration not only of their present health, but the open prevalence of disease in the surroundings as well, and that, if possible, more systematic arrangements be made for the isolation of new arrivals, which isolation should, in my opinion, be for fifteen days, and made most complete and without any exception whatsoever for all carnivora coming into the Park. My specific reasons for these suggestions will become obvious as we treat of the conditions which have prevailed during the past year.

In reporting the important diseases of contagious nature I would be allowed to proceed in the order of their clinical importance, which in this field of study I find to be best estimated, first, by the ease with which the animals may by it become infected, secondly, the rapidity of its dissemination and average death rate, and finally the number of species of animals subject

to its ravages, and from such considerations do not hesitate to group them: First, distemper; second, tuberculosis; third, actinomycosis; fourth, verminous pneumonia; fifth, Rainey's corpuscles; sixth, hairlings; seventh, filaria sanguinus.

DISTEMPER.

The outbreak of distemper, from which our post-mortem records show a total of ten deaths, was beyond reasonable doubt traced to the illness of a small coyote, which was noticed to be suffering from that disease within a few days from its admission to the Park, and while itself recovering from the comparatively mild course of the malady was the agent of its dissemination, either mediately or immediately, in most malignant form to others of the carnivora, where its ravages were only brought to an end by the most rigid isolation, disinfection, etc. Of the animals infected, fully ninety per cent. were lost.

In accounting distemper the disease of first importance, we must take fully into consideration the fact that it has not been possible up to the present for any one to write its correct etiology. Hence the difficulty in formulating a rational and successful treatment for the same, even in domestic carnivora, which easily admit of close study and treatment.

Strange as it may appear, while the mortality from this disease is found to be fully fifty per cent. higher in such of the domestic carnivora as may have suffered from a marked insufficiency or entire absence of meat in the diet, my experience both in the Park and elsewhere confirms my belief that notwithstanding all possible hygienic and medical attention the wild carnivora, or such of them as are subject to this disease while in captivity, will continue to suffer appalling mortality regardless of their meat diet, since this disease even in the domestic dog, like typhus fever of man, destroys life greatly by reason of the rapid parenchymatous degeneration of all the secretory and excretory organs, and it belongs to the things most infrequent in this work to recognize organs of animals possessing the characteristics of healthy structure, all being alike more or less advanced in degeneration, regardless of what may have led up to the immediate cause of death.

Parenchymatous degeneration of various kinds in the organs of wild animals may, and undoubtedly does at times, exist for years without giving any appreciable symptoms, but will continue to increase mortality from all general and specific disease

like distemper, and being at least an enfeebling element, always to be reckoned with along with the very plain fact that this disease is universally prevalent throughout the world, and is seldom absent for any great length of time from the channels of animal transportation and exchange, and endangers the life of primates as well as carnivora.

TUBERCULOSIS.

Tuberculosis, the disease of second importance of the past year, has been mainly, but not exclusively, confined to the inmates of the Primates' House.

Despite the comparative absence of open evidences of tuberculosis among the monkeys during the preceding year, the earlier part of the past summer was marked by numerous deaths occurring in rapid succession among those animals.

Since every reasonable precaution as regards housing, feeding, disinfection of their quarters, etc., had been systematically followed out, I am inclined to the opinion that the rather endemic condition at this time was not entirely disassociated from the general weakening of these animals consequent upon closer confinement incidental to wintering outside their natural habitat.

Incidental to routine practice among these animals there has been made and recorded at the suggestion of the Pathologist, Dr. Harlow Brooks, and myself, by Dr. W. R. Blair, numerous investigations along with microscopical examinations of secretions from the mouth and throat of healthy and diseased individuals which prove extremely interesting.

While there is little to be feared from tuberculosis of the monkey outside his immediate family, the extremely insidious nature of the disease and difficulty in controlling it in him would, I am certain, warrant me in suggesting to you the desirability of setting apart a suitable appropriation to be expended under the direction of the pathologist in order that a systematic study of this disease in monkeys may be made at his discretion, either in or outside the Park during the next year or two. That case after case of acute pulmonary tuberculosis can, and as a matter of fact frequently does exist among these animals without the individual showing any visible illness, want of appetite, or even cough, or noticeable loss of flesh up to within one week or less of its death, being at all times extremely dangerous to others (as their bronchial secretions have fully shown microscopically) should form a very potent argument for moving vigorously along

this line, especially in a biological sense; that if possible we may be helped in the matter of both treatment and prevention, I am especially moved to suggest this matter in view of important work already being accomplished elsewhere along similar lines in bovine tuberculosis, and to this end with special pleasure I pledge in advance my most hearty co-operation where possible, from the clinical side of the situation.

ACTINOMYCOSIS.

Third in order of importance and of much clinical interest is actinomycosis (so-called "lumpy jaw" of the domestic ruminant), which prevailed in the prong-horned antelope herd.

Our post-mortem reports show four deaths among the antelope and one among deer from this strange disease, due to the invasion of the animal tissues by the ray fungus of Bostrom.

The infection of the herd, which was perhaps as fine and thrifty as any in captivity, was with good reason thought to have occurred through the importation of one new specimen from western Montana, with the result that its spread was very rapid, although the usual methods of isolation and costly and repeated disinfections of the entire buildings and paddocks were made.

While the pathologist's report of findings upon the first case left no possible doubt as to the nature of the disorder, the entire clinical aspect of this disease as manifest in these animals was of the utmost interest as substantiating what I have already been pleased to allude to as dissimilarity of symptoms and course of known disease in domestic and wild animals in captivity respectively.

Actinomycosis, while it has been known to become more or less endemic among the cattle of larger or smaller areas, and even epidemic in rare cases both in Europe and America, is essentially a sporadic disease, which may be best described as a specific proliferating periostitis and rarifying ostitis, exceedingly slow in development, and with few exceptions entirely local in its manifestations, usually allowing of the animal being fitted for slaughter.

In domestic hoof stock the predilection point of infection is slight abrasions of the mucous membrane of the tongue or jaws contiguous to the molar teeth.

As studied in this outbreak among the antelope its course was very intense, the majority of the cases ending fatally within ten days from the first visible symptoms of illness, and unlike the

ray fungus disease in cattle, nearly twenty-five per cent. of the animals showed no characteristic enlargement of the bones of the head or jaw at any stage of the malady, the lesions being of a purely internal nature.

The symptoms most frequently reported, and for which isolation was enforced, were usually first an uneasy movement of the jaws, with disinclination (evidently due to disability) to partake of food in the normal manner, especially grains; second, voluntary isolation from the herd; third, weakness.

Upon closer examination about three-fourths of these cases revealed either enlargement already present, or at least soreness of the bones about the head, soon to be followed by the characteristic enlargement and suppuration of the jaws and facial region. Some of them presented the symptoms of a very tenacious discharge from the bowels containing much pure mucus, indicative of early digestive disturbances.

Treatment by the local and general use of iodine and the iodides, so singularly useful in the treatment of this disease in both cattle and man, while it did certainly appear to prolong life, failed to bring about any cures.

Both from the clinical and pathological point of view this disease as here manifest in this certain species of mammal conforms quite closely in its aspects to the disease as attacking mankind, especially since there is abundant evidence to indicate that primary invasion was through parts other than the mouth, and of metastatic nature, both of which are certainly quite exceptional as we know the disease in cattle, both at range and in the abattoir.

Since actinomycosis is seldom contracted by animals living entirely upon succulent vegetation we found it difficult during this outbreak to meet the requirements of the case by grazing the animals, as ample experience had proven that the prong-horn enjoys good health in this vicinity only so long as kept in stone-bottomed paddocks and receiving perfectly dry food; hence of the two alternatives of either jeopardizing the entire herd by turning them upon grass ranges, or by segregating as far as possible the infected animals upon dry rations, we chose the latter, using at intervals crude carbolic acid in dilution to drench the paddocks and sterilize their lodge, and since no new cases have appeared during the past four months I trust we may soon consider the danger of this somewhat remarkable scourge at an end.

VERMINOUS BRONCHITIS AND PNEUMONIA.

The number of cases of parasitic bronchitis and broncho-pneumonia among the range animals, especially the elk, and to a lesser degree the buffalo also, impels me to raise the consideration of this question of contagion from the eighth place named in my previous report to the importance of fourth place in the present.

Not only does this disease claim our special attention at this time by reason of the deaths it has already been directly responsible for, but particularly in consequence of its insidious but general undermining of health conditions in all animals involved, and unless early and more effectual steps be taken to reduce, and if at all possible to eradicate it from the Park while still new, the result will be most disastrous in the very near future. The laws which govern the propagation and dissemination of the stronguylus micrurus and stronguylus filaria (both of which are present here) are well understood in agriculture, where its ravages, notably in young stock, are not uncommon, especially along bottom lands of poor drainage with surface pools and sag spots.

My experience of the past two years in the care of the animals, along with that previously gained in handling outbreaks of this disease in agricultural stock, leads me to point out that very many of these conditions prevail naturally in certain of the paddocks in the Park, and others have been artificially produced in the course of park ornamentation.

Medical treatment of this disease in the domestic ruminants avails but little, but the proper and adequate drainage of the pastures invariably brings such outbreaks to an end, hence I trust this great improvement in the interest of animal life and well-being may be consummated at the earliest date.

CORPUSCLES OF RAINEY.

The fifth condition coming rightly under the head of contagions, is also of great clinical interest, not only to students of comparative medicine, but more particularly to those who would make a study of wild animals in captivity. While Rainey's corpuscles of the primitive bundle of the voluntary and involuntary muscles of the domesticated herbivora, and to a lesser extent the omnivora, are of extremely common occurrence, their limited numbers and location, for the most part in non-vital parts with total absence of symptoms of their presence, has long since re-

duced this condition in them to a biological rather than a pathological one requiring extended study and treatment.

While this low organism has been known to invade the cardiac musculature of the domestic animals, this tendency is so very slight as to pass almost unnoticed, the number of cases, however, which have occurred in your elk and caribou, where this condition had apparently located itself almost exclusively in the cardiac muscles, tending to cause extensive destruction of their substance, and even at times complete obliteration of well-marked areas of the same, unmistakably determined the death of the animal in several cases.

Since the consensus of opinion relegates this parasite to the order of the sarcosporidæ, and the same class of animals suffer as are infected with lung worms, I am free to maintain that what I have already suggested regarding the improved sanitation of the ranges will equally apply to this interesting subject which, of all diseases we have been called upon to treat in the animals, proves most conclusively the frequent tendencies of disease well known and of little moment in domestic animals to be the means of great loss when attacking wild animals in collections.

I would commend a careful perusal of your pathologist's instructive report relative to this peculiar and somewhat unique disease.

TRICHODECTES CERVUS (HAIRLING).

Owing to the general unthriftiness of the Virginia deer, accompanied by irritation, one of them was secured for examination, when they were discovered to be infected in the skin to the greatest degree with the peculiar gray-brown pediculus-like parasites known as hairling.

That some adequate idea of their numbers may be gained, I need only quote from the daily medical report of May 16th, which reads, "examination was made and the organisms were found distributed mainly over the back, neck, and flanks in numbers so great that a dime piece would cover ten parasites in almost any place on those areas."

Recourse was had to the application of a parasiticide in the form of creoline and linseed oil, with the result that examination made upon the fourth day showed no living hairlings present.

While there are many species of hairlings widely distributed among the different domestic animals throughout the world, their careful clinical differentiation from hæmatopinus (louse) is sel-

TRICHODECTES CERVUS: HAIRLING.

dom made, since similar remedies are amply adequate when thoroughly applied to destroy both alike.

The particular significance of this outbreak lies in the fact that these mites may at any time become epidemic, at least in the deer family, while at range, whereas the pediculus or louse is seldom or never known to become troublesome outside winter quarters, where treatment may be easily and successfully carried out.

The hairling kills from general irritation rather than by reason of living upon the blood and lymph of the host, as in the case of the louse, being, as may easily be discerned from the accompanying micro-photograph, essentially constructed to fare directly upon the epidermal cells and hair structure; hence the name hairling.

BLOOD FILARIA OF SEA-LION.

A visitation of this strange infection of the blood of aquatic mammals made its appearance in the early spring, and destroyed one after another the inmates of our sea-lion pool.

Like similar conditions not infrequently observed in man, and by no means rare in the domesticated dog, especially in eastern countries, the symptoms were so sudden as to give little time for study. While hemal vermin of this order, especially in the dog, is usually marked by such inconstancy of typical symptoms as to be rarely diagnosed with certainty, pneumonia appeared in all these cases.

The animals, which were in prime condition, were suddenly noticed to refuse food and exercise, and died in collapse within comparatively few hours after their first symptoms of illness.

Autopsy revealed broncho-pneumonia, sometimes lobar, at others lobular in nature, all other organs being in very healthy state, the liver only excepted, which showed traces of fattiness incidental to captive life.

The right side of the heart contained numerous filaria, as did also the pulmonary arteries.

The rapid succession of deaths in these animals, the quantity and repeated changing of the water in their pool, along with the infrequency of anything resembling a real epidemic, even in kennels of dogs in this country where the worm is seen, and such endo-parasites having been discovered in dolphins and porpoise as well as seal taken in the open sea, all warrant me in presupposing their infection to have been accomplished by taking the antecedent through the ingestion of raw herring and certain other fish which are well known to be the carriers of such crysts; whether this infection took place within the Park or at a period prior to the purchase of these animals it would be impossible at this time to state.

Treatment in such cases is from many reasons impossible, and can only be along preventive lines, as frequent renewal of water, better knowledge of their diet, sterilizing of pools at suitable intervals, etc. The latter was most thoroughly performed with crude carbolic acid previous to the renewal of the animals.

This somewhat extensive report upon the above states of contagion which have actually been prevalent cannot fail to engage the attention of those vitally interested on the study of animals, both in the wild and captive state, especially as I have some rea-

sons to suspect that at least actinomycosis exists to some extent among the wild antelope of the Western States, and may be an element in the rapid disappearance of this beautiful fauna.

Without going into the many interesting details connected with another year's work of this department in the treatment, both medical and surgical, of the multitude of non-contagious conditions which are constantly coming up wherever men or animals are grouped together in large numbers, all of which we have labored assiduously to relieve in the most rational and humane manner known to us in the light of present experience, I am pleased to report that good results have been gained and many lives been saved which otherwise would have been lost.

A generous amount of time has been devoted to the systematic disinfection of animal quarters at stated intervals, and in the inquiring into the state of food and shelter conditions. Gastro-enteritis among the Western ungulates, which has been under investigation since the opening of the Park, continues to receive our attention, and while its presence is still felt its ravages have upon the whole been less severe than heretofore, and from experimental conditions, due record of which is on file, I feel myself in position to say with much confidence that the past and present difficulty, at least among the caribou and buffalo, has been due much less to the climate than to the ingestion of improper grasses; the probability of contagion may be entirely excluded.

The fact that pastures or ranges upon poorly drained soil highly fertilized with horse manure, being at all times not only exceedingly distasteful but very injurious to ruminants compelled to take their food from them, along with what has become matters of record regarding internal parasites and their spread among the animals, should be the subject of a special joint investigation of the most rigid kind by the Executive Committee and the Engineering Department, in order that immediate and effective steps may be taken to give the animals some real and lasting protection from these diseases.

These problems will be found difficult of solution, and should, I think, call for the attention of experts, and unless such range as that of the buffalo can be put into more perfect order I would strongly advise it to be abandoned, so far as those animals are concerned, for a more suitable one.

While much can be gained by the right system of drainage and water supply, I respectfully suggest the advisability of inquiring into methods of reducing the superabundance of fertility of the soil and simplifying the nature of vegetation in at least

some of the paddocks by such treatment and tilling as may seem upon investigation most expedient. Not only should it be possible to secure a more desirable grazing texture throughout the Park, but the deep tilling and working will materially facilitate the drainage of this peculiarly impervious soil after the necessary conduits are in place.

Since, up to the present time, it has been found impossible to successfully keep mule deer on the ranges, I am glad to be able to state that resort has been had to stone-bottom paddocks and dry feeding for the two recently arrived mule deer. In view of the eminently successful results from a similar experiment with the caribou, we have every reason to hope for success in the case.

The number of deaths from pneumonia each winter among the peccaries and Southern otter in exposed enclosures warrants me in suggesting the advisability of providing these animals with indoor quarters during the cold months in future; the same might apply to the Virginia deer, at least during the months of December, January, and February.

The time has happily arrived when births among the animals are becoming more and more frequent, and, since the successful rearing of animals is the best possible index of success in animal collections, I would suggest that all dates of matings become a part of the daily medical reports of this department for scientific purposes, and more especially that a system of quiet, comfortable, and sanitary isolation be provided for such animals as are about to give birth; this to apply more particularly to the larger carnivora.

In closing this report I wish to express my appreciation of the hearty co-operation and support received from the executive officers of the Society, the Park officials, also of my fellow-workers, Dr. Harlow Brooks, and our asistant, Dr. W. R. Blair, whose well-directed efforts have been of great value to us in all matters pertaining to the work.

Respectfully submitted,

FRANK H. MILLER,

Veterinarian N. Y. Zoological Park.

BENGAL TIGER: RAJAH.
Gift of Charles T. Barney

MODES OF TUBERCULAR INFECTION IN WILD ANIMALS IN CAPTIVITY.

By W. REID BLAIR, D.V.S.

IN the absence of the more positive information which one acquires from a long series of experiments designed for the purpose of ascertaining the priority and manner of invasion of tuberculosis, much of this information regarding the progress of the lesions has been gathered from post-mortem examinations of natural cases. This is particularly the case in animals whose price has prevented them from figuring largely in experimental pathology.

As the existence of tuberculosis is determined by the presence of tubercle bacillus which produces the disease, consequently it is only since the characters of this were made known that we have been able to make an absolute diagnosis in suspected cases.

The identity of tuberculosis in human beings and that of certain animals, and the possibility of one infecting the other, renders this disease of the greatest importance.

The great difficulty in determining when the animal first becomes tuberculous makes it practically impossible to prevent the possibility of infection to its companions. Particularly is this danger greater among primates, where it is necessary to confine from 6 to 10, or even more, in one cage.

ANIMALS AFFECTED.

While it is quite safe to say that hardly any animal possesses absolute immunity from tuberculosis, certain species and individuals are undoubtedly less susceptible than others.

My investigations from necessity have been confined to the animals in the primate collection, owing to the fact that with one or two exceptions the animals in the Park outside the pri-

mates have been free from this disease. The experimental work along this line is not complete, but the facts already gathered are of importance.

The examinations were conducted as follows: As soon after death as possible the animal was opened, the trachea from larynx to bifurcation was ligatured at each end and removed. Smears and scrapings were then taken under sterile conditions from mucous membrane, 5 to 6 slides used in each instance. A like number of specimens were taken from the nostrils under the same conditions at the same time. Smears were taken from the living animal by the means of small cotton swabs applied to the mucous membrane of the throat or nostrils.

Smears taken from the nostrils of suspected cases and those that showed no clinical signs whatever, were interesting in demonstrating that at one time the bacilli were present in great numbers, while at other times (intervals of one or two weeks) we find them few in number or wholly absent in the same animal, hence it would seem that too great reliance cannot be placed on the occurrence of bacilli in the nostrils as indicating a diseased animal, for in several instances bacilli were found in the secretions from the nostrils when on careful autopsy no evidences of tuberculosis were found. The bacilli were found to be fairly constant in advanced cases of pulmonary lesions where breaking down of tissue was a distinct feature. Coughing is rarely present among these animals, even in the most advanced cases, but sneezing is quite frequent even in health, and this, it seems to me, is the most prolific source of dissemination of the contagium. Since the bacilli when dried may be carried by currents of air it is not necessary that healthy animals should come in direct contact with the tuberculous cases to become infected.

Without the *Bacillus tuberculosis* the disease cannot be contracted even by the most weakly animal, but it is equally true that with its presence in a building or in the body of a companion the strongest is not absolutely free from the danger of contagion. Notwithstanding the frequency of extensive pulmonary lesion, the trachea, larynx, and pharynx are seldom affected with tuberculosis in these animals. I found lesions in the larynx in only one instance, but in three cases discovered an occasional bacillus within the epithelial cells lining this organ. Some appeared to be in process of degeneration. The bacilli were never in sufficient numbers to give rise to any distinct lesions. Two of these cases had no lesions of tuberculosis present in any part of the body on examination. This fact would

seem to indicate that the lining cells of trachea and larynx possess considerable phagocytic power.

PRIMARY INFECTION BY INHALATION.

In a large percentage of the cases examined the lungs with their lymph glands (especially the nodes situated at bifurcation of tracheæ) showed calcareous deposits, while other lymphatic nodes were edematous or in process of caseation. I am led to believe that primary infection takes place in the great majority of cases by way of the respiratory tract. It seems to me probable that tubercle bacilli enter the lungs and pass to communicating glands without giving rise to preliminary lesions of the organ with which they first come in contact.

Of the smears taken from different parts of the larynx and trachea where pulmonary tuberculosis existed in over 90 per cent. of the cases tubercle bacilli were found in all parts of the tube.

In a small number of cases tubercle bacilli could not be found in trachea, though the lungs showed far advanced tuberculosis, the tubercles showing calcareous degeneration. In one instance (that of a small macaque monkey) one lung was totally functionless, appearing as a large calcareous mass attached firmly to the costal pleura; the other being only moderately affected; yet the animal was apparently well nourished, as evidenced by the amount of flesh and fat present. In this case I was unable to demonstrate the bacillus in the trachea.

An interesting case was that of a spotted lemur which was slightly injured, necessitating its isolation temporarily in the hospital room. This animal presented a fairly healthy appearance (excepting for the injury) with no clinical symptoms whatever which led me to have the slightest suspicion that the animal was tuberculous. Six smears were taken from throat and nostrils, all of which showed tubercle bacilli in abundance, those of the throat being particularly numerous. This animal was never again put on exhibition, and I did not have to wait long to confirm my diagnosis, as the animal died within a few days. The autopsy showed far-advanced pulmonary, pleural, and pericardial tuberculosis. No lesions were present in other organs.

INFECTION BY INGESTION.

While one must take into consideration the possibility of primary invasion taking place by the intestinal canal through the bacilli taken in with food or contaminated drinking water, this,

in my opinion, is not the common source of infection, but that intestines and abdominal organs are usually infected secondarily through the breaking down of tubercular deposits in lungs finding their way into bronchial tubes, finally reaching the throat, the animal swallowing secretion containing the bacilli in great numbers, some of which would doubtless escape the action of the gastric juices, pass on to the intestines, and if in sufficient number produce tubercular enteritis, or they might pass to mesenteric glands without producing any lesions whatever in the intestines.

Experimental evidence apparently shows that a relatively large number of bacilli are necessary to experimentally infect healthy animals by ingestion. Probably if the mucous membrane be not intact a smaller number of the bacilli would suffice.

The rarity or total absence of tubercular lesions in the stomach would indicate that the gastric juices possess power to prevent the growth of the bacilli.

Specimen smears were taken from œsophagus at the middle and lower third. Although I have made numerous smears I have in only a few instances found the bacilli to be in great numbers, and in a large percentage of cases none were present.

The method used in staining was that of Gabbets. After spreading the material in the finest possible film upon the glass slide a fluid composed of 100 grammes of a 5 per cent. aqueous solution of carbolic acid, and 10 grammes of absolute alcohol in which 1 gramme of carbo-fuchsin had been dissolved; a few drops of this solution was poured over the film side of slide and heated for two minutes, or until steam arose from the stain. It was then placed for about one minute in a mixture of 100 grammes of a 25 per cent. solution of sulphuric acid in which 2 grammes of methylene blue had been dissolved. It was next rinsed in alcohol and mounted in Canada balsam, microscopic examination with 1-12 oil emersion lens used.

By this convenient method the bacilli appear red or pink, and the surrounding tissue blue or greenish in color.

The fact that we are not at the present time seriously affected with tuberculosis is no reason why we should not take every possible precaution to prevent and to repress its further advance.

CYSTICERCI IN WILD RUMINANTS.

By W. REID BLAIR, D.V.S.

WHILE the tapeworm in its adult state has been rarely met with among our wild ruminants, its embryo or cystic stage has been of frequent occurrence, causing death in at least two instances.

No parasite with which we deal has a more interesting life history than the tapeworm, occupying as it does the attention of the practitioner of human medicine as well as the veterinarian.

A remarkable fact in connection with the life history of the tapeworm is that the eggs will not develop into mature worms in the body of an animal belonging to the species of the one in which they were produced. It is necessary that they should first enter the body of an animal of a different species and there develop into embryos, and there they remain in a somewhat advanced state of development until their host dies and is consumed by an animal belonging to the species of the original host. They must have a host or bearer and intermediate bearer. In a great majority of cases man and dogs act as hosts, while cattle, pigs, sheep, and deer act as the intermediate bearers.

The anterior part of the tapeworm is narrow, and presents a terminal swelling by which it attaches itself to the mucous membrane of the intestines by means of the suckers and numerous hooklets which nearly all tapeworms possess. This anterior swollen part is distinguished as the scolex, popularly called the head of the tapeworm, but it is mainly its external form which entitles it to this name, as there is no alimentary system. The parasite floating in the digested food of its host absorbs soluble material by its general surface. There is neither vascular nor respiratory system, and the body cavity is represented merely by irregular spaces. All tapeworms are hermaphrodite, and most—if not all—are probably self-fertilizing.

Following the scolex are the segments or proglottides, of which the tapeworm is made up and budded off from the head end, and

which contain both male and female generative organs. As these segments or proglottides are pushed by younger interpolated buds further and further from the scolex they become sexually mature, developing complex hermaphrodite reproductive organs. The ova produced in these are fertilized apparently by spermatozoa from the same proglottide. As each segment becomes perfect it produces a vast number of eggs, and finally drops away from the main colony. The ova, or eggs, contained within each segment may be expelled within the host or may not be released until the segment is outside the body.

The proglottides, after separation from the main colony, continue to live for some time independently, and may increase in size considerably if they remain in the body of their host. After it is cast off and reaches the exterior it retains its vital power for a short time, and has been known in some instances to crawl a considerable distance, leaving in its wake a yellowish trail composed of eggs escaping from a rupture in the body wall. The proglottis soon dies, however, and decomposes, the eggs are scattered, but they soon lose their vitality in a dry atmosphere.

The eggs are round or oval in shape, and very small, consisting of a minute ovum embedded in yolk cells, and surrounded by a thin membrane. Unless these eggs are taken into the body of herbivora by drinking contaminated water, or by eating grass or herbage with the eggs deposited on it, they quickly perish.

If a segment is eaten it is digested, and the ova or eggs are liberated, but if the eggs only are eaten the egg membranes are digested by the gastric juices, and the embryo is set free.

Each embryo is provided with six hooklets, and as soon as set free begins to bore its way into the gastric or intestinal vessels by means of its hooks.

MIGRATION OF THE EMBRYO

is said by some to be voluntary, by others to be involuntary; but when they are once within the vascular channels they are carried along passively, doubtless, until reaching a position where the embryo finds in certain parts of the organism the conditions necessary for its development and growth.

The vesicle gradually becomes a cystic worm by the formation of a hollow ingrowth, which is developed from the walls and projects into the interior of the vesicle. The suckers and circlet of hooklets are formed on the inside and at the bottom

of this invagination of the wall of the vesicle. When these hollow ingrowths are evaginated so as to form external appendages of the vesicle they present the form and armature of the cestode head, as well as a more or less developed neck, which presents a number of annulated rings, the first traces of future segmentation.

The whole embryo now presents the form of a bladder or vesicle, with which it is connected at one point, a process having all the characters of the head and neck of the mature tapeworm, the head and neck constituting the scolex, while the cyst in which the bladder worm lies is known as an hydatid cyst.

So long as the scolex remains attached and in the body of its host, it never develops into a sexually mature tapeworm, but must enter the alimentary canal of another animal of a different species.

All hydatids get their nourishment by inhibition, absorbing it from the surrounding tissues; accidental destruction of vesicle destroys its integrity and the hydatid dies. The shepherds in Europe take advantage of this fact in treating sheep affected with hydatid disease, or sturdy gid, as it is familiarly called, by manipulating the head between and behind the ears, where they usually find a softening of the bones of the cranium. This softening is due to absorption of the bone from pressure of the growing hydatid; but, of course, this sign can only be observed when the hydatid is superficially situated. After location of the hydatid the cyst is punctured, allowing the fluid to escape, and the skin over the opening covered by means of a piece of sticking-plaster.

DIFFERENTIATION OF HYDATIDS.

As most hydatids to the naked eye appear very much the same, it is only by careful microscopic examination that the differences are noted and a safe conclusion drawn. As, for instance, the distinguishing features of the *Cysticercus bovis*, or beef hydatid, are: (1) its habitat, (2) large size of scolex, (3) the considerable pigmentary matter around its suckers, and (4) the absence of hooklets on head. For this latter peculiarity it has been named the unarmed hydatid and tapeworm.

The cysts of *Cysticercus cellulosa* are elliptical, or flask-shaped. These are principally found in the muscular tissue of their host, the scolex being seen as a pearly white spot through the wall of its cyst. The cysts vary in size from a pea to that of a small

bean. The head is globular in form, the size of a pin's head, and has a projecting proboscis or rostellum, around which are arranged a double row of hooklets, 24 to 30 in number. These hooks are composed largely of inorganic matter, and are almost indestructible, resisting degenerative processes, and may be found long after the organic parts have disappeared. This hydatid is principally found in muscles of swine. Its presence

ANTELOPE'S HEART, SHOWING *CYSTICERCI CELLULOSA.*

CYSTICERCUS FROM SPANISH IBEX. NATURAL SIZE.

here during life can occasionally be detected by a string of hydatids on either side of the tongue or floor of the mouth. In pork these hydatids give the muscles a pale, moist, and flabby feeling, and this condition is spoken of by meat inspectors as measly pork. This flesh does not cure very well, and is not fit for human food.

In certain countries, *taenia,* with rare exceptions, infects all the inhabitants, among whom raw cow's flesh is looked upon as the greatest delicacy. In this instance, both men and cattle furnish the conditions favorable to propagation.

Thorough cooking kills the cysticercus, rendering it harmless. It has been demonstrated by several experimenters that a temperature of from 55°–65° C. (131° Fr.–149° Fr.) is sufficient to kill the parasite. In some of the German abattoirs, where the carcasses of animals affected with cysticerci are considered fit for food, the meat is cut into suitable pieces and thoroughly sterilized (in large ovens built for this purpose) before being exposed for sale.

In this country, where the custom is to cook the meat more or less thoroughly before eating it, the chances of an individual becoming infected with taenia are not so great. With the exception of the heart, *Cysticercus cellulosa* are seldom found in internal organs, while fat tissue is nearly always free from them.

CYSTICERCUS TENNICOLLIS.

This hydatid is found in all domestic and wild ruminants, but is probably most commonly met with in sheep and deer. The progenitor of this hydatid, *Taenia marginata,* inhabits the intestines of the dog, fox, and wolf.

This hydatid is sometimes confounded with the *Cysticercus cellulosa,* but it has a number of characteristic features which differ very materially from those of the latter, for which it should not be mistaken.

The size of the cyst depends upon its age and situation. If situated upon serous membranes (which is usually the position of this hydatid), lining closed cavities where little or no pressure is exerted upon them, they may reach the size of a hen's egg, or even larger.

In the case of the mule deer, the cysts of which show so well in the photograph, the largest cyst was about the size of a bantam's egg. In this case the cysts were contained in a sac, apparently formed from the peritoneal tissue, and having the appearance of small water bladders, and at the point of attachment there was a constricted portion produced by the weight of the fluid contained in the cyst. The outline of the scolex could be distinguished through the walls of the cyst, but not as plainly as through a cyst containing *Cysticercus cellulosa.*

In a series of experiments carried out by Leuchart, he found that cysts attained the length of .6 to 3.5 m.m. in ten days

after infection, and at the end of seven weeks they measured 15 m. m. The scolex is well developed at 45 days, possessing a double row of hooklets like the *Tænia solium*, but are more numerous, 34–38, slender, and root of the hooklets longer than those of the latter, and the blades less curved. The different habitat, larger size of cyst, number of hooklets, and the long, slender neck of the *Cysticercus tennicollis* are the best guides for distinguishing this cysticercus from the *Tænia solium*, with which it might be confounded. While the peritoneum and pleura are by far the most frequent habitats of this species of hydatid it has been found in liver, lungs, and heart muscle. They may be found attached to the surface of the liver, or to the adipose tissue of the mesentery or omentum. The number varies from several, which were found in a mule deer, to over 100 found in another mule deer. In several instances I found the hydatid shriveled up and undergoing caseous degeneration, but on microscopic examination I could distinguish numerous free hooklets.

Two cases of cysticerci are, I think, of sufficient interest to warrant a brief summary of the autopsies. In both instances two mule deer were the infected animals, arriving at the Park together, and obtained from the same source.

Autopsy on Case No. 1; Mule Deer (Female).—Greatly emaciated, visible mucous membranes anæmic; abdominal cavity contained about 3 pints straw-colored serous fluid, without inflammatory coagula. Abdominal surface of diaphragm almost wholly covered with hydatids varying in size from a pea to a walnut, several of them being fully ¾ inch in diameter. The scolex seen through the walls and fluid of the cyst as a pearly-white spot. The size of the scolex varied according to the size of the cyst. The hydatids were more numerous upon the tendinous portion, but there were eight upon the fleshy part; on the thoracic surface of the diaphragm there were six of the largest cysts; the smallest about the size of a hazel-nut. Upon the pericardium—that portion covering the apex—were three large cysts, none appearing in the muscle of the heart excepting two small ones on the surface of the right *appendix auriculæ* along its outer serrated border. On the gastro-splenic and gastro-hepatic omentum were numbers of scattered cysts, but the greatest collection was the group upon the gastro-colic omentum, where great masses of these cysts were found hanging in clusters, reminding one of grapes. The accompanying picture shows a small portion of this omentum.

On the mesentery, throughout, were a number of cysticerci scattered, but none of them being in clusters.

Perhaps the most remarkable condition was that found in the pelvic cavity and along the course of the uterus and fallopian tubes, in the folds of the broad ligaments and the ovaries themselves. These show particularly well in the photograph.

The fascia covering the dorso-lumbar region presented great numbers of these cysticerci of different sizes. In the left psoas muscles were 4 to 5 small cysticerci, three of them without caudal vesicle, and scolex of a cheesy consistency. The vesicle having burst and been absorbed, causing degeneration of the remaining parts, I tried to ascertain if the head, with its hooklets and suckers, was still intact; but pressure between the glass destroyed it, and found hooklets scattered. The ovaries were about their normal size, but the shape was somewhat altered, firm to the feeling and having the appearance of a tubercular mass. The right and left ovaries were practically identical in size, shape, and consistency. Something like 20 to 25 could be counted on the surface, all of them small; some not much larger than the head of a pin, existing as shiny white spots. On making an incision through the ovary, the following condition was noted: that the medullary portion of the ovary was wholly free from cysticerci, while in the cortical portion the cysticerci were very numerous, those nearer the surface of the organ being larger.

Notwithstanding the close proximity of the cysts in this organ, each cysticercus was separate and distinct from its neighbor. The hydatids along the course of the fallopian tubes were especially numerous and large, existing as a continuous chain, with a group of large ones attached to the folds of the broad ligament between the ovary and fallopian tubes, which cover the *parovarium*, and extending from the ligament by a slender neck. I was under the impression at first, on finding the cysts in the ovary, that they were of a different species of embryo than those found elsewhere; but a careful microscopical examination, made immediately after the photographs were taken, showed them to be the same as the others: *Cysticercus tennicollis*, the progenitor of the *Taenia marginata*.

The Autopsy of the Second Mule Deer.—The cysticerci were found in greater numbers, of larger size and more widely distributed, hardly any organ being free of them. I found them on lungs, costal pleura, diaphragm, liver, mesentery, peritoneum, and serous covering of intestines. Upon the gastro-colic omentum I counted over 50 cysts.

The abdominal cavity contained a considerable quantity of thin, yellowish fluid, in which were found several detached cysticerci without caudal vesicle.

The examinations were made by putting the cyst upon a slide and puncturing it. The hydatid is usually invaginated, but by putting it between two slides and exerting slight pressure, the head will be protruded, the suckers and hooklets plainly seen, and can be counted without staining the specimen. By the addition of a little balsam you have a permanent mount. By immersing a specimen in 8 per cent. solution of caustic potash, and then through a clearing fluid, as oil bergamot, the hooklets are better shown.

COMMON FROG SWALLOWING A CHICKEN (DEAD).

OBSERVATIONS ON THE DEVELOPMENT OF REPTILES.

WITH NOTES ON FEEDING REPTILES IN CAPTIVITY.

By RAYMOND L. DITMARS.
CURATOR OF REPTILES.

AT the close of the past year the Reptile House contained seven hundred and seventy-two specimens, representing one hundred and fourteen species. The care of over seven hundred capricious creatures demands a constant play of ingenuity, or unsatisfactory results would inevitably follow. Appetites of the most capricious character must be tempted, while ailments far different from those which inconvenience the warm-blooded animals are continually encountered. Generally speaking, a large collection of reptiles requires unusual care, and during the course of events the curator has the opportunity to observe many incidents of much interest. For the purpose of recording some of his observations, and also illustrating how reptiles are cared for, the following notes have been prepared.

Of primary importance in the care of reptiles, is the feeding. The various species of snakes require their food at intervals that depend upon their activity. The large constricting snakes, such as the pythons, boas, and anacondas, are very sluggish, and

for days at a time lie coiled in practically the same position. These snakes are fed at intervals of about three weeks apart. The majority of the snakes are fed regularly every week. There are certain species, however, which exhibit such activity that they require food every three or four days. The lizards, the majority of which are continually frisking about during the day, are fed at frequent intervals, the smaller species daily, the monitors and their allies twice a week.

As an example of the variety and quantity of food consumed by the reptiles in a year's time, the following list enumerates what was used in the Reptile House during the past year:

1,775 Rats,	272 Rabbits.
About an equal number of mice.	312 Guinea Pigs.
1,456 English Sparrows.	About 18,000 Mealworms.
624 Small Chickens.	" 25,500 Live Fish.
208 Large Chickens.	" 2,000 Toads.
210 Pigeons.	" 2,000 Frogs.
1,300 Eggs.	" 2,500 lbs. of Vegetables and Fruit.

Many reptiles are so voracious that to prevent disastrous results, their food must be given them sparingly. Others, on the contrary, are so abstemious in their feeding that they are persuaded to take nourishment only by the exercise of constant scheming and ingenuity. At times valuable specimens refuse to take food altogether, and would ultimately starve to death unless forcible feeding be resorted to. Among the most voracious feeders in the collection is the King Cobra. We believe that our specimen is the only example of this rare and interesting snake alive in this country.

The King Cobra is strictly cannibalistic. From the time of the arrival of this reptile at the Park, his appetite has been of the best. Large blacksnakes and similar serpents were preferred, and the cages of those species soon became almost depopulated. Orders for blacksnakes and coachwhip snakes were placed in South Carolina and Florida, but the appetite of the insatiable cobra demanded a supply of snakes far in excess of the returns from outside. Economy was necessary, or the serpent exhibits in the Reptile House would become scanty. The cobra demanded three snakes per week to keep his eleven feet of active length in good condition. To cut down his fare, however, might endanger the fine condition of the reptile. After due consideration, it was decided to try the novel experiment of making one

snake equal three, and note the result. A blacksnake was killed, and frogs were run down its throat until the reptile's distensibility was taxed to the utmost. A ligature of fine silk was then placed around its neck to keep the dozen frogs within the heroically distended snake. It was with some anxiety that this preparation was offered the King Cobra, but he quickly dispelled all apprehension by eating the stuffed blacksnake. Since that time, he has been fed one of these meals every week, with equal benefit to himself and to those whose duty it is to keep him alive and in good health.

It is interesting to note the likes and dislikes of the larger constricting snakes. While some pythons feed readily upon rabbits, others demand chickens and pigeons. Frequently there are examples, in the same cage, of several snakes of the same species, each demanding different fare. One will take pigeons, another chickens, while a third will eat nothing but rabbits. Each of these snakes may feed voraciously upon the creatures it specially desires, but so eccentric are their ideas that they would continually refused the food of their cage-mates, should the same be repeatedly offered, and would eventually starve to death unless provided with the food ascertained by experimental feeding to be to their liking.

It is among the boas and pythons that individuals with such capricious appetites most frequently cause apprehension as to their feeding, and necessitate compulsory measures.

The history of the big Reticulated Python, Czarina, now in the Reptile House nearly two years, illustrates the measures sometimes necessary in the care of reptiles. When Czarina arrived at the Park, she was incased in an old skin which should have been shed weeks previously. She was treated to a steam bath, which softened the old cuticle, from which she presently emerged, glittering and scintillating with all colors of the rainbow. A few days after this big snake's arrival, it was discovered that she was suffering from canker of the mouth, a disease all too common amongst reptiles.

As Czarina measured nearly twenty-five feet, and exhibited strength that matched her hostile disposition, the task of taking her from the cage, and washing the infected mouth at regular intervals for over two months' time, involved considerable energy on the part of the men. The infection of the lower jaw was as last completely cured, and various reptilian dainties were offered in the hope that she would eat. When she had refused food for another month, it was decided to take her from the cage,

and feed her forcibly. Accordingly, four large rabbits were killed, sewed together with twine, and run down her throat on an eight-foot bamboo pole until only a few inches of the pole protruded from her mouth. Twelve men held the snake during this process, and when the pole had been withdrawn, leaving the rabbits behind it, the big reptile was hurriedly replaced in the cage, where she immediately started to disgorge the meal. A stream of water played along her body, however, caused her to quickly assume a fighting mood, and was efficacious in causing her to swallow the rabbits.

For eleven months' time this python was fed in this manner, her food being repeatedly offered between times in the hope that she would begin feeding voluntarily. Such was finally the case, and for nearly a year she fed readily and regularly. Recently, however, Czarina has again evinced a stubborn inclination to fast, and the men of the python squad have been again called into active duty.

Novel as have been the incidents attending the saving of Czarina's life, one of the Hooded Cobras called for still more original measures. Shortly after the arrival of the three cobras, they engaged in a vicious discussion regarding their food. The largest specimen was bitten through the lower jaw, and although immune to the venom of its cage-mate, the snake developed an abscess. The jaw-bone was involved, and necrosis developed. Although a dangerous undertaking, the writer decided that the value of the snake warranted handling it for examination and treatment. The three specimens represent the only living cobras in this country, and had been procured only after long-continued efforts.

The Cobra was taken from its cage, and placed upon the floor. A light bamboo stick was placed across its head while it was grasped by the neck. Examination showed the jaw-bone to be badly diseased. This portion of the bone was removed, the lesion washed with antiseptics, and the snake placed back in its cage. The snake was taken from the cage daily for some three weeks. The lesion had been laid bare and a pad of cotton serving as a moist dressing was kept over the infected spot at all times. The necrosis of the jaw-bone continued, however, and the ultimate decision was to finally remove the entire bone. During all this time the reptile was nourished with beaten eggs, forced down its throat with a syringe.

To remove the entire jaw-bone great care was required in order not to disfigure the snake's head. A small incision was made

at the base of the head, and by means of an osteological preparation, as a guide, the junction of the various bones was accurately located, the diseased bone unhinged, liberated from the surrounding muscular tissue, and pulled back through the opening. Following the removal of the bone the infected center was cauterized with formalin, the incision closed with very fine silk sutures and the moist dressing replaced.

The operation was in every way successful and the snake continues on exhibition.

With the breeding of specimens, the Reptile Department has been very successful. The following species of snakes have been born and successfully reared in the Reptile House: Diamond-Backed Rattlesnake, Banded Rattlesnake, Texas Rattlesnake, Copperhead Snake, Water Moccasin, Blacksnake, Chicken Snake, Bull Snake, four species of Water Snakes, Garter Snake, Ribbon Snake, Dekay's Snake, Marcy's Garter Snake and Boa.

In the Reptile House are two generations of Water Moccasins that have been bred in captivity. The majority of the species mentioned are viviparous snakes, bringing forth the young alive. The eggs of the oviparous species when deposited were simply placed in damp sand, and kept at the regular temperature of the Reptile House. With few exceptions, these hatched within periods of from six to eight weeks after being laid. Several unique broods were brought forth by the viviparous snakes. One of these consisted of 62 young from a large Banded Water Snake (*Natrix fasciata sipedon*), a family so numerous that it literally overran the cage in a writhing mass of brightly colored bodies. The other brood referred to was from a common Garter Snake (*Thamnophis sirtalis*), numbering twenty-seven normal young, three albinos, and a strange offspring with two perfectly developed heads. The former were perfectly white and translucent. When held between a strong light and the eye, their internal organs could be distinctly located, and the beating of their hearts was visible. Their eyes were pink and brilliant. They fed readily, but only lived for a few weeks. The two-headed individual never fed, and lived only a few hours. The remainder of the brood attained maturity.

During the breeding of specimens in the Reptile House, several observations relating to the growth of reptiles have been made which are quite new. It has previously been the supposition that the growth of the Alligator was very slow. As an illustration of this idea, the writer quotes the following by Dr. Hugh M. Smith, of the United States Fish Commission, in Pro-

fessor Cope's "Crocodilians, Lizards, and Snakes of North America": "Alligators grow very slowly. At fifteen years of age they are only two feet long. A twelve-footer may be reasonably supposed to be seventy-five years of age."

Observations in the Reptile House have been very contrary to this theory. Keeper Snyder and the writer collected a large nest of alligator eggs in South Carolina, in August of 1900. The eggs numbered thirty-eight, and were about the size of hens' eggs, only more elongated. These eggs were shipped to the Reptile House, packed in the material composing the original nest, and five of them hatched between October 8 and 14. From shaking during shipment, the remainder of the eggs failed to hatch.

These young alligators measured, at the time of hatching, eight inches; each weighed one and three-eighths of an ounce. One year after hatching, they were again measured. Their average length was eighteen inches, and their weight nine and one-quarter ounces. This showed an increase in length, in twelve months' time, of ten inches and an increase of about seven and one-half ounces.

In August of the past year, these specimens were again measured. At that time their average length was twenty-three inches and the weight three pounds. Since that time they have grown rapidly, and the last measurement, taken March 5, 1903, showed them to average three feet, nine inches in length and to weigh fourteen pounds. These reptiles were at the time of this measurement only two and one-half years old; yet they had increased thirty-seven inches in length, and gained thirteen pounds, fourteen and three-eighth ounces in weight since hatching.

From observations made in the South Carolina bayous by the writer, it would seem that the growth of wild alligators must be fully as rapid, if not more so, than the specimens reared in captivity. The females construct their nests near shallows teeming with fish, and in an atmosphere of heat and humidity. The young reptiles probably grow more rapidly when wild than when confined. Of course hibernation must be considered in the case of the wild reptile. During this period, growth must be very slow, or ceases altogether. Yet the writer has always noted that reptiles in captivity, no matter how elaborate may be the facilities for their care, or the voracity evinced by the reptiles themselves, never grow so rapidly as those in a wild state. Repeatedly has this been observed by comparing the young of wild and captive-bred snakes, the ages of which are easily distinguished by their

color changes. There seems to be some tonic in the sunshine, the soil, and outdoor air. A snake born in August in a wild state will, before hibernating-time, grow a third larger than one born in captivity, no matter how much food may be provided the latter. With this taken into consideration, it is probable that captive raised and wild alligators grow at much the same rate per year, even though the latter hibernate for a few months of the year.

Although this rapid growth of young crocodilians is in direct opposition to the general ideas regarding them, it does not apply merely to the young of those reptiles. The large occupants of the crocodile pool have increased in length to a surprising degree since their arrival at the Park. Our largest Alligator, a ponderous specimen named Mose, and one of the largest crocodilians in captivity, has grown five inches since his arrival at the Park in July, 1899. Another fine alligator, now growing with such rapidity that it will soon rival "Mose" in dimensions, measures at the present time 10 feet, 11 inches. During its first year in the Park this reptile grew one foot, three inches, measuring at the expiration of the year, eight feet, two inches. During the second year it increased one foot, one and one-half inches, and measured nine feet, three and one-half inches. Last year this reptile grew one foot, seven and one-half inches, and now it measures within an inch of eleven feet.

During the rearing of specimens, the curator has enjoyed admirable opportunities for noting the transitions in color from the young to the mature form. An interesting example of this is the coloration of several of the young crotaline snakes. These reptiles are born with the tips of the tails, for the length of about an inch, of a brilliant sulphur yellow. When food is introduced into the cage with these young vipers, they communicate a writhing, twisting motion to their tails, causing the latter to closely resemble small worms, or maggots. Possibly nature has provided these young vipers with this dash of brilliant color to attract small birds, lizards, or frogs within their reach, as they lie coiled and difficult to discern from the surrounding vegetation. This characteristic has been observed in the Copperhead Snake *(Ancistrodon contortrix)*, the Water Moccasin *(A. piscivorus)*, and the Fer-de-Lance *(Lachesis lanceolatus)*. After the first year, the yellow of the tail becomes very indistinct, and during the second year it disappears altogether.

With some of the crotaline snakes, the colors of the young are very brilliant, although they exhibit much the same pattern

as the adult. Young moccasins show brilliant shades of red and yellow at birth. The adults show a dull pattern of varying shades of sombre olive. Very old specimens of the same species exhibit no pattern at all, the body being of a dull green.

Quite different from the crotalines are the young of some of the colubrine snakes. The young of our Blacksnake *(Bascanium constrictor)* are pale gray, with blotches of brown or red along the back. They much resemble the Milk Snake *(Ophibolus doliatus triangulus)*. During their second year, they become darker, and the pattern appears diffused. The third year shows hardly a trace of the spots as the black of the adult form appears, although the sides still indicate the marking of the young snake.

The Chicken-Snake *(Coluber quadrivittatus)* is remarkable, as are most of the species of the Genus *Coluber*, in showing, when young, an entirely different pattern from the adult, both forms being strongly colored. At the time of hatching the young chicken-snake presents a grayish appearance, decorated with a regular series of oblong blackish saddles. As the reptile approaches maturity, the body colors change to a yellow, a dark stripe appears on each side of the saddle-like markings, and one on the side of the reptile's body. These stripes become very distinct before the saddles begin to fade. The latter change takes place usually during the third or fourth year, the mature form of the species being a uniform yellow or brown, traversed by four longitudinal stripes.

Not alone do the snakes evince these color transitions among reptiles. A number of species of lizards show like characteristics. The Blue-Tailed Lizard *(Eumeces quinquelinactus)*, as its name implies, is a species possessing a brilliant blue tail. The body is blackish, ornamented with five yellow stripes. As this species matures, the tail becomes a sombre gray, the body changes from black to brown, the stripes entirely disappear, and the head changes to a bright red. This form is known as *Eumeces quinquelineatus erythrocephalus*, and only recently was demonstrated to be merely the adult form of the Blue-Tailed Lizard, instead of a distinct species, as had previously been supposed.

A number of interesting observations on the growth of the caudal appendage of rattlesnakes has been made in the Reptile House. It had been repeatedly noticed that the appearance of a new ring of the rattle is attended with the shedding of the snake's skin. Some weeks prior to the shedding of the skin, and in fact before the eyes become cloudy, or the pattern fades, a swelling

appears on the tail at the base of the rattle. This indicates the position of a new ring, or joint. When the epidermis is shed, this ring is uncovered. It is black and hard, and does not become dry and brittle, nor of the color of the other joints of the rattle, until it has been pushed from the tail by a succeeding joint.

As a snake in its wild state sheds its skin about three times during the warm months, the same number of rattles should be added during the year. To determine the age of a rattlesnake from the number of joints of its rattle is a very uncertain proposition. When the rattle has attained from ten to twelve joints, it usually remains at about that number, as several joints are lost annually through wear. It is only possible to estimate the age of a snake from the number of joints of the rattle when that appendage is of a tapering character and still possesses the "button" of the snake's birth. The growth of the snake is indicated by such a rattle in the increasing size of each ring from the button to the tail. By allowing three rattles for a year, the reptile's age may be determined with reasonable accuracy. When a snake's rattle possesses all the joints or rings of a uniform size, the snake is old. The tapering portion of the rattle grown in its youth has been lost, together with an uncertain number of succeeding joints, and the snake has ceased to grow.

These snakes are unable to produce any sound with the rattle until they are about three months old. By that time one skin has been cast, a new joint uncovered on which is attached the "button" of birth, and a second joint has developed to such an extent that the one preceding it has become dry and brittle. On the latter, the "button" whirs feebly when the tail is vibrated. In the Reptile House a specimen of the Diamond-Backed Rattlesnake, now fifteen months old, and born in the building, possesses "five rattles," or "four rings," and a "button." This snake measured fourteen inches at birth. At the present time it measures three feet, six inches. The length of a full-grown Diamond-Backed Rattlesnake is usually about six feet.

UPLAND GOOSE.

SOME NOTES ON THE PSYCHOLOGY OF BIRDS.

By C. WILLIAM BEEBE,
CURATOR OF BIRDS.

EVEN a superficial study of the psychology of birds compels us to attribute to them a highly developed intellectual and emotional life. A few examples may make this more patent, and I will mention only those which entail rather complex psychic processes. Birds have remarkable memories. It is said a pigeon will remember a person after many months, and a bullfinch has been known to recognize a voice after a year's time. Birds often dream, and frequently sing or chatter in their sleep. There are few species of birds which do not show the emotions of love and sympathy, and, what is a very rare trait among animals, that sincerity of affection which causes many birds to mate for life. Even in those species which pair for only a year, one of the two will sometimes pine and die with grief at the loss of its mate.

Indeed, sympathy is the key-note in the growth of the higher intellectual and social qualities which find their culmination in man, and Professor Shaler is right when he attributes to birds

a higher development of this emotion than to any other creatures below man. Reptiles can be trained to know their keeper, and an alligator will defend her buried eggs; dogs are unusually affectionate animals, and the higher monkeys have many sympathetic habits and emotions, but birds lead them all. This is not remarkable when we consider the wonderfully important place which the *family* holds in this class of vertebrates. The building of the nest, the comparatively long incubation of the eggs, and the patient feeding and complex education of the young birds all are duties in which both parents often share. It is this continued association, this "bridging over of generations," which has made sympathy so prominent a factor in the minds of birds. In what other class of animals are vocal signals of fear, distress, or terror so widely understood, or so willingly met with efforts of assistance?

To me it seems puerile to try to believe that a bird's affection for her young, so great that she will often give her life in their defense, can be correlated with an *instinct,* using that word in the common acceptance of the term. It is no more an instinct in the sense of an uncontrollable emotion than is the analogous action of an heroic human being. Altruism, pure and simple, has governed the action of more than one bird under my observation during the past year, and that, too, in some instances, between birds of different species. Three instances come to mind: a female red-winged blackbird which carried a mouthful of worms to a nestful of young red-wings near by, before passing on to brood her own eggs, as yet unhatched; a loon which voluntarily risked his life to free a pied-billed grebe from a nearly fatal ice-trap; and a great crowned pigeon which assumed the care of and sheltered a nestling ring-dove deserted by its parents.

Another aspect of the mental processes of birds shows us examples of revenge being taken after long and patient waiting for a favorable opportunity, while on the other hand crows have been known again and again to sit in judgment upon one of their number, and to sentence and punish it with death.

The language of birds is most complex, and all, from the marvellous song of the nightingale and the imitative powers of the mocking-bird, to the many moods and feelings reflected in the apparently meaningless chirps of our city sparrows, tell of mental powers striving for expression.

In man the various emotions depend upon language and the range of expression of the face for their outward demonstration, and it is interesting to compare with this the state of affairs

among birds. These creatures, handicapped by a vocal language very inferior to our own, and faces, for the most part sheathed, like those of insects in expressionless masks of horn, yet are able by movements of their feathers, limbs, and other portions of the body, to express a wide range of emotions, and to clearly communicate even delicate shades of meaning.

Interrupting, for a moment, the mention of these finer qualities which show the high mental position of birds, it is desirable to emphasize a factor common to all animals, but which in birds is very important, and developed to a remarkable degree—that of extreme *individuality*. It is to this plasticity or wide variation on the already high level of knowledge or "platform of determination," as Baldwin happily terms it, that gives to birds the numerous chances for new *accidental opportunities,* as we may call them—stepping-stones on the road of deduction, to some new and higher expression of psychic power. Every-day accidents in the search for food may be instantly seized upon by the quick perception of birds and turned to good account.

Birds had early learned to take clams or muscles in their beaks or claws at low tide, and carry them out of the reach of the water, so that at the death of the mollusk the relaxation of the adductor muscle would permit the shell to spring open and afford easy access to the inmate. Probably it needed only the accidental dropping of a few shells on the hard rocks, and a taste of the appetizing morsels within, to fix the habit which, by imitation, has spread so widely among birds at the present day. To how trivial an accident might the beginnings, the psychic *anlaga,* of many modern cosmopolitan traits of birds be traced if we could but read the past clearly!

Play and courtship—while they go hand-in-hand, so to speak —afford opportunity for the vast resources of variation to be abundantly expressed. Groos, in his admirable *"Spiele der Thiere,"* has given five separate classes under the head of courtship:

1. Love plays among young animals.
2. Courtship by arts of movement.
3. Courtship by display of unusual or beautiful colors and forms.
4. Courtship by means of noises and tones.
5. Coquetry in the female.

In the Zoological Park each spring, and indeed during almost every month of the year, many examples of these courtships and plays can be observed. The dances of cranes and eagles, the

magnificent showing off of pheasants and ducks, the screams of parrots and all the songs vibrant with sentiment, in which birds strive to outdo each other in the eyes of the female, show how greatly the spirit of emulation and recognition of their respective accomplishments inspire the suitors. We should also realize how pronounced must be the discriminative power and æsthetic appreciation of the females. The display of the peacock combines the classes of movement, color, and noise; for the beauty of its argus-eyed feathers is made more effective by their being raised in a halo above the bird, the shivering of its wing-quills forming a castanet accompaniment.

A genuine delight is taken in these various displays. So far from being intuitive or mechanical exercises they are conscientiously practiced for weeks beforehand, and are kept up long after the period of courtship and nesting is over. For instance, in the Zoological Park, when a peacock in early spring timidly erects his plumes before an unappreciative crow it is for practice in anticipation of its later use in competition with his rivals. After the period of courtship, when he struts back and forth before a line of admiring people, the exercise is from pure delight and appreciation of his own beauties. The Germans, in their finely discriminating language, express the delicate shade of meaning in these acts by *vorübung* and *ausübung*. Even in birds, which pair for life, I have noticed a coquetry and pretended courtship, spring after spring.

One more interesting fact about courtship among birds—another indication, perhaps, of their individuality—is that it is not always the most highly decorated suitor, nor the one victorious in combat, who wins the female for whom he is putting forth his utmost efforts. I have seen a peahen show a very decided preference for, and ultimately pair off with, a young bird who had but small display, and was almost spurless. An amusing instance also noticed in the Park was that of some mallard ducks. Three drakes vied with each other for the favor of a little brown duck. One of the drakes seemed to put but faint hope in his splutterings and bowings, and little wonder, for his tail feathers and the snowy curl, one of the decorations of his sex, had been shot away, and shot-scars had spoiled the symmetry of other parts of his plumage. The other two were large and beautiful birds, bred in the Park. The iridescent emerald of their heads and necks, and their immaculate shining collars made them incomparably more conspicuous than the smaller wild bird. Nevertheless, all their efforts were in vain, while the occasional pitiful

attempts of the handicapped suitor to spread an imaginary tail and declare his everlasting devotion prevailed. He was accepted, and the pair were inseparable until the nest was finished and the duck began sittting on her eleven eggs.

Turning from the birds in the collection to our wild native birds which make the Park their home, or pay it frequent visits, we find much of interest in their changed habits and dispositions. The sight of so many birds flying unharmed in the flying cages or walking about their ranges or swimming on the various ponds undisturbed, although in close proximity to man, is fraught with significance to the quick perceptions of wild birds, large and small. Their keen perceptions and superior powers of intelligence tell them that such unwonted altruistic conditions must offer advantages.

The almost immediate recognition of their security in the Park is remarkable, and birds which seldom show themselves within sight of civilization have come again and again, and exhibited a tameness which deceives many people into thinking they must be escaped birds. The honored visitation of Canada geese will long testify to the truth of this. Wild sea-gulls quite often drop from their loose flocks passing overhead, and consort for a few days with their wing-clipped kindred. When they leave, the young gulls which have been hatched in the Park usually accompany them, but return in a few hours to their home and flock. Ducks, herons, and hawks show as quick a realization of their immunity from danger in the Park.

Green herons creep like feathered phantoms among the branches of the trees overhanging the water, while great blue- and black-crowned night herons, forgetting all shyness, clamber over the arches of the big flying cage in broad daylight, and in sight of hundreds of people, peering down at their brethren inside and uttering envious quawks as they see the bountiful repast of fish and shrimps prepared for those fortunate ones.

The treatment of the tame crows raised from the nest by their wild relations offers an interesting psychological study. Casual notes of mine show that the condition of affairs is about as follows: The tame individuals are a source of great concern to their feral friends. That no gun will be turned against them these wild birds well know, but such utter contempt as familiarity with man has bred in the tame crows—closely superintending every important change of cages or birds, often alighting on the very head or shoulders of the attendants—this the wild crows, viewing from a distance, seem to think is evidence of a disordered mind,

and they forthwith use every wile, every stratagem in their power, to entice the tame birds back to their ranks.

Often in summer when I arrive early at the Park I surprise a company of them "having it out"—the tame bird surrounded by a ring of his fellows, all talking at once, and giving him no chance for argument. But they have their trouble for their pains, for his is a life of unnumbered daily meals, not to mention the opportunities for stealing and hoarding sundry keys, knives, and other bright plunder—the occupation dearest to a corvine heart.

CARRYING A MEDIUM-SIZED TORTOISE. TAGUS COVE, ALBEMARLE ISLAND.

IN THE HOME OF THE GIANT TORTOISE.

By R. H. BECK.

Illustrations from photographs by the author.

THE Galapagos Islands, lying about 600 miles off the coast of South America, have long been known to be the home of large land tortoises. Over 100 years ago the captains of whaling vessels touching there often sent a part of their crews ashore to procure tortoises for meat, and at one or two of the harbors the names of sailors and their vessels can still be seen

on the sandstone rocks, where they were cut over 75 years ago.

In the last five years several expeditions have visited the Galapagos Archipelago, and over 150 tortoises, dead and alive, have been taken away. The last lot contained over fifty specimens, and was brought to San Francisco in August, 1902, in the schooner Mary Sachs, and taken across to London for the Honorable Walter Rothschild.

The largest tortoise in that shipment was obtained near the top of a large crater, 18 miles from the shore, and 12 men were required to carry it the last 6 miles of the distance. So far as known this specimen is the largest ever taken from the Galapagos Islands, and is larger than any other of the dozens seen there by the collectors.

It is only within the last two years that the home of these very large tortoises has been invaded by man, but the rapidity with which they are being killed, and the reason for their destruction, leaves us but little hope that they will survive any longer than did the American bison after the hide hunters began their work of extermination.

A description of the south side of Albemarle Island, where the largest tortoises live, will give one a fair conception of the vegetation and general character of the other mountains and islands occupied by tortoises.

The first 1,000 feet above sea level, which slopes up gradually, is composed of rough lava, in the cracks of which trees and bushes take root and grow during the three or four months of the rainy season. In the next 1,500 feet vegetation is more abundant, and the vines and bushes form a serious impediment to travel. On the trees, ferns and orchids grow in large numbers.

From about 2,500 feet upward the forest ceases, and long, rank grass and brake-ferns form the principal growth. At this height, during the summer season, a heavy fog hangs over the mountain almost continuously, and here a majority of the tortoises spend their time from May until January. On the mountain particularly described, on Albemarle Island, are thousands of cattle, descended from a few placed there years ago.

Three years ago a gentleman from Guayaquil settled here with some laborers for the purpose of killing the cattle for their hides; and upon finding it would take three or four years to do this, he established a ranch at the upper edge of the forest, where the cattle and tortoises were most abundant. Last year (1902), in March, we spent two weeks at this ranch, collecting and study-

ing the tortoises. On our walk up to the ranch, 10 miles by trail from the shore settlement, we counted over 30 tortoises in the last three miles, and it was quite evident that at this place were more tortoises than we had ever expected to see in their native state.

At the time of my visit, the majority of the tortoises were in the open glades and sunny parks in the upper edge of the forest. In every such place along the trail, and near other trails traversed near the ranch, they could be seen feeding, walking about, or quietly sleeping with their heads against the base of some bush or tree where they had dug a form in which to lie. The form which a tortoise occupies is similar in shape to that of the common hare in California; but instead of facing outward, as does the hare, the tortoise always faces inward.

The tortoise seemed to have no regular time for feeding, being at all hours of the day eating or walking about. During the middle of the day, if the sun is shining, they keep in the shade of the trees, but if it is cloudy many spend the time wandering back and forth on the trails. We were told by the natives that in the summer the tortoises go up to the top of the mountain; and this statement confirmed my observations of similar habits of other species in the Archipelago.

We found that the tortoise trails extend up and down the mountain side for miles, one of the objective points at the lower part of the range being a rocky basin where water collects during rains. By centuries of constant use these rocks have been worn so smooth that it is almost impossible to walk over them after a rain, while they are wet. Once we noticed four tortoises slaking their thirst at a rocky pool near the trail, but during our stay at the ranch the rainfall was so great that every little hollow in the ground held water, and a tortoise could get a drink anywhere.

One afternoon, while standing under a tree during a heavy downpour, I was surprised to see a big tortoise come slowly down the hill through the wet grass, walk into a rapidly-forming pool of water, take a long drink, and then lie down in the pool. When he settled down the depth of the water was only two inches, but in a few minutes it had increased to eight inches, and he seemed entirely content, until his attention was attracted to a female tortoise, which also came to the pool to drink. That attraction was the stronger, so he left the water and set out to make her acquaintance.

After the rain had ceased, I went down the trail some distance

TESTUDO VICINA DRINKING AT A POOL.

and saw another tortoise lying in a hollow filled with water. He remained there all night apparently, for on our return the next morning he was still in it. These two observations rather tended to disprove my theory regarding one of the causes of the annual migration which affects nearly all the species of Galapagos tortoises. I had formed the opinion that the migration was partly due to the slightly colder weather and heavy rains high up on the mountains during the winter season, but it would seem from the actions here cited that these causes have but little to do with it after all. With this species *(Testudo vicina)*, it might be the mating instinct that causes them to wander down three or four miles from their summer home.

Love affairs were in full progress during our stay, and the amorous exclamations of the males could be heard at a distance exceeding 300 yards, even in the thick forest. Being told by the natives that the largest tortoises were on the top of the mountain we took a couple of burros and went up to secure the largest specimen obtainable. The shell of the one selected is shown in the photograph, on the back of a burro. It was necessary to skin this animal, for the reason that even two burros could not carry such a specimen alive.

In a little valley, 10 miles from the ranch, and but a short distance from the mountain's top, we found a number of big fellows, considerably larger than any seen at the lower altitude around the ranch. This valley was undoubtedly the home of the patriarchs of the mountain, and a better spot for their development could not be found. There were several deep ponds of water, and judging by the number of cattle present, the grass was of the sweetest. The absence of female tortoises at this height was very noticeable, not over half a dozen being seen out of probably 75 individuals observed. Whether the wild dogs, which are so numerous and ferocious here, have eaten the females, or whether, as is not unlikely, they had gone lower down on the mountain, we were not able to determine. We saw a number of skeletons of tortoises that the dogs had killed, and noticed that, as a rule, the females being the smallest were the ones to suffer. However, we saw a couple of males over three feet long, showing that when hunger is keen enough even the large ones are killed. The presence of these oldest and largest males at this elevation during the rainy season would indicate that they traveled but little, and after noting their surroundings we could see no reason why they should ever journey more than a thousand feet away from the water-holes. A constant abundance of

TESTUDO MICROPHES AT HOME.

grass, scattering trees, plenty of bushes to lie under when the sun shines too fiercely, and water within easy reach, surely should constitute conditions conducive to long life and perfect contentment.

An interesting scene was several times witnessed here, when one, and sometimes two, of the little birds *(Geospiza fuliginosa)*, so common on the islands, would fly up on the back, head, or neck of a tortoise to pick off the minute grass seeds that lodged in the folds of the skin, in the corners of the mouth, and in the nose. We noticed it on several occasions, and the tortoises never evinced the least displeasure in the proceedings of their small visitors. Once, while watching a bird picking seeds from the nose, and even reaching over to pick them from the mouth of a large tortoise, the thought occurred to me that the story of the little bird that enters the mouth of the crocodile for flies is now not nearly so improbable as when first read years ago. Once I saw one of the brilliant red fly-catchers ride along on the back of a giant tortoise for some distance, flying off now and then to catch an insect, but immediately returning to its odd perch, apparently enjoying the ride as much as we enjoyed watching it.

The actions of the tortoises living in the hollows and small valleys along the mountain top were very similar to those of the cattle that occupied the same range. Walking cautiously over a rise we would see perhaps three or four at a water-hole, drinking, and dispersed in the open valley would be others busily nibbling at the short grass. During the heat of the day many would be seen lying in the shallow pools of water that the heavy rains had formed, or under the bushes near by them. One hot day I saw two large tortoises and two young bulls lying side by side under a small tree. Nearby were other cattle, and another large tortoise was headed for the tree, having just left a water-hole a few rods away.

After seeing on this mountain dozens of tortoises of good size, one wonders where the small ones are; but after spending a few days a-foot and seeing the many wild dogs in that region—descendants of those left years ago by sailing vessels—we can only wonder that so many of the large ones remain. From the time that the egg is laid until the tortoise is a foot long, the wild dogs are a constant menace, and it is doubtful if more than one out of 10,000 escapes. We certainly saw none, and the natives told us that the dogs ate them as fast as they were hatched.

In November, 1897, we found several nests in the lower edge

DRINKING AT THE SPRING.

of the forest. Of these, two had been rifled, and the broken egg-shells were what first attracted our attention to them. All the eggs found on that date (November 12th) were perfectly fresh, and we saw two or three newly dug holes with tortoises but a few feet from them. Most of the nests found were in well-traveled cattle or tortoise trails. They were so placed that the sun shone on them but a few hours each day; when it did it was very hot. Ordinarily it was very difficult to recognize the site of a nest, the very slight elevation in the trail, or slightly fresher-looking earth being our sole guide. Several times we imagined that we had discovered nests, and prodded about with our sticks, and dug with our hands until finally we realized that we had misinterpreted the signs.

On finding our first nests in the trail the old adage, "Don't put all your eggs into one basket," was forcibly brought to mind. This is a rule that is followed by the tortoise, for within a radius of 15 feet four nests were found, each containing 8 to 17 eggs. The holes were about 15 inches in depth, and nearly a foot in diameter. The eggs were placed in layers of 3 to 6, the first layer being on the soft soil on the bottom, separated from the next by an inch or so of dirt, and the second layer separated from the third in the same manner. The dirt surrounding the eggs was loose, but the top of the hole was covered to a depth of 3 or 4 inches with a very hard crust that had probably been formed by the tortoise lying on it and working from side to side in the same manner that we frequently noticed them working down a form to lie in.

Judging by the size and number of the eggs found in several of the tortoises that we dissected, it would seem that one or two nests are finished at a given period, and a week or two later the remainder of the eggs are laid. From 10 to 20 eggs were ready for extrusion together, while 20 or 30 more were from one-half to two-thirds the normal size. A peculiar fact regarding the tortoises that inhabit this mountain is the scarred appearance of the shells of those living near the top as compared with those living near the base, or, for the matter of that, any of the other species in the archipelago. The young tortoises near the top are very smooth, but with hardly an exception the old ones show irregular spots on their shells that thus far have not been satisfactorily accounted for. It seems hardly possible that they could have been made by a shower of lava, and yet, within a mile of the spot where the old patriarchs of this species are found, there are a number of living volcanoes which might, a hundred years

ago, have burst forth in explosions of sufficient violence to hurl lava for miles.

The roughness alluded to cannot be due, as has been suggested by some persons, to the tortoises having fallen and rolled over rocks, for were this the case, the tortoises living on Duncan Island, where the ground is much rougher and rocks more plentiful, should be scarred worse than any, but no marks upon them indicate any such experiences. While at the ranch, where nearly 50 men were at work, we were amazed at the reckless and heartless manner in which some of the natives destroyed the tortoises. The proprietor informed us that only the males were killed, but we noticed that the working people made little distinction in the sexes when killing for food. Some evenings, two or three men coming in from different directions would each carry in his hand a small piece of tortoise meat, and a pound or so of fat with which to cook it. Of each tortoise killed not over five pounds of meat would be taken, the remainder being left for the wild dogs that swarmed about.

One Saturday evening I had occasion to go down the trail a mile or so, after some of the natives had departed for the shore settlement, where all the women and children lived. I found a large tortoise, three feet six inches long and hundreds of years old, which had been cut open with a machete, but apparently not more than three pounds of meat had been taken from it. A little farther on lay a dead female, from which nothing had been taken save a string of eggs and a very little meat.

At the rate of destruction now in progress it will require but a few years to clear this entire mountain of tortoises, and when we see the methods pursued by the proprietor in getting tortoise oil for shipment to the mainland, we know that the large tortoises can last but a few months after the work of the oil hunter begins in earnest.

To show what has already been done by oil hunters, I took two photographs at the water-hole, where lay the largest number of tortoise skeletons. There were about 150 skeletons at this pool, and a half-mile away, in another depression, were about 100 more. While there were more skeletons at these two places than we saw elsewhere, frequently 10 or 15 were observed in other basins where the tortoises had gone for water.

The outfit of the oil hunter is very simple, consisting merely of a can or pot in which to try out the oil, and three or four burros for carrying the five- or ten-gallon kegs in which it is transported to the settlement. After making a camp near a wa-

WORK OF THE OIL HUNTERS.

ter-hole, and killing the tortoises there, the collector brings up a burro, throws a couple of sacks over the pack-saddle, and starts out to look for more tortoises, killing them wherever found. A few strokes of the machete separates the plastron from the body, and 10 minutes' work will clear the fat from the sides. The fat is then thrown into the sack, and the outfit moves on.

When the burro is well laden, man and beast travel back to camp, where the oil is tried out. Each large tortoise yields from one to three gallons of oil. The small ones are seldom killed, because they have but little fat. By daily visits to the few water-holes during the driest season, in the course of a month the hunters get practically all the tortoises that live on the upper part of the mountain.

When we first stepped ashore at the settlement we saw a number of casks lying on the beach, and learned on inquiry that they contained 800 gallons of tortoise oil. In a large boat, under a nearby shed, were 400 gallons more. While we were there the boat sailing between the island and Guayaquil left for that port with those casks and a cargo of hides. The value of the oil in Guayaquil was about $9.00 (American) per 100 pounds. While the tortoises are as plentiful as we saw them, this price yields a fair profit to the hunters, but two more raids such as that shown in the photograph will clear that mountain of all the fair-sized tortoises upon it, and then the oil business is ended.

The photograph of seven tortoises at a pond was taken ten miles from the ranch at 3,500 feet elevation, where the hunters had not yet been, but soon these will be discovered and go the way of the rest. Those that the hunters overlook will be killed by the wild dogs as soon as the cattle are decimated. Between men and dogs the creatures that live on the ground must soon disappear. On the northern end of the island the land iguanas have been exterminated, although they were much more numerous and better able to escape than are the tortoises. Near Tagus Cove, the best harbor in the northern part of the island, situated at the foot of another large mountain of volcanic origin, there were formerly, if the number of trails can be taken as a criterion, hundreds of tortoises. To-day it is a hard matter to find one, for it appears that this species *(Testudo microphes)* has been used as food for whalers more than any other.

Quite a large valley extends along the southern base of the mountain, near Tagus Cove, and here the tortoises were in the habit of coming every rainy season when the grass was young

ON THE TRAIL WHERE IT WENT OVER A RECENT FLOW OF LAVA.

and tender. Several smooth rocks of irregular basin shape, where water collects in rainy weather, indicate by their worn appearance the visits of innumerable tortoises in days gone by. On the small sandstone ridges which terminate at the valley can be seen trails two feet deep, and just the width of a tortoise. It must have required centuries of travel to wear such trails as these. Higher up on the mountain, among the thick trees and bushes, the trails often extended around the mountain side from one basin or grass flat to another; but here, instead of quenching their thirst at water-holes, as do those on South Albemarle, the tortoises usually have to be satisfied with what moisture they

can get from the cactus leaves, as do the species on Abingdon, Duncan, and Indefatigable, at least to a large extent.

It seems remarkable that soft-tongued tortoises should be able to eat the sharp-spined cactus leaves, but that they do so, and greatly relish them, is proven on several islands by the way the cactus leaves and blossoms disappear from under the trees. On the north end of Albemarle, where still another species is found, we noticed several small cacti, the growing leaves of which had been partly eaten by tortoises.

On Duncan Island, a few miles from Albemarle, lives *Testudo ephippium*, the species with which I first became acquainted, and the remembrance of my first sight of a Galapagos tortoise in his native haunts will never be forgotten.

After climbing at least 1,500 feet up the mountain, we came to an extinct crater, filled with a growth of bushes and trees. The floor of the crater was several hundred feet below us, and the steep sides, covered with loose rocks and thorny bushes, made the descent very difficult. After reaching the bottom, the members of our party separated, and each of us went looking about independently to find a tortoise. We had seen a number of wallows where tortoises had been lying in the mud, and each member of the party was on the alert to find the first living specimen.

I wandered through narrow lanes, over little grassy meadows, and sometimes went under bushes on hands and knees to avoid their thorns. The high walls of the crater towered aloft all around me, and the intense stillness of the place was broken only by the drone of a cricket. I easily imagined we were back in a bygone age, and then, as a large tortoise, with neck outstretched, ponderously appeared from behind a thick bush, I felt that it would not be surprising to see a pterodactyl come flying over the rim of the crater, or a megalosaurus rise out of the bushes near by.

We found several tortoises in that crater, and after considerable search, discovered a steep trail leading up to the mountain-top. Going up this trail the next day, a large tortoise was found placidly devouring a fallen cactus limb. On a hillside farther on, the trails from one cactus tree to another were as plain and as well worn as cattle trails are on a well-stocked range in California.

We soon learned that the easiest way to get about through the thick brush was to use the tortoise trails, even to the extent of crawling part of the time. This island (Duncan), being much

THE LAST MOMENT ON THEIR NATIVE LAND. *TESTUDO VICINA*.
Iguana Cove, Southwest Albemarle Island.

lower than Albemarle, has less fog and rain, and there are times when the tortoises get no water for months together. We found, however, that they knew every good-sized cactus tree on the hillside and in the valley where they lived, for there were no leaves nor limbs lying about under the trees, as was the case in other places.

We camped for a week on that mountain-top, and captured altogether nearly thirty live tortoises, which were later on sent to Europe. We were much chagrined, however, at finding no very small specimens, but soon came to the conclusion that the large rats, of recent introduction, and now common everywhere on the island, eat the young as soon as they are hatched.

There are still a few tortoises on Duncan Island, and probably will be for some years to come, unless the natives should elect to visit it and hunt them with dogs, in which event they would be quickly exterminated. They live in a space of less than five square miles, and I doubt if 50 still remain.

In 1901 the natives of Chatham Island, where there is a large sugar and coffee plantation, sometimes visited other islands to procure iguanas for food, their supply of cattle having been exhausted. It may happen at any time that a few expeditions will stop at Duncan Island long enough to clear the tortoises of that spot from their native home.

So far as known, *Testudo abingdoni*, of Abingdon Island, is practically extinct. We secured two specimens in 1901, but last year, after thoroughly hunting over the ground where tortoises were formerly common, only a single fresh trail was discovered, where a lone tortoise had passed a few months before. The part of the island where this species lived is fairly easy to travel over, and therefore it was not a difficult matter for the hunters with dogs to make a clean sweep. While there are about 40 square miles of surface on this island, not over 7 or 8 are suitable for tortoises, and for some of the other species the proportion of suitable ground is still less.

A very few years will probably see the extinction of two or three of the present living species, and while a few specimens of the others may linger for a much longer time, they, too, are bound to disappear under the attacks of their enemies. The ease with which these long-lived reptiles may be kept in captivity, and the great interest displayed by the public in watching the ponderous movements of a 500-pound tortoise, hundreds of years old, should induce each of our American zoological gardens to obtain several specimens before it is altogether too late.

SWIMMING CARIBOU, BIRCHY PONDS, NEWFOUNDLAND.

Antlers of the stag on the right of the photograph, from which the velvet was stripped, were bright red, while from the antlers of the other stag, the velvet hung in strips.

THE CARIBOU

BY MADISON GRANT.

THE name caribou is one of the few names manufactured by the American pioneers to describe an animal found here. Unlike the name moose, which is of Indian origin, caribou is a modern French-Canadian corruption of "*carré-bœuf*"—or square ox—a word not without a certain descriptive power. The Algonquin equivalent is *an-en-a-dik*.

The term "caribou" is properly applied to all the American species of the genus *Rangifer*, while the word "reindeer" is limited to the old-world forms. In Europe, however, the latter name covers the entire genus.

The origin of the word reindeer is of considerable interest. The first syllable, *rein* in English, *raine* in Dutch, *renne* in French, and *renn-thier* in German, are not only equivalents, but are also related to the Latin-French form *rangi*-fer. The Lapp word *reino*, meaning pasturage, should also be noted. Curiously enough, the second syllable of rein*deer*, renn*thier*, and rangi*fer* are also of a common origin. Beginning with the Greek *therion*, a wild beast, we have Latin *ferum* by the metamorphosis of the *th* into *f*, and both equivalent to *thier* in German; and this latter by a similar transformation of the *th* into *d*, becoming *deer* in English.

CLASSIFICATION.

Before going into a detailed description of the genus, it may be well to briefly summarize the different classifications which

obtain at present, but which will probably be subjected to considerable alteration in the future by new discoveries. Many of the species, especially those of the extreme north of America, are rapidly diminishing in numbers, and it is most important that they should be thoroughly studied at once.

In describing the genus *Rangifer,* European naturalists have until recently held that there was but one species with a circumpolar distribution. Lately, however, they have partly yielded to the American view, and admitted the existence of either two or three distinct species. In the former case they identify the old world reindeer with the Barren Ground Caribou, to which indeed it is closely allied. Judge Caton made a very serious error in identifying the reindeer with our Woodland Caribou.

The most recent European classification is as follows:

1. *Rangifer tarandus typicus,*
2. " " *spitzbergensis,*
3. " " *caribou,*
4. " " *terraenovae,*
5. " " *groenlandicus,*
6. " " *arcticus.*

The differences between these types entitle them, under this system, only to sub-specific rank. This classification separates the Spitzbergen form from the typical Scandinavian reindeer, chiefly on the ground of its smaller size, but ignores the existing Siberian forms, concerning which very little authentic information is available.

The writer believes that all the existing species should be divided into two groups:

I. The Barren Ground Caribou.
II. The Woodland Caribou.

and that the species should be classified as follows:

I. BARREN GROUND CARIBOU.

a. European species.

1. *Rangifer tarandus,*	Northern Europe and Siberia.
2. " *spitzbergensis,*	Spitzbergen.
3. Undescribed Siberian races,	Siberia.

OSBORN'S CARIBOU (*RANGIFER OSBORNI*, ALLEN).

Photographed by Andrew J. Stone, in the Cassiar Mountains, B. C., Autumn, 1897.

b. American species.

1.	*Rangifer groenlandicus,*	Greenland.
2.	" *pearyi,*	Ellesmere Land.
3.	" *arcticus,*	Extreme north of America and the Arctic Islands.
4.	" *granti,*	Alaskan Peninsula.
5.	" *stonei,*	Cook Inlet.
6.	Undescribed American races.	

II. WOODLAND CARIBOU.

American species.

1.	*Rangifer terraenovae,*	Newfoundland.
2.	" *caribou,*	Canada, Maine, west to Manitoba.
3.	" *montanus,*	Rocky Mountains from Idaho to Central British Columbia.
4.	" *osborni,*	Cassiar Mountains of British Columbia, northward.
5.	Undescribed American forms,	Alaska and Arctic Canada.

These types will be considered in detail further on.

BASIS OF CLASSIFICATION.

All classification is, in the first instance, a question of definition. To-day, nearly all the large North American mammals are undergoing a systematic revision. There is a wide divergence of opinion as to whether or not certain departures from accepted types should be recognized as species, or merely as local races. The determination of this question naturally depends upon the importance attached by different zoologists to the characters upon which distinctions are based.

Most of the distinctions between caribou species are based on size, color, and antler development. The writer is perfectly aware of the uncertainty of any of these tests. Size alone does not often form a sufficient reason for specific distinction. Color, especially in an animal subject to seasonal variations, is apt also to be an uncertain factor, and the warning of Linneus—*ne nimium crede colori*—has been too often ignored by zoologists.

Antler development is, if anything, a more variable quantity than either of the preceding characters. There is a wide range of irregularity in the antlers of all deer, reaching what is perhaps

its maximum among the various groups of caribou. Animals in the same herd may differ widely in this respect. Even the antlers carried in the successive years of an animal's growth may, and often do, vary; and the two antlers on the same animal may not be symmetrical. Nevertheless, within the extreme limits of this irregularity there are certain types of architecture which, though clearly defined, are difficult to describe. This is true of nearly all the genera of the deer family.

The antlers of the Scandinavian elk and of the two species of moose are generally distinguishable, as are also antlers of the Virginia deer from certain localities. Furthermore, it is often possible to pick out moose antlers from the Rockies from those of Eastern Canada.

The above remarks apply to the caribou with peculiar force. The caribou from Newfoundland can be distinguished from those of the mainland by those who have sufficient experience in this matter, although the distinction might defy definition in words. The typical eastern forms of antler could not possibly be mistaken for a typical antler from the Northwestern United States, or from British Columbia. Selected specimens from each locality might be found closely approximating, but, nevertheless, the main statement remains true that one familiar with the modifications of caribou antlers could, in many cases, name the locality of a typical set of antlers.

When the antlers are distinguishable, and the color of the pelage of two animals at the same season is in marked contrast, and still further when there is added to these two characters a third—size—sometimes extremely marked, as between the Barren Ground and the Woodland groups, sometimes less extreme, as between the British Columbian forms and the Eastern Woodland, we have a group of variations clearly indicating that the extremes of the genus in the different portions of the range are at least well on the road toward forming distinct species.

When, in addition to the permanent variations in size, color, and antlers, well-marked anatomical features are found in the skulls or other part of the bony structure, the case in favor of specific rank becomes greatly strengthened.

When the ranges of two species adjoin or overlap, careful search must be made for intermediate and annectant forms. Such forms may be found among the western Woodland Caribou

—where it is within the possibilities that *R. montanus* and *R. osborni* merge, although there is as yet no evidence of this.

We have some twenty-odd specimens from the Cassiar Mountains, and all clearly indicate a species distinct from the southern form. We are not so fortunate in our specimens from the habitat of *R. montanus*. So far as known, all Alaskan Caribou belong to the Barren Ground group, in spite of the general impression to the contrary. *R. osborni* probably crosses the eastern border for a short distance. On the south coast of Alaska *R. stonei* is an isolated and clearly defined species, and unless specimens are discovered on the mainland it will probably be exterminated before we know much more about it. *R. granti,* inhabiting the extreme west of the Alaskan Peninsula, has, thanks to the agency of man, been separated from its nearest relatives, so that we have lost whatever forms there may have existed intermediate between it and its close kindred on the Arctic coast.

This last example is very suggestive of the manner in which species originated. A group of animals spreading over a large and diversified area slowly evolves variations in conformity with local conditions. As long as there is a continuous intermingling of all the members of the original group, the development of distinguishing characters is held in check. When for any reason this distribution ceases to be continuous, as by a severance of land connections, by the disappearance of water or forest in some particular tract, or by persecution by enemies, and the isolation caused thereby is maintained sufficiently long, the group is broken up, interbreeding ceases, and free play is given to tendencies toward divergence. Perhaps another change in local conditions occurs, resulting in the migration of one of the new groups back into the territory of another. If the isolation has continued sufficiently long to do its work, the two forms are distinct, and we have, side by side, two animals recognized as different species. Such is the case at the point where the range of the Barren Ground and the Woodland Caribou groups overlap. Such is the case in the West where the ranges of the blacktail and the white-tail deer overlap. Such is the case in Alaska, where members of the grizzly and brown bear groups range over the same country.

The case of the Virginia deer (*Odocoileus virginianus*) is in point. This deer ranges from Lower Canada and Maine, in

varying abundance, to the Gulf States and Mexico. In this enormous extent of country local conditions have produced their expected results. As we go south this deer becomes a smaller and more delicate animal, the antlers simpler and lighter, until a Florida or Mexican specimen placed beside one from Maine or Canada would show a degree of divergence in size, color, and antlers clearly sufficient to constitute a separate species. As a matter of fact, these outlying types are recognized as sub-species, and I greatly doubt whether a hunter starting in Quebec or New Brunswick, and securing a continuous series of specimens as he passed down through Maine and New England, through the Adirondacks and Pennsylvania along the line of the Blue Ridge to the Gulf States, and thence to Mexico, could at any point in his travels find the locality where one group ends and another begins. As he progressed, one type would fade into another, new characters appearing in an ever-increasing percentage of individuals. If, by some convulsion of nature, the deer of the Central States were destroyed and the Maine deer driven into Florida or Mexico—and such migrations have been common since terrestrial life first appeared—two valid species would exist in Florida. The Columbian Black-tail dwindling to the north into the Sitka deer furnishes a similar case.

These examples are parallel in the case of the caribou. Individuals taken from widely distant points on the Pacific coast show widely different characters. So do deer taken from Maine, Florida, and Mexico. In the case of the deer, we know that intermediate types exist, and yet different sub-species are recognized from the localities just mentioned. In the case of the caribou we do not know whether intermediate types exist or not. If they do not exist, the question of the specific distinction of the forms described in this article may be considered settled. If they are found to exist, their case will be analogous to that of the Virginia deer, and the so-called species will fall to the rank of sub-species or local races.

The distinction between a species and a sub-species is founded on this very point. Several groups of animals, presenting characters of a certain value, and without intermediate forms, constitute as many different species. Groups of animals with the same characters, but fading imperceptibly into one another, are recognized as sub-species. Many types recognized now as sub-

species are being rapidly raised to the rank of full species through the agency of man and his repeating rifle, and long before the last word on this subject has been said, the animals themselves, in many instances, will have disappeared.

DISTINCTION IN TYPE.

Before turning to the distribution of species, it may be well to briefly mention the several characters which distinguish the genus *Rangifer* as a whole from the other genera of the deer family.

All the members of this subdivision of the Cervidæ are extremely migratory in their habits, far more than any other deer, and consequently range over large areas. Their most distinguishing character, however, is to be found in the structure of the bones of the foot, where the so-called dew-claws attached to the ends of the metacarpal bones are functional, and are of use not only on glare ice, but in snow, and in the soft mossy bogs and barrens the caribou frequent. If the development of the metacarpal bones be given much weight, the nearest allies of this genus would be the moose and the American deer (*Odocoilcus*). With the former, further affinity is suggested by the palmation of the antlers. Both the metacarpal structure and palmation, however, are probably cases of parallel development, and would not indicate any close relationship. The palmated antlers of the fallow deer present another example of such parallelism.

The presence of small horns on the females of this genus is in striking contrast to their absence in all the other members of the deer family. An effort has been recently made to show that in the ancestral deer antlers were present in both sexes, in which case their persistence among the caribou should be considered a primitive character. I cannot see any reason why this theory should be adopted in preference to the older view, which considered all antlers to be secondary sexual characters, and the antlers of the female caribou an acquired rather than a primitive character. This point remains, however, unsettled.

In the Woodland Caribou group one of the brow antlers is frequently enormously developed, projecting far down on the face, sometimes to the extremity of the nose, and serving as a guard to the eyes and face during the combats of the stags.

This development of one or both of the brow antlers is considered by some of the European naturalists to be so characteristic of the American Woodland Caribou that they rely upon it alone to distinguish the American Woodland from the Barren Ground Caribou, as well as from the old-world species. Several magnificent heads of the Barren Ground Caribou from Labrador, in the Smithsonian at Washington, show one heavily palmated brow antler, and consequently such palmation cannot be confined to the Woodland group. Among the Newfoundland species both brow antlers are occasionally heavily palmated, and almost symmetrical. This double palmation occurs in one out of six or eight heads, but is much more rare in the Woodland Caribou of the mainland, and apparently occurs but seldom among the Barren Ground Caribou.

FOSSIL FORMS.

The distinction between the two types referred to above as the Barren Ground Caribou and the Woodland Caribou is found not only among the existing species, but is clearly foreshadowed in the fossil remains found in the pre-glacial and inter-glacial deposits of the British Isles and continental Europe. The fossil reindeer found in the oldest Pleistocene deposits in Norway, Ireland, western and southern France, and in the Pyrenees are practically identical with the existing Scandinavian species. The Pyrenees were their extreme southern limit, and it is probable that they appeared there only as winter migrants.

In these deposits the antlers referable to the Barren Ground group are round, slender, and long in proportion to the small size of the animal, and the beam and the tines, including the brow tine, are but little palmated. The antlers of the Woodland Caribou group, on the other hand, are flatter, thicker, and more heavily palmated, both on the beam and tines, especially the brow antler, while the tine immediately above the brow antler, and corresponding to the bez-tine in the red deer (*Cervus*), is elaborately developed, and palmated in marked contrast to the same tine in the Barren Ground group. *The development of this tine, the writer considers to be the most distinctive character separating the two types.* There are also important differences in the angle of curve in the main beam. In Stone's Caribou this tine is of a

somewhat intermediate character. The fossil remains of the Woodland Caribou denote a larger animal, and this contrast in size holds good to-day between the existing species of the two groups.

DISTRIBUTION OF THE VARIOUS SPECIES.

At the beginning of the glacial period there was a land connection between Greenland, Spitzbergen, and Norway, which was in turn joined to Scotland and to Ireland, thence across England to the Continent; and it was over this land connection that the Arctic Barren Ground Caribou found its way into Western Europe. At that period, those portions of Russia lying between the Black Sea and the White Sea and the major part of Sweden were entirely submerged, as well as a large part of northern and eastern Germany. This condition prevented the spread of this group into Eastern Europe at that time. Its extreme eastern limit was near Berlin, where in one of the oldest Pleistocene deposits fossil remains of the Barren Ground Caribou have been found. At a much later period, probably during the interglacial phase of the glacial period, a land connection was established across Russia, and an invasion of Siberian mammals took place, bringing with it the Woodland Caribou. This animal pushed as far west as England, the north and east of France, but never reached either Scandinavia or Ireland, the latter having become detached from England at that time.

In the lands lying south of the Baltic this Woodland type abounded, increasing in numbers toward the east, but vanished before the historic period. Some member of the genus, probably the existing reindeer, persisted in the forests of Northern Europe until comparatively recent times, and were known to the Romans as inhabitants of the German forests. In fact, there is some slight evidence of the existence of reindeer in Caithness, Scotland, as late as the twelfth century.

All fossil remains found in Siberia and Eastern Europe are of the Woodland Caribou type, but all existing species found in Europe or Siberia to-day belong to the Barren Ground group, with the possible exception of a race in eastern Siberia, which may be found to belong to the Woodland group.

It thus appears that the separation of the two groups, the Barren Ground Caribou and the Woodland Caribou, dates from

pre-glacial times, and that the former entered Europe from the Arctic regions at a much earlier period than the latter. The Woodland Caribou, on the other hand, entered Europe from Siberia, and probably originated in Northeastern Asia, together with much of the fauna common to the Eurasian and North American continents, so that although no Woodland Caribou exists to-day in Europe, and while there is very little evidence of their existence in eastern Siberia, it is probable that they entered North America from the old world over the land connection, which, until recent times, existed across Bering Straits; and it was by this connection that North America received many of its best known animals—the wapiti, the bison, the mountain sheep, the grizzly and brown bears, the wolverine, and the lynx.

It may be noted in this connection that the fossil remains give us no good clew to the place of origin of the genus as a whole, but there is much negative evidence to indicate that it was in some Arctic land. In fact, all deer are clearly of northern origin.

The Barren Ground Caribou.

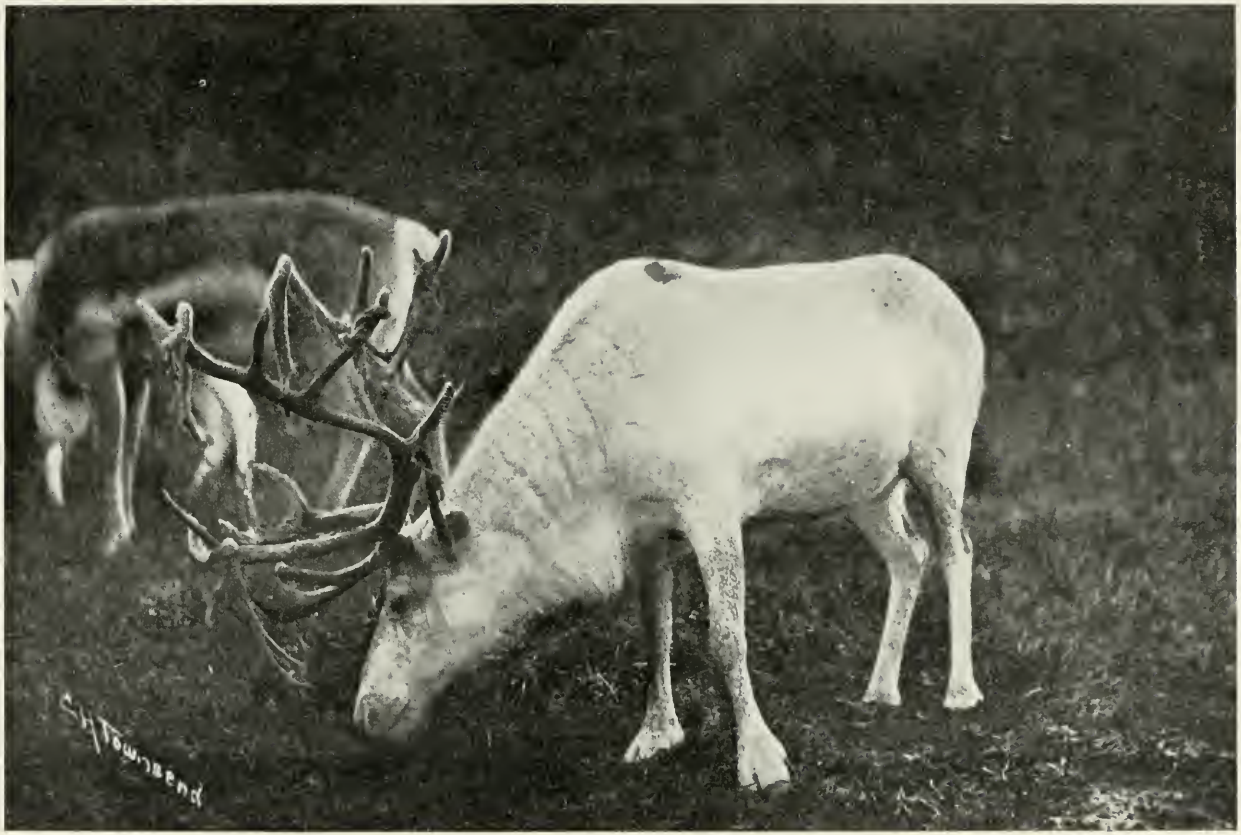
In contrast to the east Siberian origin of the Woodland Caribou, the original centre of distribution of the Barren Ground Caribou appears to have been in the north Atlantic region. Possibly this group entered America by way of Greenland. At present, species of the Barren Ground group are found throughout northern Scandinavia and Lapland, Spitzbergen and Nova Zembla, in suitable localities throughout Siberia, Alaska, the portions of North America east and west of Hudson Bay beyond the limit of tree growth, Greenland and the Arctic lands lying to the north of the American continent.

The Scandinavian reindeer (*Rangifer tarandus*) is of course the earliest and best known, and is the type of the whole genus. The domesticated race is smaller than the wild animals which still persist in the more inaccessible regions of Lapland. This relatively small size of the domesticated in contrast to the wild races also holds good in Siberia.

To the east of Lapland the reindeer extends throughout northern Russia and Siberia, in places as far south as the 54th parallel, and in the Ural regions as far south as the 52d parallel. Throughout this vast extent of country it is more than probable

SIBERIAN REINDEER (*RANGIFER TARANDUS*, LINN.).

Height at shoulder, 39⅝ inches.



IMPORTED DOMESTIC REINDEER IN ALASKA.

Photographed by Charles H. Townsend.

that there are well marked and distinct species, which could be established by a careful comparison of specimens from different localities. In fact, recent discoveries indicate the existence of several distinct races of both the wild and domesticated reindeer in eastern Siberia.

In the Government of Kazan it is said that the reindeer are of an exceedingly large size, and that the females are without antlers. A snow-white reindeer has been reported recently (1902) from the mouth of the River Lena. This may be a new species, or, more probably, merely the common form in its winter pelage.

To the north of the old world, reindeer are absent from Francis Joseph Land, but appear to abound in Nova Zembla and in Spitzbergen. The race in the latter islands (*Rangifer spitzbergensis*) has clear claim to specific rank, chiefly on the ground of its size, which is far smaller than the type race, but also on account of well-defined characters in the skull.

In America the different species of Barren Ground Caribou all lie to the north of the various members of the Woodland group. The Greenland race is a separate species (*Rangifer grœnlandicus*). Nearly all of the Parry Islands and other large land areas lying between Greenland and the mainland are inhabited by Barren Ground Caribou, formerly identified with those of the mainland (*Rangifer arcticus*).

A new Barren Ground Caribou from Ellesmere Land was described by Dr. J. A. Allen on October 31, 1902, under the name of *Rangifer pearyi*. Its chief character is in the coloring, which is pure white, except for a large dark patch on the middle and posterior part of the back. The new species is thus sharply defined from the darker caribou of Greenland. Its nearest relatives will be found among the caribou now grouped together under the name of *Rangifer arcticus*. It is very probable that investigations among the Parry Islands, and other land masses to the north of the continent, will disclose intermediate forms between these two.

Caribou, probably of this species, have been found as far north as the neighborhood of Fort Conger, Grinnell Land, in latitude 82°. It appears to be the northernmost member of the genus, and shares with the musk-ox and polar bear the distinction of being one of the few land mammals able to maintain

existence at that latitude. The Newfoundland Caribou had, before the discovery of this species, been considered the whitest of the caribou.

On the American mainland west of Hudson Bay the typical Barren Ground Caribou (*Rangifer arcticus*) is found in large herds throughout the barren grounds, migrating in winter into the timber belt as far south as the neighborhood of the Churchill River, latitude 59° north, and the southern end of Reindeer Lake.

That a portion of the herds remain along the northern coasts throughout the winter has been demonstrated by Mr. Andrew J. Stone. The recent investigations of this explorer have brought to light the interesting fact that the Mackenzie River, throughout its entire length, including a belt of land one hundred miles wide along its banks, is uninhabited by caribou, and appears to form the western limit of the *Rangifer arcticus*. To the west of the river the caribou are nearly twice the size attained by those on the east, and further explorations in that country will probably show this west Mackenzie caribou to be a new species. The caribou on both sides of the Mackenzie River, however, are threatened with extinction, owing to the increased number of whalers wintering on the northern coast. The natives are employed to bring in immense quantities of meat, and are supplied with fire-arms for that purpose.

The portion of northern Alaska drained by the Colville River is inhabited by a caribou which probably will prove on investigation to be a new species, possibly identical with the West Mackenzie form above referred to. The mountains to the north of the Porcupine River in Alaska are said to contain a *red caribou*, extremely rare, if not already exterminated. The caribou of the Kuskoquim River in southern Alaska is said also to be distinct, but is probably closely related to or the same as *R. stonei*. All these undescribed Alaskan caribou will probably be found to belong to the Barren Ground group.

Some five thousand domesticated reindeer from East Siberia have been introduced among the Eskimo of northwest Alaska. It is well within the probabilities that some of these animals may escape, and, in time, form a wild race. At all events such a possibility must hereafter be borne in mind.

In the autumn of 1901 Mr. Andrew J. Stone discovered a new species of Barren Ground Caribou on the Alaskan Peninsula,

GRANT'S CARIBOU, ADULT FEMALE (*RANGIFER GRANTI*, ALLEN).

Length, nose to root of tail, 64 inches; height at shoulder, 42 inches.

Courtesy of American Museum of Natural History.

GRANT'S CARIBOU (*RANGIFER GRANTI*, ALLEN).
Length, nose to root of tail, 80 inches; height at shoulder, 44½ inches.
Courtesy of American Museum of Natural History.

far beyond the western limit of tree growth. Fifteen fine specimens were secured, and described by Dr. J. A. Allen of the American Museum as *Rangifer granti.** A group of these animals is now being mounted at the American Museum. Mr. Stone states that this caribou inhabits the barren land of the Alaskan Peninsula, ranging well up into the mountains in summer, but descending to the lower level in winter, generally feeding on the low, flat lands near the coast and in the foot-hills. They formerly lived in considerable numbers on Unga Island, where they are now practically extinct. The only other island inhabited by them is Unimak Island, at the western end of the Alaskan Peninsula. Formerly they were exceedingly abundant, but of late they have been greatly reduced in numbers through the agency of the market hunters. The habitat of *R. granti* is thus an isolated area in the treeless portion of the Alaskan Peninsula, and (formerly at least) some of the adjoining islands at the western end of the peninsula. The nearest relations of the *R. granti* are to be sought on the barrens of northwestern Alaska, a district from which we have as yet no authentic specimens.

The caribou of the Kenai Peninsula, Alaska (*R. stonei*), is very much larger than *R. granti,* and appears to be the largest of the Barren Ground group. The animal has a totally different scheme of horn architecture, as may be seen from the accompanying cut, and shows signs of approaching the *R. osborni* and *R. montanus* toward the east and south. It is in fact an outlying member of the Barren Ground group, approximating to the Woodland group. Between *R. stonei* and *R. granti* there is no near relationship.

The caribou of the Kenai Peninsula, as stated above, constitute a well marked species of the Barren Ground type. It was described in May, 1901, by Dr. Allen, and named from the discoverer, Andrew J. Stone. As yet only three specimens are known. On the peninsula itself this fine animal seems to be on the verge of extinction, being now limited to one small herd, but it is highly probable it is to be found on the mainland west and north of Cook Inlet. A heavy bunch of white hairs in the front of the head and throat constitutes one of the most marked characteristics of this animal. The antlers are clearly of the Barren Ground Caribou type, but present two marked

* This species was named in honor of the author of this article.—EDITOR.

peculiarities. These are the extreme length of the tines on the upper part of the main beam, and a peculiar structure of the antler above the brow antler, which, taken alone, is not unlike the antlers of the American deer (*Odocoilcus*). This animal is large, and by far the handsomest known species of the Barren Ground group. Its relationship to the caribou of the north and east cannot be determined until a full series of specimens is obtained.

Of the Barren Ground Caribou group there remains to be considered those of Labrador; but the caribou of the barren grounds to the east of the Coppermine River and north of Chesterfield Inlet need careful investigation, as do those of Southampton Island.

We are indebted to Mr. A. P. Low, the Canadian explorer, for most of the knowledge we possess of the interior of the Peninsula of Labrador, which includes one of the largest unexplored areas on the globe. Mr. Low states that there are three distinct herds of Barren Ground Caribou on the barren and semi-barren lands of the peninsula. These herds frequent the coast of Hudson Straits, Ungava Bay, and the Atlantic coast as far south as Hamilton Inlet. On the Hudson Bay coast they are found only at present in small numbers to the north of Whale River, about the 54th parallel, and are being rapidly exterminated by the Indians. It is probable that the Barren Ground Caribou of Labrador occupy at times the same area in the interior as the Woodland Caribou (*Rangifer caribou*).

An interesting question here arises as to whether the caribou of northern Labrador and those of Baffin Land are identical, and as to the possibility of crossing Hudson Straits, which lie between. Inasmuch as the Straits of Belle Isle appear to interpose a barrier sufficient to prevent the intermingling of the Newfoundland and mainland species, and as Hudson Straits are very much wider, and the probability of an ice bridge far more remote, it would seem that the two groups have been separated for a long period of time. It is highly probable, therefore, that future investigations will develop some distinctive features between the Labrador animals and those of Baffin Land and show a close relationship between the latter and the caribou of Ellesmere Land.

Mr. Arthur Moore, of New York, led an expedition into the Hudson Bay region during the summer of 1901 and obtained

caribou on the mainland of Labrador, and on Salisbury Islands, lying on the Baffin Land side of Hudson Straits. He writes me as follows:

"The tides are so swift, and their rise and fall so considerable, that the ice does not afford a practicable road. This view is supported by the further fact that there is, and has been, no communication between the Baffin Land and south shore Esquimaux. Moreover, where the land bridge is least broken, the shores are very bold, and consequently clear of permanent ice by reason of the most severe tide rips. The natural movement would be from the south, northward, as at the time of the spring migration the ice conditions would be most favorable after the winter's freezing; yet fewer caribou are reported on the islands off the south shore than off the islands on the Baffin Land coast.

"Salisbury Island is a large island, and is somewhat free from the strongest set of the Straits currents along its northern shore. The existence of Esquimaux on this island proves that it must be accessible from Baffin Land shore; yet even here, on the nearest and most accessible large island, communication has been so uncertain and difficult that from evidence drawn from the Salisbury natives I should judge that many years had elapsed since their arrival, as I could gather from them no knowledge of Baffin Land or any inhabited land in any definite location.

"Resolution Island, which is in sight of both Baffin Land and North Labrador, is never visited by Esquimaux, on account of the dangerous ice, and I imagine that few caribou ever travel to it, as men who have landed there say nothing of caribou, and I should expect to find such an island stocked with caribou that had migrated there from the more disturbed land inhabited by Esquimaux. In the latter case the hunters would soon follow, as the Esquimaux always follow migrating deer, and often they can go where the caribou cannot travel; consequently the absence of hunters on the south coast islands, even the larger land masses, would argue against the migration of caribou to these districts. The only argument in favor of migration across the Straits is the presence of caribou on Salisbury Island, which, as we have seen, is situated close to the Baffin Land coast."

Woodland Caribou.

The known range of the Woodland Caribou in North America extends from Newfoundland in the east, throughout Canada as far as the Cassiar Mountains of British Columbia and the Alaskan border in the west; and it is more than probable that the caribou known to inhabit the mountains west of the Mackenzie between the Dease and Pelly rivers belong also to this group. Passing over for the moment the Newfoundland species, the typical Woodland Caribou, *Rangifer caribou*, ranges from Nova Scotia through New Brunswick and Maine to the St. Lawrence River. In Maine their numbers have greatly declined in the last few years, probably from some unknown epidemic; and then, too, in spite of the excellent game laws of that State, which have adequately protected the other large mammals. It formerly existed in small numbers in northern Vermont and New Hampshire, but it may be stated in passing that there is absolutely no evidence of the existence of caribou in historic times in the Adirondacks, while there is much evidence of a negative character against it.

On the north of the St. Lawrence this animal extends throughout the entire Province of Quebec as far as the East Main River in Labrador. In the country to the north and east of Lake St. John, and on the southern watershed of Labrador, it has been nearly exterminated, presumably by the devastating fires which have swept over this district in recent years. West of Lake St. John it is found to the height of land and northward to James Bay and Hudson Bay, and in small numbers between these bays and Lake Superior. It was found in northern Minnesota, but I have been unable to verify Judge Caton's statement that in the early part of the century they occurred in small numbers on the southern shores of Lake Superior.

The Woodland Caribou extends westward throughout suitable forest areas in Manitoba, Saskatchewan, and Athabasca, to Great Slave Lake on the north. In the neighborhood of the Churchill River, west of Hudson Bay, the range of this animal and the Barren Ground Caribou from the north overlap at some seasons of the year, but there is no evidence of interbreeding. In west Canada it is holding its own well, owing to the fact that, unlike the Barren Ground Caribou, it does not gather in

WOODLAND CARIBOU (*RANGIFER CARIBOU*, GMEL.).

Height at shoulder, 49⅝ inches.

The New York Zoological Park.

WOODLAND CARIBOU, ADULT FEMALE (*RANGIFER CARIBOU*, GMEL.).

Height at shoulder, 43 inches.

New York Zoological Park.

large herds. Throughout most of the range the Woodland Caribou inhabits the same country as the moose, although in the east it is generally found somewhat to the north of the latter.

The caribou of western Canada have until recently presented some serious taxonomic difficulties.

The mountains of northern Montana, Idaho, and Washington and the Provinces of British Columbia and Alberta are inhabited by a caribou which has long been known as the "Blackface" Caribou. This animal was thought to be identical with the eastern Woodland Caribou until, in August, 1899, Mr. Ernest Thompson-Seton described it as a new species under the name of *Rangifer montanus*, the type being a mounted specimen from Revelstoke, in the Selkirk range of British Columbia. The northern limits of its range are at present unknown, but it is possible that it fades gradually into the next species, *Rangifer osborni*. Nearly two years prior to the discovery of *R. montanus*, Mr. Andrew J. Stone killed in the Cassiar Mountains of northern British Columbia six specimens of a very large caribou, which were shipped to the American Museum of Natural History in New York, but were delayed on the way and did not reach New York until after the description of *R. montanus* had been published.

This new caribou from the Cassiar Mountains was generally considered to be identical with *R. montanus*, but the writer believed, from antlers of the Cassiar animal he had seen, that further comparison would result in proving them to be distinct species. To this end he secured for the American Museum four caribou from the type locality of *R. montanus*. As a result, the Cassiar specimens were described as *Rangifer osborni*, in honor of Professor Henry Fairfield Osborn. The *R. osborni* are found living throughout the year in the high mountains above timber line, and are the largest and handsomest caribou known—large males weighing from 550 to 700 pounds, and consequently approaching the wapiti in size.

A specimen killed in the summer of 1902 measured 4 feet 11 inches in height at shoulder and 7 feet 9 inches in length. This is one of the largest individual caribou of which we have authentic record.

Like most animals of the damp Pacific coast, both the *R. osborni* and *R. montanus* are very dark, the latter in fact almost

as black as a moose. The antlers of Osborn's caribou are large and sweeping, and are characterized by large size, often palmation and prongs at the end of the main beam. The posterior prong on the main beam is nearly always very heavy. The brow antlers also are sometimes greatly developed. The range of this animal is probably much the same as that of Stone's mountain sheep, the southern limit in each case being the Rocky Mountain divide separating the head waters of the Peace and Fraser Rivers. On the north this splendid animal probably extends into Alaska and the head waters of the Yukon River.

Professor J. A. Allen describes the relations of *R. montanus* and *R. osborni* as follows:

"*Rangifer montanus,* in late September pelage, may be described in general terms as a black caribou, with the neck and shoulders, especially in the males, much lighter than the body and limbs; while *R. osborni,* in corresponding pelage, is a brown caribou, with much more white on the rump and posterior ventral surface, and the whole neck and shoulders, as well as the back and limbs, much lighter than in *R. montanus.*

"The specimens of *R. montanus* are without measurements, but the species is apparently about the same size as *R. osborni,* as shown by the measurements of the skull.

"In addition to the marked contrast in color, there are striking differences in the size and form of the antlers in the two forms, the antlers of *R. montanus* being of the typical Woodland Caribou type, and in their relative shortness and much-branched character recall strongly the antlers of *R. terraenovae,* but they are much lighter and more slender than in that species. They have the same abrupt upward curvature of the main beam, in contrast with the much longer and heavier and more depressed backward-sweeping main beam seen in *R. osborni.*"

NEWFOUNDLAND CARIBOU.

Toward the end of the Pleistocene period the Island of Newfoundland, extending over the now submerged banks to the southeast, was connected with Labrador over the Straits of Belle Isle, which even now are little more than nine miles wide. Between Newfoundland and Cape Breton and Nova Scotia on the west, the present Straits of Cabot formed part of a deep sea which

NEWFOUNDLAND CABIBOU FAWNS (*RANGIFER TERRAENOVAE*, BANGS).
The New York Zoological Park.

WOODLAND CARIBOU FAWN (*RANGIFER CARIBOU*, GMEL.).
The New York Zoological Park.

extended into the Gulf of St. Lawrence. This land connection to the north explains the distribution of fauna upon the island, especially the absence of moose, which on the north shore of the St. Lawrence appear to have never extended east of the Saguenay River into Labrador.

Until recently it was believed that caribou crossed the Straits of Belle Isle when they were occasionally frozen over, and that the type found on the island was considered to be identical with that on the mainland, forming at best no more than a well marked local race. It is now known that no such crossings occur. Since 1896 they have been recognized as a separate species of Woodland Caribou (*Rangifer terraenovae*), and until the discovery of the Cassiar Mountain Caribou were considered the largest and handsomest representatives of the genus. The nearest relatives of the *R. terraenovae* are of course the *R. caribou* of the adjoining mainland.

Two types of caribou are recognized by the natives of Newfoundland. The smaller variety inhabiting the southwest portion of the island south and west of Grand Pond, where the country is timbered with hard wood, is locally known as the "mountain caribou," and is said not to migrate. The antlers are for the most part much smaller than those of the larger and better-known animal in the east and north of the island. There is no satisfactory explanation of the existence of these two types, but there are many similar instances among the various members of the deer family. Some moose are short legged and thick bodied, with widely palmated antlers, in contrast to others which are taller and more rangy. In the Adirondacks a similar contrast is found between the ordinary deer and the meadow buck, or swamp deer. This swamp deer has a thick body, short legs, and black dorsal stripe. Its antlers, which sometimes present the bifurcated prong of the closely allied mule deer of the West, have a heavy beam and burr thickly studded with small knobs. These variations, however, must be confined to individuals, as both forms mingle freely, and in fact these special characters appear to be confined to the males. In Newfoundland, however, the smaller or mountain race inhabits a distinct locality.

The larger variety migrates annually, going north in the spring and returning in September, in bands of five to ten, seldom numbering over twenty-five. These bands are generally led

NEWFOUNDLAND CARIBOU (*RANGIFER TERRAENOVAE*, BANGS).

Wild stag, photographed, 1902, on a Newfoundland barren,
by Charles D. Cleveland, and reproduced by permission.

NEWFOUNDLAND CARIBOU (*RANGIFER TERRAENOVAE*, BANGS).

Courtesy of C. Grant La Farge.

by an old doe, while the "stags," as the bulls are called in Newfoundland, are usually found in pairs. Many of the finest stags, however, do not migrate, but remain on the high barrens of the south. The migratory habits of the animals have been greatly disturbed by the recently completed railroad, along the line of which a cordon of sportsmen formerly gathered in the fall, shooting at everything that passed. If this had continued a few years more the result would have been the separation of the caribou into two herds, as was the case of the buffalo when the Union Pacific Railroad first crossed the United States.

The velvet is shed during the first week of September, and for some time after the antlers are bright red in color, due not to dried blood, but to the rubbing of the antlers against spruce-trees and alders.

As a general thing, only those antlers which have a double brow antler count high in points, a point being defined as a knob upon which a watch can be hung. One of the handsomest and most highly prized types of antlers is locally known as the "going-back head," belonging to old stags on the decline; the beam is extremely massive, and the points short and numerous. Antlers with thirty points are considered to form a good head. Forty points are rare, and the days of the fifty-pointers appear to have passed, even if they ever existed. In the future the finer antlers will become increasingly rare, as one of the first symptoms of the decline of any given race of deer is the deterioration of antlers. In proof of this, witness the increasing scarcity of handsome wapiti heads. This also holds good of the moose of Maine and New Brunswick, where the best heads scarcely equal the average of those taken along the Upper Ottawa River. The antlers of the Scottish red deer are as inferior to those taken in the German forest as the latter are in turn inferior to Hungarian antlers from the same species. In all those countries, collections of antlers dating back several centuries show a tremendous decline in the best heads. Antlers in the castle of Moritzberg, near Dresden, dating from the sixteenth and seventeenth centuries, are so large that it is difficult to believe that the animals which bore them were of the same species as their degenerate descendants in the neighboring forests. This deterioration is chiefly brought about by long-continued elimination of the best stags, but too close inbreeding has probably aided the general decline.

A new game law was enacted in 1902 which shows a very earnest purpose on the part of the Newfoundland authorities to protect their magnificent herds of caribou. If the law can be enforced against the natives, as well as against the visiting sportsmen, the former indiscriminate slaughter of deer can be regulated, if not stopped. The difficulties of educating the natives of new countries to respect game laws are, it is needless to say, very great. The new law, however, organizes the local guides, and makes them to some extent responsible for the observance of the law. This is, of course, a great step in the right direction. The prohibition of water killing, a special close time during the migrating season, and the prohibition of hunting within five miles of the railroad, are also features which commend the new law very strongly to all interested in game preservation. The deer, however, have been so abundant in the past that they are still regarded by the natives as their chief supply of fresh meat, and it will be some years before the Newfoundlanders themselves come to realize that intelligent and efficient protection is in their own interest. This, however, is the history of the enforcement of game laws everywhere. The law itself must be in advance of public opinion, and complete enforcement of the law can only be achieved long after the statutes are on the books.

In closing the writer desires to acknowledge his indebtedness to Prof. J. A. Allen, to Mr. Andrew J. Stone for much of the information, and for many of the photographs which appear in this article, and to Mr. F. A. Lucas, of the U. S. National Museum at Washington, to Mr. A. S. Reed, of Victoria, British Columbia, to Mr. R. T. Varnum, Mr. Chas. D. Cleveland, Mr. Wm. T. Hornaday, Mr. C. Grant La Farge, and Mr. Arthur Moore, of New York, for illustrations.

Showing Distribution of Woodland and Barren Grou

ıou in North America, with type localities of species.

GRANT'S CARIBOU (*RANGIFER GRANTI*, ALLEN).
Specimen in the velvet, from the Alaska Peninsula.
Courtesy of Charles H. Townsend.

SIBERIAN REINDEER (*RANGIFER TARANDUS*, LINN.).
Antlers; length of main beam, 40⅜ inches; greatest spread, 33½ inches.
Courtesy of American Museum of Natural History.

Side view of specimen shown on opposite page.

GREENLAND CARIBOU (*RANGIFER GROENLANDICUS*, GMEL.).

Specimen from west coast of Greenland.

Antlers: length of main beam, 49 inches; greatest spread, 39 inches; total points, 22.

Courtesy of American Museum of Natural History.

Side view of specimen shown on opposite page

BARREN GROUND CARIBOU (*RANGIFER ARCTICUS*, RICH.).

Specimen from northwest coast of Hudson Bay.

Antlers; length main beam, 42½ inches; greatest spread, 29½ inches; total points, 25.

Courtesy of American Museum of Natural History.

Side view of specimen shown on opposite page.

BARREN GROUND CARIBOU (*RANGIFER ARCTICUS*, RICH.).

Specimen from Fort Chimo, North Labrador.

Antlers; length of main beam, 58 inches; width of brow antler, 21 inches.

Courtesy of United States National Museum, Washington.

BARREN GROUND CARIBOU (*RANGIFER ARCTICUS*, RICH.).
Specimen from Fort Chimo, North Labrador.
Antlers; length of main beam, 60 inches; greatest spread, 34 inches.

GRANT'S CARIBOU (TYPE) (*RANGIFER GRANTI*, ALLEN).

Specimen from Alaska Peninsula.

Antlers; length along curvature, 33⅞ inches; greatest spread, 35⅛ inches; total points, 27.

Courtesy of American Museum of Natural History.

Side view of specimen shown on opposite page.

STONE'S CARIBOU (TYPE) (*RANGIFER STONEI*, ALLEN).

Antlers ; length of main beam, 49 inches ; greatest spread, 34 inches : total points, 36.

Courtesy of American Museum of Natural History.

Side view of specimen shown on opposite page.

NEWFOUNDLAND CARIBOU (*RANGIFER TERRAENOVAE*, BANGS).

Specimen from Red Indian Lake, Newfoundland.

Length, main beam, 41 inches; extreme width brow antlers, 36 inches; total points, 36.

Author's Collection.

NEWFOUNDLAND CARIBOU (*RANGIFER TERRAENOVAE*, BANGS).

Showing development of brow and bez antlers.

Length, nose to root of tail, 75½ inches; height at shoulder, 47 inches.

Antlers; length of main beam, 29½ inches; greatest spread, 28 inches; total points, 37.

Courtesy of American Museum of Natural History,

MOUNTAIN CARIBOU (*RANGIFER MONTANUS*, SETON).

Antlers; length of main beam; left, 35 inches; right, 32 inches. Number of points; left, 13; right, 18; total points, 31.

Greatest spread—21 inches.

Side view of specimen shown on opposite page.

OSBORN'S CARIBOU (*RANGIFER OSBORNI*, ALLEN).
Specimen from Cassiar Mts., B. C.
Antlers; length of main beam, 44 inches; greatest spread, 38½ inches; total points, 36.
Author's collection.

Side view of specimen shown on opposite page.

OSBORN'S CARIBOU (TYPE) (*RANGIFER OSBORNI*, ALLEN).
Length, from nose to root of tail, 82 inches; height at shoulder, 50 inches.
Courtesy of American Museum of Natural History.

OSBORN'S CARIBOU (*RANGIFER OSBORNI*, ALLEN).
Specimen from the Cassiar Mountains, British Columbia.
Antlers; right, 48 inches; left, 50½ inches; total points, 45.
Courtesy of A. S. Reed, Victoria, B. C.

BY-LAWS

OF THE

New York Zoological Society

AMENDED TO FEBRUARY 1, 1903.

ARTICLE I.

MEETINGS OF THE SOCIETY.

SECTION 1. The office and place of business of the New York Zoological Society shall be in the City of New York, unless otherwise ordered.

SEC. 2. The Society shall hold its annual meeting for the election of Managers, and other business, on the second Tuesday of January, or such day thereafter during the month of January to which said annual meeting shall adjourn.

SEC. 3. Special meetings of the Society shall be called by the Secretary, upon the request of the President or the Chairman of the Executive Committee, or at the written request of ten members.

SEC. 4. Notices of all meetings shall be mailed to each member of the Society at least three days before such meeting.

SEC. 5. At meetings of the Society twenty members shall constitute a quorum.

SEC. 6. The order of business shall be as follows:

1. Roll call.
2. Reading of minutes not previously read.
3. Report of Executive Committee.
4. Report of Secretary.
5. Report of Treasurer.
6. Report of Director of the Zoological Park.
7. Report of Director of the Aquarium.
8. Election of Managers.
9. Communications.
10. Miscellaneous business.
11. Reports and resolutions.

ARTICLE II.

BOARD OF MANAGERS.

SEC. 1. The Board of Managers shall consist of thirty-six members, together with the Mayor of New York and President of the Park Board, or Commissioner for the Bronx, who shall be members *ex-officio* of the board.

SEC. 2. Nineteen managers shall constitute a quorum, but ten managers may transact current business, and adjourn, subject to the subsequent approval of a meeting at which a quorum shall be present.

SEC. 3. The Board of Managers shall hold an annual meeting on the third Tuesday of January, or on such day thereafter to which said annual meeting shall adjourn. Regular meetings of the Board may also be called

by the Secretary on the third Tuesdays of October and April, upon the request of the President or Chairman of the Executive Committee. Special meetings of the Board shall be called at any time by the Secretary, upon the request of the President or the Chairman of the Executive Committee, or at the written request of five Managers.

SEC. 4. Notices of meetings of the Board shall be mailed to each Manager at least three days before such meetings.

SEC. 5. The successors to the outgoing class of Managers shall be elected by the Society at its annual meeting, but vacancies in the Board may be filled for the unexpired term by the Board of Managers, or by the Executive Committee.

SEC. 6. A Nominating Committee shall be annually appointed by the Executive Committee, and shall consist of three members of the Society at large, who shall nominate and post ten days before the annual election the names of twelve persons to succeed the outgoing class of Managers in a conspicuous place in the office of the Society.

SEC. 7. No person shall be eligible for election to the Board of Managers, except to fill vacancies, unless his name shall have been posted as a candidate by such Committee, or by not less than ten members, in writing, in a conspicuous place in the office of the Society ten days before the annual election. All candidates for election as Managers must be Life Members, Patrons, Associate Founders, or Founders of the Society.

SEC. 8. Any Manager who shall fail to attend three consecutive meetings of the Board, unless excused by vote of the Board, shall cease to be a Manager.

SEC. 9. The Board of Managers shall at its annual meeting elect a President, two Vice-Presidents, a Secretary and a Treasurer, who shall hold office for one year, or until their successors are elected. The President, Vice-Presidents, and Treasurer shall be members of the Board.

SEC. 10. The Director of the Zoological Park, the Director of the Aquarium, and all other persons employed by the Society, shall be appointed by the Board or by the Executive Committee, and shall hold office during the pleasure of the Board.

SEC. 11. The Board shall, at its annual meeting, elect an Executive Committee and Auditing Committee, which shall hold office for one year, or until their successors are elected. The Board of Managers and the Executive Committee shall also have authority to appoint such other Committees or Officers as they may at any time deem desirable, and to delegate to them such powers as may be necessary.

SEC. 12. The order of business of the meetings of the Board shall be as follows:

1. Roll call.
2. Reading of minutes not previously read.
3. Report of Executive Committee.
4. Report of Secretary.
5. Report of Treasurer.
6. Report of Auditing Committee.
7. Report of Director of the Zoological Park.
8. Report of Director of the Aquarium.
9. Election of Officers.
10. Election of Committees.
11. Election of new members.
12. Communications.
13. Miscellaneous business.

SEC. 13. All reports and resolutions shall be in writing, and the ayes and nays may be called on any resolution at the request of one Manager.

SEC. 14. Whenever the funds of the Society shall permit, the Board of Managers or the Executive Committee may award medals or other prizes for meritorious work connected with the objects of the Society.

ARTICLE III.

OFFICERS.

SEC. 1. The officers of the Society shall consist of a President, two Vice-Presidents, a Treasurer, a Secretary and a Director of the Zoological Park. These officers, with the exception of the Director, shall be elected at the annual meeting of the Board of Managers, but any vacancy may be filled for an unexpired term by the Board of Managers, or by the Executive Committee, until the next annual election.

SEC. 2. The President shall preside at all meetings of the Board and of the Society, and shall be *ex-officio* a member of the Executive and Auditing Committees.

SEC. 3. The Vice-Presidents shall, in the absence of the President, perform his duties and possess his powers, acting in the order of their election.

SEC. 4. The Treasurer shall receive, collect and hold, subject to the order of the Board of Managers, or the Executive Committee, all dues, subscriptions, warrants from the City, fees and securities. He shall pay all bills as ordered by the Board of Managers or the Executive Committee, and shall report to the Society at its annual meeting, and to the Board of Managers at all regular meetings and to the Executive Committee at each meeting. He shall keep all moneys and securities in some bank or trust company to be approved by the Board of Managers or Executive Committee. The books of the Society shall at all times be open to the inspection of the Managers.

SEC. 5. The Secretary shall be a salaried officer of the Society. He shall be present, unless otherwise relieved by the Board or Executive Committee, at all meetings of the Society, of the Board and of the Standing Committees. He shall keep a careful record of all proceedings, shall have the custody of the seal, archives and books, other than books of account, and shall conduct the correspondence of the Society. He shall issue all notices and tickets and shall perform such other duties as the Board may direct. He shall be a member *ex-officio* of the Executive, Aquarium and Auditing Committees and of the Scientific Council.

SEC. 6. The Director of the Zoological Park shall be elected annually by the Executive Committee at a salary to be determined by said Committee, and paid monthly from funds of the Society. He shall be the responsible administrative officer of the Park, and shall recommend to the Executive Committee candidates for the various positions in the Park. He shall also perform all such other duties in connection with the business, scientific and literary administration of the Society as may be assigned to him by the Executive Committee.

SEC. 7. The Director of the Aquarium shall be elected annually by the Executive Committee, and shall hold office until removed or his successor is chosen by said Committee. He shall be the responsible administrative officer of the Aquarium, and shall recommend to the Executive Committee all candidates for positions in the Aquarium. The Director of the Aquarium shall be *ex-officio* a member and Chairman of the Aquarium Committee. He shall perform such other duties in connection with the Aquarium as may be assigned to him by the Executive Committee.

ARTICLE IV.

COMMITTEES.

SEC. 1. There shall be two standing committees, the Executive Committee and the Auditing Committee, which shall hold office for one year or until their successors are elected.

Sec. 2. The Executive Committee shall consist of seven Managers, together with the President and Secretary of the Society *ex-officio*. Four members shall constitute a quorum, and all meetings shall be called by the Chairman. The Executive Committee shall fill all vacancies in its own number and shall have the full powers of the Board of Managers, except so far as such delegation of power may be contrary to law.

Sec. 3. The Executive Committee shall have the control and regulation of the collections, library and all other property of the Society, and shall have power to purchase, sell and exchange specimens and books, to employ and control all officials and employees of the Society, Park, and Aquarium, and generally to carry out in detail the directions of the Board of Managers and the terms of any contract between the City, or Park Board, and the Society.

Sec. 4. All the rules and regulations for the examination of applicants for the various positions in the Park and Aquarium shall be made or approved by the Executive Committee.

Sec. 5. The Executive Committee may regulate the auditing and payment for all current accounts.

Sec. 6. The Executive Committee shall annually appoint an Aquarium Committee, whose duties and powers are set forth in Section 11 of Article IV. of these By-Laws.

Sec. 7. The Executive Committee shall annually appoint a Nominating Committee, whose duties and powers are set forth in Sections 6 and 7, Article II. of these By-Laws.

Sec. 8. It shall also appoint a Scientific Council, whose powers and duties are set forth in Section 2 of Article V. of these By-Laws.

Sec. 9. The Committee shall make a written report at each regular meeting of the Board of Managers.

Sec. 10. The Auditing Committee shall consist of three regular members of the Society, in addition to the President and Secretary, members *ex-officio,* and vacancies shall be filled by the Executive Committee. It shall be the duty of the Auditing Committee to audit, annually, the accounts of the Treasurer, of the Director of the Zoological Park, and of the Director of the Aquarium, and any other accounts of the Society, and shall report to the Board of Managers at its annual meeting.

Sec. 11. The Executive Committee shall annually appoint an Aquarium Committee of five members of this Society, who shall hold office until their successors are chosen. All vacancies shall be filled by the Executive Committee. The Director of the Aquarium shall be *ex-officio* a member and the Chairman of the Aquarium Committee, and such Committee may vest in him any or all of its powers. The Chairman of the Executive Committee and the Secretary of the Society shall also be *ex-officio* members of the Aquarium Committee. Three members shall constitute a quorum. The Executive Committee may delegate to the Aquarium Committee such powers as it may deem proper.

ARTICLE V.

SCIENTIFIC COUNCIL.

Sec. 1. The Executive Committee shall annually appoint a Scientific Council of not more than ten members, and shall fill all vacancies. Members of the Council shall hold office until their successors are appointed.

Sec. 2. The duties of the Council shall be to act as an advisory board in all matters pertaining to the scientific administration of the Society, and especially as to the scientific features of the Park, the promotion of zoology by publications and otherwise, and the preservation of the native fauna of America.

Sec. 3. Four members, including the Chairman, shall constitute a

quorum. The Chairman shall be elected annually by the Council. The Chairman of the Executive Committee and the Secretary of the Society shall be members *ex-officio* of the Council.

ARTICLE VI.

MEMBERS.

SEC. 1. The present members and such others as shall become associated with them, under the conditions prescribed by the By-Laws, shall be members of this Society as long as they shall comply with the By-Laws.

SEC. 2. Members failing to comply with these By-Laws, or for other good and sufficient cause, may be expelled from the Society by the Executive Committee.

SEC. 3. Candidates for membership shall be proposed and seconded by members of the Society. The name, occupation and place of residence of every member so proposed shall be submitted for election to the Board of Managers or the Executive Committee, and such person, when elected, shall become a member upon payment of the annual dues, or of the fees as prescribed below.

SEC. 4. The annual dues shall be ten dollars, payable in advance, on the first day of May of each year, but the Executive Committee may remit the dues for the current year in the case of members elected between January 1st and May 1st of each year. The classes of membership shall be as follows:

SEC. 5. The payment of $200 at one time shall constitute any member a Life Member.

SEC. 6. The payment of $1,000 at one time, or in the case of a Life Member, of $800, shall constitute any member a Patron.

SEC. 7. The payment of $2,500 at one time, or in the case of a Patron of $1,500, or of a Life Member of $2,300, shall constitute any member an Associate Founder.

SEC. 8. Any member who shall donate to the Society $5,000, or property of equal value, or any Associate Founder who shall donate $2,500, or any Patron who shall donate $4,000, may be elected by the Board of Managers or Executive Committee a Founder.

SEC. 9. Any member who shall have donated to the Society ten thousand dollars ($10,000), or its equivalent, may be elected by the Board of Managers or the Executive Committee a Founder in Perpetuity. Such Founder in Perpetuity shall have the power to designate by a last will and testament his successor, who shall thereupon be entitled to all the rights and privileges of the original Founder in Perpetuity, including the right of designating in turn his successor.

SEC. 10. Any member who shall donate to the Society $25,000, or any Founder who shall donate $20,000, may be elected by the Board of Managers or Executive Committee a Benefactor. A Benefactor shall have all the rights and privileges of a Founder in Perpetuity.

SEC. 11. Persons who have rendered marked service in the science of zoology or natural history may be elected Honorary Members, but not more than three such Honorary Members shall be elected in any one calendar year.

SEC. 12. A resident member who shall have rendered marked scientific or professional services to the Society in any branch of its work may be elected by the Executive Committee a Life Member, Patron, Associate Founder, or Founder. A resident of New York who shall have rendered marked services in zoology or natural history may be elected by the Executive Committee a Permanent Fellow.

SEC. 13. Non-residents who communicate valuable information to the Society, or who have rendered marked service in the science of zoology or natural history, may be elected Corresponding Members.

SEC. 14. Benefactors, Founders in Perpetuity, Founders, Associate Founders, Patrons, Life Members, Honorary Members, Permanent Fellows and Corresponding Members shall be exempt from annual dues.

ARTICLE VII.

PRIVILEGES OF MEMBERS.

SEC. 1. A member's ticket admits the member and his immediate family to the Park on reserve days, and to all lectures and special exhibitions, and may be used by the member's immediate family, and shall be good for the current year.

SEC. 2. Admission tickets to the Park and Aquarium on reserve days are issued to members for distribution, and are good for the current year.

SEC. 3. Each member of the Society is entitled annually to a member's ticket and to ten admission tickets.

SEC. 4. Each member shall also receive one copy of the catalogue or handbook, the report and official publications of the Society, and shall have all the privileges of the Library and Members' Building.

SEC. 5. No member shall be entitled to the privileges enumerated in this Article unless his annual dues shall have been paid.

SEC. 6. The Life Members shall have all the privileges of Members and ten additional admission tickets.

SEC. 7. Benefactors, Founders in Perpetuity, Founders, Associate Founders and Patrons shall have all the privileges of Life Members, and shall in addition receive copies of all scientific works published by the Society.

SEC. 8. Any member who shall fail to pay his annual dues within three months after the same shall have become due, and after notice of thirty days, by mail, shall cease to be a member of the Society; subject, however, to reinstatement by the Board of Managers or Executive Committee for good cause shown.

SEC. 9. Any person elected to membership who shall fail to qualify within three months after notice of his election shall be considered to have declined his election; but such term may be extended by the Board of Managers or Executive Committee.

ARTICLE VIII.

FINANCES.

SEC. 1. The fiscal year of the corporation shall be the calendar year commencing January 1st and ending December 31st.

SEC. 2. Neither the Society nor any of its Managers or Officers shall contract any debt which, with existing debts, shall exceed in amount the funds then in the Treasury, except to meet expenditures for which the city is liable, and for which the Society will be reimbursed by warrants from the Comptroller's office.

ARTICLE IX.

AMENDMENTS.

SEC. 1. Amendments to these By-Laws may be proposed, in writing, at any meeting of the Board of Managers, and adopted by unanimous consent of the Managers present, or if such proposed amendment shall fail to receive unanimous consent, the Secretary shall, with the notices of the next meeting, send a copy of it to each Manager and state that it will be brought up for action at such meeting, when it may be passed by a majority vote.

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