

what extent the author had his tongue in his cheek throughout the entire book, in view of his remark on page 31: "But make no mistake; one can quite readily become an excellent physicist even if one's intellectual faculties are not highly developed."

The final chapter, "The atomic scientist and the believer," seems quite uncalled for and has no apparent connection with the rest. One wonders whether there is in France an intransigent core of fundamentalists who have to be appeased in some way.

All in all, in spite of its lively style and not infrequent flashes of insight, the book leaves an unpleasant taste.

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## Birds, Bees, and Good Society

### Communication among Social Bees.

Martin Lindauer. Harvard University Press, Cambridge, Mass., 1961. 143 pp. Illus. \$4.75.

**The Herring Gull's World.** Niko Tinbergen. Basic Books, New York, ed. 2, 1961. 255 pp. Illus. \$5.

These books are about similar subjects, and you can more than double your enjoyment by reading them one after the other, for then there is the added pleasure of contrasting both the authors and their favorite animals.

Lindauer was a student of Karl von Frisch. And this book carries further the studies summarized in von Frisch's wonderful *Bees: Their Vision, Chemical Senses, and Language*. Lindauer continues by asking specific questions about the society of the honeybees. First he asks how the work is divided among the inhabitants of the hive. He approached the question by watching individual bees, night and day, with stop watch in hand, until he had a detailed time-motion study. Bee No. 107, observed for 177 hours, spent all of 69 hours and 53 minutes just loafing. Between rests, she frequently strolled through the hive, not aimlessly it seems, but on patrol to see which chores—cell cleaning, brood tending, guarding, and the like—needed doing. In the hive, labor is organized by the workers coming across something that has to be done and then doing it, not by directives from above.

Lindauer goes on to consider communication among the bees. In the heat of summer, the bees cool the hive, as much as 35° centigrade, by sprinkling water over the brood cells. Water is fetched to the hive by the older, foraging bees. The number of trips made by the foragers is determined by how quickly the hive bees take the water load. This relationship is demonstrated on a graph in which the number of collecting flights is plotted as a function of the time taken to deliver the water load. When the delivery time is less than 40 seconds, the foragers also give an "alerting" dance, to recruit others to the work. This kind of careful measurement is the mark of von Frisch passed on to his student.

Next Lindauer asks how a swarm of bees selects a new site for a hive. It turns out that the scouts report by means of a dance which shows the direction, the distance, and the quality of a proposed site. The swarm remains, for days if necessary, in temporary quarters until the scouts reach a consensus on the best possibility, then the whole swarm moves off to the new site. These are just samples of the book's contents. Lindauer also discusses the evolution of communication in honeybees, which he studied by observing other species of bees, and some of the sensory and computational problems involved in using the sun as a reference point for the well-known food collecting dances. One fascinating discovery is that bees which have been raised in a cellar under artificial light need to practice for some days before they can navigate by the sun. They must learn how the sun moves. But after seeing the arc of the sun only in the afternoon, they can navigate in the morning on the first try.

Tinbergen's book has a broader goal. For years he watched with infinite, patient care the day-to-day life of the herring gull. His aim was to understand the significance of every movement and of every call and to see how the somewhat rudimentary society of the gullery is organized. Tinbergen's conclusions are drawn mostly from field notes; the relatively few experiments reported here were also discussed in his *Study of Instinct*. The focus of *Herring Gull's World* is not on the experimental analysis of behavior; the volume is, in the finest sense, a work of natural history. He pays particular attention to reproduction and rearing of the young, from the first arrival at the

gullery, the establishment and defense of the territories, pair formation, incubation, and the feeding and behavioral development of the chicks. The present book is a slightly revised edition of the work first published in 1953.

These books by Tinbergen and Lindauer are clearly separated by aspiration and by method. Undoubtedly Lindauer's approach is more satisfying to the experimental scientist; we know the questions, the observations, and the numerical results. On the other hand, Lindauer's questions are based on generations of observation of life in the bee hive, exactly the sort of natural history that Tinbergen provides for the herring gull. Both types of work are necessary, and the two books are perfect examples of two levels of scientific exploration. It is somewhat amusing, however, to see that Tinbergen reaches far more sweeping conclusions about behavior in general.

Perhaps in these books there are also line-by-line hints of how the authors' temperaments determine their approach. Tinbergen loves his birds, he delights in their motions and abilities, he writes of them with joy and verve—and his enthusiasm is catching. He also tells a good deal about Niko Tinbergen—every reader will want to meet the charming author. Lindauer writes with precision. He leaves untold his adventures encountered in following bees from Germany to Ceylon to South America; the excitement comes from the subject itself. Both books are well illustrated.

A comparison between the animals only re-emphasizes the astounding complexity of the bees, whose behavior puts most vertebrate societies to shame.

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## New Books

### Biological and Medical Sciences

**British Flies.** Empididae. J. E. Collin. Cambridge Univ. Press, New York, 1961. 227 pp. Illus. + plate. \$6.

**The Cell and the Organism.** J. A. Ramsay and V. B. Wigglesworth, Eds. Cambridge Univ. Press, London, 1961. 357 pp. Illus. \$9.50.

**The Ciliated Protozoa.** Characterization, classification, and guide to the literature. John O. Corliss. Pergamon, New York, 1961. 310 pp. Illus. + plate. \$12.

**Contributions to the Systematics of Oriental Termites.** M. L. Roonwal and P. K. Sen-Sarma. Indian Council of Agricultural Research, New Delhi, 1960. 420 pp. Illus. + plates. \$9.

**The Extra Pharmacopoeia Martindale.** Supplement 1961 to vol. 2, ed. 23 (1955), and vol. 1, ed. 24 (1958). Pharmaceutical Press, London, 1961. 324 pp. \$6.50.

**Faune de France.** 65. *Poissons d'Eau Douce*. Charles Jacques Spillmann. Lechevalier, Paris, 1961. 303 pp. Illus.

**Mammals of the Southwest Mountains and Mesas.** George Olin. Southwestern Monuments Assoc., Globe, Ariz., 1961. 141 pp. Illus. Paper, \$2; cloth, \$3.25.

**The Mites of Stored Food.** Ministry of Agriculture, Fisheries, and Food, Technical Bulletin No. 9. A. M. Hughes. Her Majesty's Stationery Office, London, 1961 (order from British Information Services, New York 20). 293 pp. Illus. \$3.30.

**Physiological Responses to Hot Environments.** MRC Special Report, No. 298. Compiled by R. K. MacPherson. Her Majesty's Stationery Office, London, 1960. 338 pp. Illus. \$6.55.

**The Salmon.** J. W. Jones. Harper, New York, 1959. 208 pp. Illus. \$4.50.

**Physiology of Plants.** P. Font Quer. Harper, New York, 1960. 126 pp. \$2.25.

**Pioneer Microbiologists of America.** Paul F. Clark. Univ. of Wisconsin Press, Madison, 1961. 383 pp. \$6.

**Progress in Industrial Microbiology.** vol. 3. D. J. D. Hockenhull, Ed. Interscience, New York, 1961. 237 pp. Illus. \$8.50.

**The Spinal Cord.** Basic aspects and surgical considerations. George Austin. Thomas, Springfield, Ill., 1961. 546 pp. Illus. \$26.50.

**Stedman's Medical Dictionary.** Williams and Wilkins, Baltimore, Md., 1961. 1680 pp. Illus. + plates. \$14.95.

**A Survey of the Dragonflies (Order Odonata) of Eastern Africa.** E. C. G. Pinhey. Clowes, London, 1961. 221 pp. 50s.

**Synopsis of Histology.** Henry J. Werner. McGraw-Hill, New York, 1961. 156 pp. \$4.25.

**Toxicology.** Mechanisms and analytical methods. vol. 2. C. P. Stewart and A. Stolman, Eds. Academic Press, New York, 1961. 937 pp. Illus. \$25.

**Vitamins and Hormones.** Advances in research and applications. vol. 18. Robert S. Harris and Dwight J. Ingle, Eds. Academic Press, New York, 1960. 629 pp. Illus. \$15.

**Weed Control.** As a science. Glenn C. Klingman. Wiley, New York, 1961. 429 pp. Illus. \$8.50.

## Economics and the Social Sciences

**An Introduction to Psychoanalytic Theory of Motivation.** Walter Toman Pergamon, New York, 1960. 365 pp. \$9.

**Life and Ritual in Old Siam.** Three studies of Tai life and customs. Phya Anuman Rajadhon. Translated and edited by William J. Gedney. HRAF Press, New Haven, Conn., 1961. 191 pp. Illus. Paper, \$4.50.

**Man in Process.** Ashley Montagu. World, Cleveland, Ohio, 1961. 313 pp. Illus. \$4.50.

**The Political Kingdom in Uganda.** A study of bureaucratic nationalism. David

E. Apter. Princeton Univ. Press, Princeton, N.J., 1961. 514 pp. Illus. + plates. \$10.

**A Rorschach Reader.** Murray H. Sherman, Ed. International Universities Press, New York, 1960. 456 pp. Illus. \$7.50.

## General

**The Biblical Archaeologist Reader.** G. Ernest Wright and David Noel Freedman, Eds. Quadrangle Books, Chicago, Ill., 1961. 358 pp. Illus. \$6.75.

**A Catalogue of Instruments and Models in the Possession of the American Philosophical Society.** Robert P. Multhauf. American Philosophical Society, Philadelphia, Pa., 1961. 91 pp. Illus. \$1.50.

**Cybernetics.** Or control and communication in the animal and the machine. Norbert Wiener. M.I.T. Press and Wiley, New York, ed. 2, 1961. 228 pp. Illus. \$6.50.

**Dinosaurs.** Their discovery and their world. Edwin H. Colbert. Dutton, New York, 1961. 314 pp. Illus. \$7.50.

**European Military Museums.** A survey of their philosophy, facilities, programs, and management. J. Lee Westrate. Smithsonian Institution, Washington, D.C., 1961. 215 pp. Illus.

**I Can Learn about Calculators and Computers.** Raymond G. Kenyon. Harper, New York, 1961. 112 pp. Illus. \$2.95.

**Writing a Technical Paper.** Donald H. Menzel, Howard Mumford Jones, and Lyle G. Boyd. McGraw-Hill, New York, 1961. 141 pp. Illus.

## Mathematics, Physical Sciences, and Engineering

**Advances in Electronics and Electron Physics.** vol. 14. L. Marton, Ed. Academic Press, New York, 1961. 351 pp. Illus. 88s.

**Axial Flow Fans.** Design and practice. R. A. Wallis. Academic Press, New York, 1961. 375 pp. Illus. \$10.

**Azo and Diazo Chemistry.** Aliphatic and aromatic compounds. Heinrich Zollinger. Translated by Harry E. Nursten. Interscience, New York, 1961. 444 pp. \$16.50.

**Calculus.** George B. Thomas. Addison-Wesley, Reading, Mass., 1961. 863 pp. Illus. \$8.75.

**Colorimetric Methods of Analysis.** Including photometric methods. vol. 3A. Foster Dee Snell and Cornelia T. Snell. Van Nostrand, Princeton, N.J., 1961. 586 pp. Illus. \$10.75.

**Columbium Metallurgy.** D. L. Douglas and F. W. Kunz, Eds. Interscience, New York, 1961. 762 pp. Illus. \$26.

**Concepts in Electricity and Magnetism.** Reuben Benumof. Holt, Rinehart and Winston, New York, 1961. 384 pp. Illus. \$5.75.

**Crossed-Field Microwave Devices.** vols. 1 and 2. E. Okress *et al.*, Eds. Academic Press, New York, 1961. Illus. 670 pp., \$22; 542 pp., \$18.

**Dispersion Relations.** G. R. Screaton, Ed. Oliver and Boyd, Edinburgh; Interscience, New York, 1961. 303 pp. Illus. \$9.25.

**Dispersion Relations and the Abstract Approach to Field Theory.** Lewis Klein,

Ed. Gordon and Breach, New York, 1961. 283 pp. Illus. \$4.95.

**Electromechanical System Theory.** Herman E. Koenig and William A. Blackwell. McGraw-Hill, New York, 1961. 520 pp. Illus. \$14.50.

**Field Geology.** Frederic H. Lahee. McGraw-Hill, New York, ed. 6, 1961. 957 pp. Illus. \$10.75.

**Forces and Fields.** The concept of action at a distance in the history of physics. Mary B. Hesse. Nelson, London, 1961. 328 pp. Illus. 35s.

**Fortschritte in der Kinetik der homogenen Gasreaktionen.** Z. G. Szabó. Steinkopff, Darmstadt, Germany, 1961. 251 pp. Illus. DM. 40.

**Geology of Norway.** vol. 1. Olaf Holte-dahl, Ed. Oslo Univ. Press, Oslo, 1960. 540 pp. Illus. + maps. \$15.

**Management Models and Industrial Applications of Linear Programming.** vol. 1. A. Charnes and W. W. Cooper. Wiley, New York, 1961. 490 pp. Illus. \$11.75.

**Mathematical Machines.** vol. 1, *Digital Computers*, 307 pp., illus., \$12.50; vol. 2, *Analog Devices*, 373 pp., illus., \$17.50. Francis J. Murray. Columbia Univ. Press, New York, 1961.

**Mathematical Programming.** S. Vajda. Addison-Wesley, Reading, Mass., 1961. 319 pp. Illus. \$8.50.

**Mechanical Behavior of Materials at Elevated Temperatures.** John E. Dorn, Ed. McGraw-Hill, New York, 1961. 541 pp. Illus. \$14.50.

**Natural Polymer Man-Made Fibres.** C. Z. Carroll-Porczynski. Academic Press, New York, 1961. 314 pp. Illus. \$9.50.

**Norway North of 65.** Ornuly Vorren, Ed. Oslo Univ. Press, Oslo, 1961. 271 pp. Illus. \$5.50.

**The Optimal Design of Chemical Reactors.** A study of dynamic programming. Rutherford Aris. Academic Press, New York, 1961. 191 pp. Illus. \$7.

**Physical Chemistry of Macromolecules.** Charles Tanford. Wiley, New York, 1961. 724 pp. Illus. \$18.

**Physics of the Aurora and Airglow.** Joseph W. Chamberlain. Academic Press, New York, 1961. 722 pp. Illus. \$16.50.

**Progress in Astronautics and Rocketry.** vol. 3, *Energy Conversion for Space Power*, Nathan W. Snyder, Ed., 795 pp., illus., \$7.25; vol. 5, *Electrostatic Propulsion*, David B. Langmuir, Ernst Stuhlinger, and J. M. Sellen, Jr., Eds., 590 pp., illus., \$5.75. Academic Press, New York, 1961.

**Progress in Optics.** vol. 1. E. Wolf, Ed. North-Holland, Amsterdam; Interscience, New York, 1961. 354 pp. Illus. \$12.

**Reactor Handbook.** Fuel reprocessing. vol. 2. S. M. Stoller and R. B. Richards, Eds. Interscience, New York, ed. 2, 1961. 677 pp. Illus. \$21.40.

**Shock and Vibration in Linear Systems.** Paul A. Crafton. Harper, New York, 1961. 426 pp. Illus. \$10.

**Temperature Measurement in Engineering.** vol. 2. H. Dean Baker, E. A. Ryder, and N. H. Baker. Wiley, New York, 1961. 517 pp. Illus. \$13.

**The Third Law of Thermodynamics.** J. Wilkes. Oxford Univ. Press, London, 1961. 150 pp. Illus. 15s.

**Water Hammer in Hydraulics and Wave Surges in Electricity.** L. Bergeron. Wiley, New York, 1961. 316 pp. Illus. \$15.