Casting Doubt on Ptolemy

The Crime of Claudius Ptolemy. ROBERT R. NEWTON. Johns Hopkins University Press, Baltimore, 1977. xvi, 412 pp., illus. $22.50.

Ptolemy is commonly considered one of the outstanding scientists of antiquity. His most famous work, the *Syntaxis Mathematike*, better known as the *Almagest*, is seen as a model of clear exposition in which each result is derived from a set of stated observations by rigorous mathematical procedures that are carefully described. This view has been challenged by a number of post-Renaissance scientists, most recently by R. R. Newton. In *The Crime of Claudius Ptolemy*, the latest in a series of studies, Newton asserts that Ptolemy fabricated *all* his own observations to fit a predetermined theory; that is, that the observations were made up to agree with the numerical tables, rather than that the tables were based on the observations as Ptolemy asserted. Moreover, Newton concludes: "His work is [also] riddled with theoretical errors and failures of comprehension. . . . The *Syntaxis* has done more damage to astronomy than any other work ever written, and astronomy would be better off if it had never existed" (pp. 378–379).

Unfortunately, Newton's arguments in support of these charges are marred by all manner of distortions, misunderstandings, and excesses of rhetoric due to an intensely polemical style. Those who denigrate Ptolemy typically claim that he "borrowed" his results from Hipparchus. The evidence is almost always taken from the *Almagest*, which is the largest repository of information about Hipparchus, whose major works are all lost. So, for example, Newton argues that Ptolemy's value for E (the maximum lunar equation) came from Hipparchus. In support of this he refers to Ptolemy's remark that he used the same method as Hipparchus to find this parameter. There is, however, overwhelming evidence that Hipparchus had values for E that differ significantly from Ptolemy's value, and the evidence is from Pappus citing lost works of Hipparchus as well as from Ptolemy (*1*). Moreover, the method is probably due to Apollonius, who preceded Hipparchus (*2*). If anything, recent studies have shown that Ptolemy overpraises Hipparchus, the great "seeker of truth," and we now know that many Hipparchian parameters derive from the Babylonians (see, for example, *3*).

Newton's misunderstanding of the recent secondary literature can be illustrated by his treatment of Ptolemy's procedure for finding the obliquity of the ecliptic (the angle between the celestial equator and the ecliptic) from noon altitudes of the sun. Britton (*4*) showed that with the instrument Ptolemy described he could not take the measurement at noon because at that time the graduated arc would be entering the shadow cast by the instrument. If, as is most likely, he took the observations about half an hour before noon and extrapolated the noon altitude from the observed altitude, he would get the results he claims to have obtained, and not the correct value. The reason is that a subtle error (not even mentioned by Newton) enters the extrapolation that remained unnoticed from antiquity through modern times. By no stretch of the imagination can one say that Britton was arguing that Ptolemy made an error of half an hour in determining noon (Newton, p. 100, and a news report in *Science* [*5*] notwithstanding).

On his own account the strongest argument for Newton's case is that Ptolemy's observations of the equinoxes agree with Hipparchus's solar model very closely but differ from modern recomputation by about a day, from which Newton concludes that the data were fabricated: "Whatever assumptions [the reader] makes, he cannot explain the errors in Ptolemy's times by the hypothesis that they were obtained from observation" (p. 92). First, Ptolemy gives full credit to Hipparchus for his solar model (though the tables in the *Almagest* may not be in the form that Hipparchus used). Second, the errors in the observations and their agreement with Hipparchus are not in doubt. But how did Ptolemy proceed? He was prepared to make his observations at the times predicted by Hipparchus's theory, and when he failed to come up with better results he kept his predecessor's theory. Ptolemy described the difficulties with these observations that may even lead to multiple apparent equinoxes, and other problems have been noted by Britton (*6*; cited by Newton, p. 93). For example, Ptolemy does not consider the effects of atmospheric refraction, which Britton shows cannot be neglected (and which Newton neglects). But this brings up another point. Ptolemy presents the solar theory before his lunar, stellar, and planetary theories because the solar theory is invoked in all of them. Indeed, it is probable that the success of his lunar theory was taken by him as confirming evidence for his solar theory. But even the *observations* depend on the solar theory, and his planetary observations began in A.D. 127, well before his solar observations. His research program was surely to assume that Hipparchus's solar theory was correct in order to use it to deal with the hitherto unsolved problems of planetary motion. To reject this solar theory at the end of his research would have meant rewriting the entire book and perhaps redoing many of the observations. Having published all the necessary procedures, Ptolemy preferred to indicate the difficulties and to leave it to his successors to come up with better solutions.

Finally, it has long been known that many of Ptolemy's planetary and lunar parameters are more accurate than his observations. But to posit unknown predecessors as does Newton (p. 367) is a move of desperation. Indeed, Ptolemy tells us that he had more observations at his disposal than he cites (*Almagest* IX, 2), and this suggests that those displayed were chosen for their agreement with a theory that in some sense derives from the larger body of observations. There are a number of ways to pursue this line of research, but Newton's work does not point us in that direction.

BERNARD R. GOLDSTEIN
Department of History and Philosophy of Science, University of Pittsburgh, Pittsburgh, Pennsylvania 15260

References

1. G. J. Toomer, *Centaurus* **12**, 145 (1967).
2. O. Neugebauer, *A History of Ancient Mathematical Astronomy* (Springer-Verlag, New York, 1975), p. 265.
3. A. Aaboe, *Centaurus* **4**, 122 (1955).
4. J. P. Britton, *ibid.* **14**, 29 (1969).
5. N. Wade, *Science* **198**, 707 (1977).
6. J. P. Britton, "On the Quality of Solar and Lunar Observations and Parameters in Ptolemy's Almagest," Ph.D. dissertation, Yale University, 1967.

Persons and Situations

Personality at the Crossroads. Current Issues in Interactional Psychology. Papers from a symposium, Stockholm, June 1975. DAVID MAGNUSSON and NORMAN S. ENDLER, Eds. Erlbaum, Hillsdale, N.J., 1977 (distributor, Halsted [Wiley], New York). x, 454 pp. $24.95.

One assumption behind much personality theorizing has been that people can be meaningfully described in terms of characteristics such as friendliness or honesty or persistence. To have utility for psychologists this view requires that there be reasonable consistency in these behaviors across a range of relevant situations. That there is such consistency is compellingly self-evident. Unfortunately it has not been demonstrated in research; instead the importance of situational factors in determining behavior has become apparent. As a result, researchers in personality face a crisis. This book addresses the crisis and is aimed toward resolving it by studying the interaction between personal and situational factors. Most of the 29 chapters were written by psychologists who are sympathetic to the traditional viewpoint. A variety of defenses and remedies are proposed.

Magnusson and Endler's introductory section makes some fine conceptual points; however, it is unnecessarily so full of jargon and so abstract that it would make little sense to anyone not already totally familiar with the issue.

The authors of the seven chapters in part 2 tend to deny that any crisis exists, either by retaining a belief in behavioral consistency or by down-playing the importance of the problem. Block, for example, concedes that overt behaviors have not been demonstrated to be consistent but blames this failure on inadequate research, not faulty theory. He points out that there is evidence of agreement over time in self-reports of personality, agreement between observers' ratings, and agreement between self and observer ratings.

Part 3 contains eight chapters which present some of the best traditional type of research on the person-situation interaction. The chapters by Fiedler and by Berkowitz, for example, each focus on one type of behavior (leadership and aggression) and investigate how personal and situational factors combine to determine behavior.

Part 4 presents three different methodological critiques. Nisbett's comments are particularly interesting. He points out some pitfalls of the traditional interactionist approach and warns against a wholesale switch in that direction. This is undoubtedly not a popular position to take at a symposium on interactional psychology. The chapter definitely merits reading.

The final section contains ten chapters which provide new strategies for investigating the person-situation interaction. Raush recommends an analysis of ongoing interpersonal interactions. This approach, which recognizes the dynamic relation between persons and situations (including other persons), is suggested in some form by a number of contributors. Mischel, a major instigator of the current crisis, provides a fine statement of his position. He also points out that interactions have been demonstrated repeatedly but have not been explained and suggests clarifying how situations influence behavior by investigating cognitive variables such as competencies, expectancies, and self-regulatory systems.

This book is not intended for the lay reader. The chapters vary considerably, but all assume some sophistication in psychology. This is a very valuable collection. The controversy itself is an important one and has served as a vehicle for discussing many important aspects of personality research and theory.

ANDREA ALLEN
Department of Psychology, University of Virginia, Charlottesville 22901

Developmental Interactions

Cell and Tissue Interactions. Papers from a meeting, Woods Hole, Mass., Sept. 1976. JAMES W. LASH and MAX M. BURGER, Eds. Raven, New York, 1977. xiv, 318 pp., illus. $23.50. Society of General Physiologists Series, vol. 32.

Understanding of the molecular events in cellular interactions that lead to new or altered patterns of gene expression will require fundamental knowledge of the makeup of the interaction interfaces between cells. These interfaces include not only the plasma membranes, with their component glycoproteins, but also extracellular macromolecules such as collagens and proteoglycans.

This collection of symposium papers offers a series of updated reviews of what is known about tissue interactions as they apply to the morphogenetic behavior and differentiation of selected developmental systems. The trick for a successful book of this kind is to provide an impact greater than the sum of the individual papers. It seems to me that the book has that potential, which can be realized by a reorganization of the papers into two integrated groups. The first such group are the papers on interaction-dependent adhesion and migration. Abercrombie *et al.* provide an updated view of the roles of intracellular organelles and cellular adhesivity in controlling the shape and locomotion of fibroblasts in vitro and emphasize the importance of the environment in regulating translocomotory activity. Seen in this light, the correlations between in vivo locomotion and the hyaluronate and proteoglycan constitution of extracellular matrices, discussed by Toole *et al.*, take on added significance. Similarly, since cell-cell recognition must occur during cell migration in the embryo, the papers on cell surface adhesion offer insight into that process, assessing the components, properties, and theoretical nature of the events in several model systems, including sponge reaggregation (Burger and Jumblatt) and neural retina reaggregation (Moscona and Hausman, Lilien and Rutz). In addition, Glaser *et al.* review their work on factors involved in neural retina–optic-tectum adhesion, an interaction that, in vivo, follows the migratory phase of axonal growth. Finally, the possibility that cell surface glycosyltransferases function in these recognition interactions is supported by the demonstration by Roth *et al.* of a correlation between such enzymatic activity and migratory cell types in the embryo. These papers culminate with the studies of Le Douarin, which suggest few, if any, innate migratory preferences in neural crest cells. Rather, the environment appears to dictate the migratory routes. However, acquisition of a final differentiated phenotype appears not to require migration but to be a function of the final environment in which the cell finds itself.

This conclusion leads to what could be seen as the second integrated section of the book, one dealing with tissue interactions and extracellular materials in the differentiative activities of defined or "localized" tissue or organ primordia. This group includes the general discussion by Saxén of such "classical" systems as kidney and integument and his introduction of the view that both permissive and directive influences are involved in embryonic determination. Papers on tooth development (Slavkin *et al.*), cartilage development in somites (Lash and Vasan) and limb (Toole *et al.*), and corneal development (Hay) provide evidence that tissue interactions lead to alterations in the composition of the extracellular matrix and that the extracellular matrix can alter the synthetic and secretory activity of the cells in developmentally significant ways. These conclusions are underscored by the reviews of Miller and Muir on the collagens and proteoglycans of extracellular matrices, precisely the molecules that are present and involved in developmental tissue interactions. Thus, cells respond to their environment and contribute to it and respond again as the environment alters. The interaction interface mediates the interaction.

These two themes are not all the book offers. The review of calcium ion and cyclic nucleotide involvement in cell surface regulatory events (Rasmussen) draws attention to the ionic composition of the environment as potentially instrumental in tissue interactions. The relations between these small molecules and the macromolecules of the extracellular matrix remain to be determined. Auerbach reports on the inductive capabilities