doubt. Again, Polanyi presents us with the image of scientists necessarily living within a framework of tacit beliefs and commitments, where personal faith is the presupposition of even the most radical revolution. However, as I mentioned above, this faith, while personal, is not "subjective"—that is, not arbitrary or capricious. It is, Polanyi holds, "responsible."

Part 3 attempts a justification of personal commitment, in order to distinguish it from the capricious and the arbitrary. This is, in my opinion, the weakest section of the work. "Within the framework of a commitment, to say that a sentence is true is to authorize its assertion . . . the verification of a statement is transposed into giving reasons for deciding to accept it, though these reasons will never be wholly specifiable" (page 320). Polanyi's problem now is to make sense out of his distinction between the personal and the subjective; for if knowledge contains an irreducible factor of belief—a belief moreover which can never be adequately grounded—how is it to be distinguished from superstition and error? And Polanyi most certainly wants to distinguish science from superstition, wishful thinking, and fantasy. The latter are "subjective"; the former is personal—that is, "responsible." But both rest upon beliefs which can never be formalized or demonstrated adequately. How, then, are the two to be distinguished? And here I must admit to a profound disappointment. "It is enough" Polanyi says, "to establish here once more the principle which distinguishes them: namely, that commitment is personal choice seeking and eventually accepting something believed (both by the person incurring the commitment and the writer describing it) to be impersonally given, while the subjective is altogether in the nature of a condition to which the person in question is subject" (page 302). And a few sentences further on he states, "The scientist pursuing an enquiry *ascribes* [italics mine] impersonal status to his standards and claims, because he regards them as impersonally established by science. But his submission to scientific standards for the appraisal and guidance of his efforts is the *only sense* in which these standards can be said to pre-exist or even to exist at all for him. . . . I can speak of facts, knowledge, proof, reality, etc., within my commitment situation for it is constituted by my search for facts, knowledge, proof, reality, etc., as binding on me. These are proper designations for commitment targets which apply so long as I am committed to them; but they can not be referred to non-committally. . . Commitment is in this sense the only path for approaching the universally valid" (pages 302–303). "*Our claim to speak of reality serves thus as the external anchoring of our commitment in making a factual statement*" (page 311).

And so: if I regard the standards of my activity as universal, "impersonally given," then I am personal and responsible, and my activity is scientific, whereas, if in fact I am merely subject to some condition, then I am in fact "subjective." But, the "facts" in question are themselves facts only for *belief*. Hence, we end up with the spectacle of science calling astrology subjective superstition, since science doesn't "believe" in the "facts" of astrology, and of astrology repeating the compliment with respect to science, since its feeling is reciprocal. Each has its own facts, truths, beliefs; each calls itself personal and responsible and its opponent "subjective" and merely involved in certain mental "conditions"; and there is no way out of the impasse.

Now this last, it should be understood, is the conclusion *I* draw from Polanyi's argument, not his; in short, I do not see that Polanyi has provided us in the end with any means whatsoever for distinguishing truth from error, the personal from the subjective, science from superstition, although he is most anxious to do so. For in Polanyi's universe of discourse there are *no* facts, and there is *no* reality independent of a belief which can never be adequately grounded. But surely this is a serious logical muddle. A madman is not less mad by virtue of the passion of his commitment to his world but more so; and to distinguish him from the sane by saying he suffers from "a condition" becomes meaningless within any system such as Polanyi's where fact is dependent upon sheer belief. The logical muddle consists in mixing together two points of view. If, as Polanyi argues, we must always dwell *within* a framework of belief within which there are such things as "facts" and "truths" but outside of which there are none, then indeed we have no right to adjudge any other belief whatsoever "subjective," except insofar as we simply do not share that belief. Page 304 states this as clearly as one could wish: "The 'actual facts' are accredited facts, as seen within the commitment situation while subjective beliefs are the convictions accrediting these facts as seen non-committally by someone not sharing them." And so after a long argument we come at last to this —that questions of true and false, fact and fiction, science and superstition, are merely questions of two different frameworks, two different beliefs, two different commitments; the ontological war of worlds is now a war of beliefs. And where do we go from there? To put it briefly, I think Polanyi has overstated his case and ends up with such a radical subjectivism that he can no longer make sense of some rather crucial distinctions.

The last section of the book develops a theory of evolution which is something like Bergson's, except that Polanyi's is directed to an end. Life culminates in ourselves, and here Polanyi is thinking of the scientist—men who are responsible to a "firmament of obligations . . . truth . . . greatness, and universality." Life is an "ordering principle" which moves toward "liberating" itself, which it does through commitment and belief, and which progresses toward an "unthinkable consummation." God is the last word in the book. Here Polanyi exhibits an admirably synoptic view and achieves expressions of a high order of disciplined beauty.

This sketchy account, however, utterly fails to do justice to a most impressive book. I believe there is a major flaw in Polanyi's position; but even so, his argument against the "objectivist" school is, for me, decisive. I do believe that Polanyi is too much concerned with tracing every activity of man down to the chimpanzees, bees, and worms, and too little concerned with the ultimate logic of his position. But I should not wish to give the impression that this work is anything but a very major attempt to rethink the conditions of scientific knowledge.

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The Geology of South Australia. Prepared by members of the South Australian Division of the Geological Society of Australia. M. F. Glaessner and L. W. Parkin, Eds. Melbourne University Press on behalf of the Geological Society of Australia, 1958 (order from Cambridge University Press, New York 22, N.Y.). Illus. + plates. $8.50.

South Australia, far exceeded in area by three other Australian political subdivisions, is larger than Texas by more than 100,000 square miles. Wide plains and low hills characterize much of the land surface, but in the southeastern part of the state, ranges that trend generally northward are locally rugged, with maximum altitudes exceeding 3000 feet. The northwestern section of the state is arid and has extensive areas mantled with dune sand. The eastern part has moderate rainfall, and a large northeastern district is within the Great Artesian Basin.

Bedrock in South Australia includes great thicknesses of ancient sedimentary strata, which are best displayed in low ranges that extend northward from Gulf Saint Vincent. The oldest bedrock unit, mapped as Archean, consists of many deformed and metamorphosed sedimen-

tary beds and intrusive bodies of igneous rock. A minimum thickness exceeding 30,000 feet of the altered strata has been determined. Unconformable on these basement rocks is the Adelaide system of varied sedimentary formations, classified as Proterozoic or late Precambrian, essentially unmetamorphosed and with maximum total thickness of more than 50,000 feet. Extensive glacial deposits are found at two widely separated horizons in this thick section. Marine formations of Cambrian age, many thousands of feet thick, were laid down conformably above the Adelaide system. Deformation that began later in the Cambrian period culminated in the early Paleozoic orogeny. The resulting chain of mountains extended from Kangaroo Island, southwest of Adelaide, at least 1000 miles to the north and northwest. The present low chains in the state are remnants of this ancient mountain belt, after repeated uplifts, erosion, and local burial by younger sedimentary deposits.

Except for limited outcrops of beds dated doubtfully as Ordovician, the only Paleozoic rocks known to have been formed in South Australia after the mountain making are Permian glacial deposits, which locally rest on glaciated bedrock floors. Mesozoic deposits, partly marine and partly continental, have limited distribution and thickness and are only moderately deformed. Workable coal beds occur locally in Triassic sections. During Cenozoic time some downwarped areas received marine sediments; a widespread cover of continental deposits was formed, and important local uplifts have resulted from warping and faulting.

Details of the geology and of the inferred history are presented in ten chapters, each dealing with a specific province of the state. A brief summarizing chapter integrates the salient points. Geology is represented without topography, on black-and-white sheets—some page-size; others folded tip-ins; the four largest, separate sheets in a pocket. The scales of these maps range from 8 to 16 miles to the inch. The one complete map of the state, in color, is a one-page frontispiece, with scale one inch to 120 miles. Stratigraphic and structural relationships are clearly represented by diagrams, sketches, and a number of excellent halftone plates.

Thus, the treatise is brief and in large part of reconnaissance character. Nevertheless it is a welcome reference volume, presenting the salient geologic features of the entire state and bringing together for the first time much critical information won through field studies during the past 30 years.

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Descriptive Meteorology. Hurd C. Willett and Frederick Sanders. Academic Press, New York, ed. 2, 1959. xix + 355 pp. Illus. $7.50.

This book is very useful. It is a welcome revision of the first edition, which was written, like so many meteorological texts in the United States, as an aid for the training program of World War II. Thousands of weather forecasters were needed by the Armed Forces. At that time the emphasis was on mapping, analysis, and forecasting of weather features. The senior author (who has acquired an able collaborator in this second edition) tried then to meet both the practical demands and the requirements for thorough understanding.

The present volume backs off a little from the practical aspects. It makes up fully for this change by an expanded and much more penetrating probing into the behavior of the atmosphere. After a relatively brief introduction to the thermal and radiative properties of the air, most of the space is devoted to atmospheric motions. The general circulation of the atmosphere and the smaller circulation systems embedded in it and the relative interdependence of these systems, together with their causes, are extremely well discussed. In particular, the chapter on secondary circulations of the thermal type, which includes the monsoons and tropical storms, is excellent. The confusing assortment of currents and eddies, which so bewilders the beginner in atmospheric science, is presented as a logical system. The shortcomings are those inherent in our lack of knowledge of many of the phenomena.

A final chapter is devoted to weather forecasting and weather modification. It contains no magic recipes for either. Rather, the authors give a critique of present capabilities and a seasoned outlook regarding what may reasonably be expected in the next decade or two. In neither field is there anything to please the pseudo scientists who have stirred up extravagant hopes for perfect forecasts and widespread weather control. The research path is a long and hard one, and the incipient meteorologist might as well know it.

This book is designed to give information at the professional level in the field of meteorology. It will serve best in conjunction with a course on the subject, for it raises questions that a beginner will have difficulty in answering for himself. But it can admirably support the necessary companion studies on meteorological observation, dynamic meteorology, and the synoptic laboratory.

On one point I find myself out of step with the authors. In the whole text only five persons are named (presumably, because basic material came from their papers). This leaves the student entirely without historical perspective of the field and its development. I am sure there is little doubt about the stature of Rossby, V. Bjerknes and J. Bjerknes, Palmén, and a good many others. Why not give them credit for their contributions? This would not necessarily require extensive literature citations, which the authors expressly wanted to avoid.

On the whole, it is gratifying to see this addition to the solid texts in a field which needs to attract much talent in the future to help in the solution of its many problems.

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Advances in Chemical Physics. vol. 1. I. Prigogine, Ed. Interscience, New York, 1958. xi + 414 pp. Illus. $11.50.

This is the first of a series of volumes which, it is anticipated, will be published annually. The field of chemical physics is assumed to include such problems as those of chemical kinetics, molecular physics, molecular spectroscopy, transport processes, thermodynamics, the study of the states of matter, and the variety of experimental methods used. The purpose of the series is to make available a group of comprehensive articles each of which is the report of an expert in a particular field, who explains his view on a subject freely and without limitation of space. For the most part the articles are of a review nature and are well done, at an authoritative, advanced level; they are not exactly light reading for one not a specialist in the field under treatment.

The emphasis in this volume is on nonequilibrium effects in transport processes and chemical kinetics, but several articles on other subjects are included. The titles and authors represent adequately what one may expect to find in the volume: "Statistical mechanical theory of transport processes. X. The heat of transport in binary liquid solutions" (13 pages), Richard J. Bearman, John G. Kirkwood, and Marshall Fixman; "Theoretical and experimental aspects of isotope effects in chemical kinetics" (62 pages), Jacob Bigeleisen and Max Wolfsberg; "Some physical aspects of gaseous chemical kinetics" (16 pages), G. Careri; "Dielectric properties of dilute polymer solutions" (42 pages), L. de Brouchere and M. Mandel; "Transport processes in liquids" (30 pages), Frank C. Collins and Helen Raffel; "The relation between structure and chemical reactivity of aromatic hydrocarbons with particular reference to carcinogenic properties" (37 pages), R. Daudel; "Molecular theory of surface tension" (35 pages), A. Harasima; "Re-