essary consequence of the rise of science—which in itself is among the highest intellectual achievements of man. . . . This is no prophecy, only a nightmare. Though I have not taken part in applying scientific knowledge to destructive purposes . . . I feel my own responsibility.

We come closest to Max Born in the last of these three books, in which, just before his death, he collected and commented on his correspondence with Albert Einstein. The two men became acquainted in 1909 at a scientific meeting in Salzburg. Both were in Berlin during the First World War, and their friendship grew during those difficult years. Born was only a few years younger than Einstein, but he looked up to him throughout his life as one might look up to a wiser, more experienced, ideal older brother. The correspondence actually involved three people, with Born's wife, Hedwig, joining in. Her lively and witty letters, often accompanied by her poetry or other writings, drew replies from Einstein written in a lighter vein than his answers to her husband's uniformly serious letters. Born's comments on the correspondence, explaining many of the allusions to people and events, help to fill out the picture of the two men and their changing settings.

An extended correspondence between two thoughtful and articulate men is bound to interest us in a variety of ways. In the present case, the particular fascination is in following the direct exchange of ideas between two great physicists both concerned with fundamental issues during a crucial period in the history of their science. In the early 1920's both men were struggling to find a way out of the seemingly hopeless confusions and contradictions that beset the quantum theory, Einstein proposing one "crucial experiment" after another and Born adapting the complicated methods of Poincaré's perturbation theory to quantum problems. When Werner Heisenberg proposed a new way of attacking the problems in 1925, and Born and Jordan helped give this idea mathematical form as matrix mechanics, Einstein was at first very impressed. "Dull resignation has given way to a unique kind of suspense," he wrote to Mrs. Born early the next year. But within a few months he had grown more skeptical: "An inner voice tells me that it is still not the true Jacob. The theory produces a lot, but it brings us hardly any closer to the secret of the Old One. In any case I am convinced that He doesn't play dice." Einstein never accepted the enormously successful quantum mechanics as a really satisfactory theory. His long exchanges with Born on this issue in the 1950's, sometimes sharp in tone despite their long friendship, bring out his commitment to the goal of a theory that will describe the world as it is, rather than one that relates only our observations.

Physicists of a later generation could dismiss Einstein's objections as misguided or simply wrong, but to his contemporaries such an attitude was impossible. Niels Bohr felt the need to go on defending his ideas against Einstein's criticism even after his old antagonist was dead, and Born's reaction was basically similar. He deeply regretted Einstein's refusal to accept and to help develop the new quantum mechanics, and once wrote: "Many of us regard this as a tragedy—for him, as he gropes his way in loneliness, and for us who miss our leader and standard-bearer. . . . But in spite of this he remains my beloved master."

I know no better way to summarize the impression produced by the Born-Einstein correspondence than to quote from Bertrand Russell's brief preface to the book:

> These letters, which clearly were not written for publication, record their hopes and anxieties in war and peace, their private thoughts about the progress of their work and that of colleagues, and much that will prove invaluable source material in the history of science.
>
> Something of the nobility of their lives is also revealed. I have deeply valued their friendship over many years. Both men were brilliant, humble and completely without fear in their public utterances. In an age of mediocrity and moral pygmies, their lives shine with an intense beauty. Something of this is reflected in their correspondence, and the world is the richer for its publication.

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Perceiving and Thinking

Visual Thinking. RUDOLF ARNHEIM. University of California Press, Berkeley, 1969. xii, 348 pp., illus. $11.50.

It is unique to find an inquiry about thinking that takes visual perception as paradigm. This way of looking at thinking—and perceiving—comes naturally, however, to Rudolf Arnheim, a psychologist widely known for his studies of the visual arts, who brings to this work the fruits of his reflections upon a persistent issue in psychology.

The issue, as the author poses it, is the relation of perceiving to thinking. A long tradition has separated these functions. Perceiving, it is said, has to do with the concrete, the individual, while to think is to abstract and generalize. Arnheim rejects this starting point. To describe perceiving as unthinking and thinking as nonperceptual is to distort the character of both functions. The title of the work, *Visual Thinking*, states in compressed form the author's thesis of the unity of perceiving and thinking. He proposes that the essentials of thinking are present in perception itself, that there is no difference in principle between them.

In support of this position Arnheim argues that perceiving is an intelligent activity; the book is a wide-ranging examination of this proposition. He chooses to talk about visual perception, in many ways the richest modality. Foremost is the point that to perceive is to apprehend patterns or structures. This is a constructive activity that goes far beyond the recording of what is given. We perceive not only—or mainly—data, but the constructions we form out of them; structures are not given as things that the mind or brain copies. Thus visual perception is from the start visual interpretation. Most important for the main argument, to perceive is to see the general in the concrete, the universal in the particular. The percept of a single triangle, even if it is the only triangle one has experienced, contains the generic features of triangles. Only because this is the case does it become possible to compare one triangle with another. In this sense a visual form is a visual concept.

Arnheim is most effective in his account of perceiving. He draws skillfully upon familiar phenomena and puts them to novel use. Consider the perception of a body as a solid. At no time do we see it in its entirety; at any one moment we have only a partial view of it. To bring the successive views into a single representation, to see each as part of a whole, is an instance of productive activity, of problem solving. Other perceptual effects, such as transparency and the constancies, are treated similarly, as well as the connection between perceiving and artistic representation. A few strokes on a page evoke an object in restlessness or repose; despite omissions and simplifications, often because of them, an immobile pattern makes forces and their inter-

actions visible. This is what everyday perception accomplishes. In this manner Arnheim develops the theme that there is intelligence at every level of cognitive functioning.

The discussion of abstraction brings us to the center of Arnheim's concern, and here he makes telling points. The classical account of abstraction as the removal of elements from other elements presupposes knowledge of what is to be abstracted and is therefore circular. Moreover, the same element cannot, strictly speaking, be found in more than one entity, nor can an arbitrary selection of elements produce a sensible abstraction. To abstract is not to free oneself of what is concretely present, but to apprehend a structure through its embodiment; abstraction occurs from organized wholes. More generally, Arnheim takes exception to the view that thinking involves detachment from the concrete, that it is an ascent to a more powerful but sensorily more impoverished representation of experience. Thinking is for him a direct apprehension. His ideal of understanding is the kind of self-evidence in which relations and forces become simultaneously visible, as they do in perceiving.

Arnheim has stated an issue of absorbing interest and has thrown new light upon it. He is most challenging when he points to continuities between perceiving and thinking. These are indeed impressive: in both regions one finds evidence of ordering, transposing, judging, restructuring. One of the merits of this work is to provoke further questions. Since continuity is not necessarily identity, what is the precise import of the foregoing similarities? Are the operations of perceiving and thinking identical, or are the similarities based upon different mechanisms? What is, for example, the relation between inference in thinking and inference-like perceptual operations? At the risk of sounding inconsistent one is tempted to say that Arnheim is more convincing about perceiving than about thinking. It is unlikely that the distinction between them is simply the product of inadequate theory. The fact that perception often accomplishes instantly what thinking finds difficult to comprehend suggests that each solves its problems in its way. In the present state of knowledge it may be fruitful not to lose sight of the differences or of the similarities.

Among the most valuable parts of this work are the discussions of a variety of relevant topics, to which the author brings insightful, often surprising observations. Few readers will fail to enjoy what Arnheim has to say about pattern perception of computers, about discrimination learning experiments, Kurt Goldstein's treatment of concreteness and abstractness in brain-injured patients, or education in the visual arts. They will not learn much about the nuts and bolts of psychology, but they will make the acquaintance of an author with a keen appreciation of the structure of experience. Arnheim deepens the reader's sensibilities about the nature of psychological events. In the current intellectual climate it is easy to slight a contribution that does not claim to produce new information or discoveries. Yet the clarification of a basic problem eventually controls the course of investigation. The refreshing angle of vision of this work should appeal to experts and to nonpsychologists. As befits its content, the format and the reproductions of the book are most attractive.

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Down's Syndrome

Epidemiology of Mongolism. ABRAHAM M. LILIENFELD, with the assistance of Charlotte H. Benesch. Johns Hopkins Press, Baltimore, 1969. xiv, 146 pp., illus. $7.

Sequín in 1864 described a form of mental retardation that he called "furfuraceous idiocy" ("furfuraceous" meaning "scurfy," "resembling bran"), a term suggested by the dry, cracked, and scaly skin often seen in older patients with this disorder. In 1867 Langdon Down described the same syndrome as "mongolism" because of a supposed facial resemblance of the affected individuals to persons of the Oriental race. (The unfortunate term persists although the disorder was later renamed Down's syndrome or Down's anomaly.) For almost the next 100 years little was added to our knowledge of the disease except to establish its incidence as about 1/750 births and show it to be one of the more frequent causes of moderate and severe mental retardation. The disorder was noted to occur more often in some families than would be expected by chance, and repeated observation was made of an increasing incidence of the disorder associated with advancing maternal age. At least 40 different etiologies were suggested.

A major breakthrough occurred in 1959 when, independently, Lejeune, Gautier, and Turpin in France and Ford in England observed that patients with mongolism had 47 chromosomes; the additional small, acrocentric chromosome was arbitrarily labeled a No. 21 chromosome. This was the first example discovered of a chromosome aberration as a cause of disease in man, and the observation has stimulated an enormous number of cytogenetic, biochemical, and epidemiological studies on mongolism, many of which are discussed and summarized in this volume by Lilienfeld.

The author, an epidemiologist, has been very resourceful in assembling the scattered literature on mongolism, in presenting the most useful and accurate studies, and in using frequent tables and figures to illustrate his points. The reader can obtain a great deal of information in relatively few pages.

In the opening chapter the author gives consideration to the chromosomal abnormality; more appropriate figures and legends would have improved this portion of the book. The majority of studies show the incidence to be between 1.0 and 1.9/1000 live births; the incidence at conception is estimated at 7.3/1000, the difference being reflected in fetal loss due to spontaneous abortions. The studies on maternal age point out that 20 percent of affected children (compared to 1 percent of all births) are born to mothers over 40 years of age, 50 percent (compared to 7 percent of all births) to mothers 35 years of age or older. The author comments on reduction in incidence of mongolism through family planning; more recent events suggest that the use of early amniocentesis to detect the disorder in utero, followed by abortion when indicated, could be an equally feasible preventive measure.

Many prenatal factors have been studied and only two emerge as possibly significant: maternal ionizing radiation and the presence of maternal thyroid antibodies. There is a good discussion of the increased frequency in patients with mongolism of other diseases, including leukemia, congenital megacolon, and other chromosomal abnormalities. The trisomic state offers the opportunity to study gene dosage effects, and the author reviews many of the biochemical studies, large-