exclusively as it does with space-time relations, can not reject the future from its explanation of the present in behavior, because any event in an organismic cyclic system is an integral part of both the future and the past."

To conclude—it is time biology shook itself free from the limitations imposed upon it by a blind trust in the classical doctrine of materialism. This doctrine is not in harmony with the modern development of philosophical thought, nor with the modern development of physical science, and it is not well adapted to the study of living things.

We must adopt a more concrete and more adequate concept of the living organism, one that will take account of its essential characteristics. We must think of the organism as a four-dimensional whole, or directive cyclical process, and no longer attempt to contain it within the static scheme of the classical materialism. This does not lead to any form of dualistic vitalism. The relation of behavioural or 'psychological' activities to physiological is not the relation of mental to physical activities, but is, quite simply, the relation of a whole spatio-temporal directive process to its parts.

Finer Structure of Chromosomes

RECENT studies of the chromosomes in various somatic tissues of *Drosophila* and other insects is throwing further light on the processes of heredity. It has been known since 1881, when Balbiani studied the chromosomes in the salivary gland cells of the *Chironomus* larva, that they are relatively very large and are marked with transverse bands or discs. Last year, Prof. T. S. Painter expressed the view that these bands, which show equally in the giant chromosomes of the salivary glands of *Drosophila* larvæ, correspond with the locations of the genes. An exciting line of investigation is now being pursued, in which the positions of the discs or bands are compared in different genotypes of *Drosophila* having deficiencies, translocations and other alterations in their chromosomes.

In two recent papers in *Genetics* (May and September, 1934), Painter has made further studies of the bands of varying widths which occur at fixed positions on the chromosome, making a pattern which may be compared with a spectrogram. It is well known that in Diptera the somatic chromosomes are often closely paired, but he finds that in the salivary gland cells of old larvæ the homologous chromosomes fuse completely, "line for line and band for band", but it is not at present clear how this can take place. This somatic synapsis is accompanied by separation of the long chromosomes into two parts at the spindle fibre attachment, while about three-eighths of the *X*-chromosome—the portion found genetically to be free from genes—as well as the greater part or the whole of the *Y*, disappear completely.

By studying deletions and translocations in which a series of genes are present the position of which on the *X*-chromosome has been mapped, particular bands can be closely identified with particular genes. When certain genes are deleted, corresponding bands will be absent, and if a section of the chromosome is transposed, its bands and their affinities are correspondingly altered. By such methods the chromosomes can be more accurately mapped, and much breeding work can be eliminated by the direct observation of the position of known bands in the chromosomes.

In an investigation of the ganglion cells of *Drosophila*, Dr. Kaufmann (*J. Morph.*, **56**, No. 1) has shown that some of them have satellites, and that, as in plant cells, certain chromosomes (in this case loci of the *X* and *Y*) are concerned in producing the nucleolus. He also finds the anaphase chromosomes double, consisting of two coiled chromonemata as in plant nuclei.

Following these advances in knowledge of the morphology and inner structure of *Drosophila* chromosomes, come fresh observations and speculations regarding the relation between the visible discs and the hypothetical genes. Prof. N. Koltzoff announces (*Science*, Oct. 5, 312) that the diploid somatic non-dividing cells in the salivary glands of insect larvæ contain giant chromosomes because the chromonema in each has divided successively to form probably 16 strands, which he calls genonemes. In addition to the discs at intervals on the chromosome, chromomeres are seen on the individual strands, and these structures can be photographed in the living cell. Koltzoff is inclined to regard the gene as corresponding, not to the chromomere but to the intervening portion of thread between two chromomeres, the discs being regarded as joints between the genes.

Dr. C. B. Bridges has independently come to conclusions in many respects similar, as announced by Science Service in the same number of *Science*. The chromosomes in the salivary glands of fruit-fly larvæ are in some cases seventy times the size of the ordinary chromosomes. By using a method for removing the outer chromatin, Bridges finds the solid discs composed of a bundle of parallel rods like a handful of cigarettes, threads connecting corresponding rods from one disc to another to

form a twisted cable. He concludes that each gene locus corresponds with a particular size or shape of chromomere, always in the same relative position. The sub-units of the discs are apparently regarded as the real genes, and many of them are believed to be no larger than one or a few molecules of the more complex proteins.

While Koltzoff and Bridges thus differ in certain of their interpretations, it is evident that they have both examined the same structures, and it has been shown that these giant chromosomes can be used in a further analysis of the ultimate structure of animal chromosomes and the relation of their finer structure to the processes of inheritance. This new line of investigation is one of much promise as rendering possible a more specific identification of genic structures in the chromosome.

R. RUGGLES GATES.

Obituary

PROF. JAMES MARK BALDWIN

WE regret to announce the death of the distinguished psychologist and philosopher, James Mark Baldwin, which occurred in Paris on November 8. Born at Columbia, South Carolina, in 1861, Baldwin, who originally intended to devote himself to the ministry, studied first at Princeton. Here he came under the philosophical influence of Principal McCosh, which left a lasting imprint upon his mind. Here, also under McCosh's sympathetic tuition, he became acquainted with the general theory of biological evolution and with the leading ideas of Wundt's recently published "Physiological Psychology". In the light of this early orientation, the subsequent development of his psychological interests becomes clear.

So impressed was Baldwin by the possibility of the then novel project of experimentation in psychology that, on gaining a graduation fellowship, he spent two semesters in Germany, studying at Leipzig, Tübingen and Berlin; and, as he himself says, the chief result of these studies was "a sort of apostolic call to the 'new psychology' ", which he accepted with enthusiasm. Returning as a teacher to Princeton, though still occupied with apologetics and theology, his 'call' soon led him to Mount Forest, where he was appointed to a chair in philosophy. This was the first of a number of university posts, including chairs at Toronto and Johns Hopkins, which he filled with great distinction; and here, dissatisfied with the barren associationism and structuralism of the textbooks of the day, he began his "Handbook of Psychology", in which he stressed his own developmental and functional theories.

At Princeton, Toronto and Johns Hopkins successively, Baldwin founded psychological laboratories on the model of Wundt's, where courses were given in experimental psychology, and numerous important researches were carried out; but in the end he became somewhat critical of the experimental method of approach because of the paucity of results in respect of the genetic problems with which he was mostly concerned; and he turned definitely to the study of mental origins, development and evolution that formed the abiding interest of his later work. This took the form, in the first place, of an attempt to correlate psychological with general biological data covering the widest field; and it issued in the principle of 'circular reaction' ('trial and error'; 'give and take') which he formulated as the groundwork upon which all the variations of the original life-act rest. In this way he accounted for the evolution of living organisms, individual development and social progress. Evolution, as a process, he thus viewed from a psychological angle as well as a biological one; and the problem as to whether or not there is any directive factor in its course was raised.

Baldwin's solution of this problem in its wider aspect—similar to that of Lloyd Morgan, which appeared at about the same time—relied neither upon a presumed inheritance of acquired characters nor upon any vitalistic determining agency. According to him, the spontaneous variations that occur in individual organisms are not handed on; but in each generation they act as factors which favour the developing function of the species, and thus allow the principle of natural selection full scope. Applied especially to the evolution of mind, in which Baldwin was more keenly interested, this theory becomes one of 'emergence'. The then prevailing view, that mental process should be explained by the quantitative method of analysis, by reduction of the whole to its constituent parts, destroyed the possibility of reaching any real genetic solution of the problem. Higher forms of mentality cannot be accounted for by mere reference to, or analysis into, lower ones. The properties of water—he takes the example from chemistry—cannot be explained by saying "water *is* (=) H_2O"; but only by saying "$H_2 + O$ *becomes* (<) water" (a view strongly reminiscent of the old theory of the 'mixt', and closely akin to, if not a foreshadowing of, that of configurationism). Accordingly, the proper position to adopt is that every true genetic development is irreversible; and that every phase in such a development indicates a new, higher, and heretofore unrealised, manifestation of what we call 'reality'.

These manifestations, so far as mind is concerned, may be studied in various ways: phylogenetically, anthropologically and ontogenetically; and all these methods of approach supplement one another. Accordingly, animal behaviour will form an objective subject of research, in which biogenetic results will be discovered; the stages of mental growth, as exhibited in all its phases from that of primitive peoples to the highest cultures, will be investigated, again objectively, by an examination not only of the mentality of existing peoples, but also of the languages, mores, laws, institutions and the like, to