realize. Recent advances in the derivation of exact values for critical loads are discussed.

The application of plasticity theory to steady-flow problems in which large plastic deformations occur, although stress and velocity fields do not change with time, is illustrated by reference to the plane problem of sheet extrusion. Another class of problem involving large plastic deformations arises when the shape of the plastically deforming part of a body remains constant, while the size increases as more and more of the originally rigid material becomes plastic. The lecture ends with a short section dealing with dynamic problems, and quotes as an example the case of a beam subjected to a transverse uniformly distributed blast load. The energy given to the beam and stored momentarily as kinetic energy is dissipated in deformation at plastic hinges, which may move progressively along the beam, thus producing plastic deformation over considerable lengths.

Dr. Prager's lecture certainly reveals a remarkable advance in the development of the theory of plasticity in recent years. The large part played by mathematical intuition in the derivation of many of the solutions is evident, and the many cases in which this intuition is successful in achieving solutions to practical problems represent the most stimulating feature of the theory of plasticity for the engineer. As progress continues, the place of intuition declines and systematic analysis takes its place. This survey has been made at a time when the second stage is well under way in many branches of the theory—a period full of danger as well as promise. The danger is that mathematical models found successful for certain problems may be applied indiscriminately under conditions where they become quite inadequate. This is revealed most clearly at the end of the lecture in the section dealing with dynamic loading, where a factor of over-riding importance, namely, the effect of rate of strain on the stresses producing the deformation, is scarcely mentioned. The lecture is concerned with the theory of plasticity, of which it is a most outstanding and opportune summary. It is for the engineer who applies the theories to satisfy himself that the mathematical model on which the theory is based is appropriate to his problem, either by fundamental investigations or by carrying out suitable tests under practical conditions. M. R. HORNE

CARNEGIE INSTITUTION OF WASHINGTON

REPORT FOR 1953–54

THE report of the president of the Carnegie Institution of Washington, Dr. Vannevar Bush, for the year ended June 30, 1954*, explains in some detail the features of the new retirement plan which came into operation on July 1, 1954. He discusses the principles on which it is based, notably the importance of reaching understanding with those affected at the outset, and securing individual assent in advance to whatever changes or modifications are seen from time to time to be desirable to serve the best interests of the group concerned and provide a balanced provision against the risks which savings inevitably face. Of the research activities of the Institution, Dr. Bush notes that fully half the observing time of the 60-in., 100-in. and 200-in. telescopes at the Mount Wilson and Palomar Observatories continues to be devoted to spectroscopic and photometric studies of individual stars. Preliminary results of the spectroscopic investigations of globular cluster stars during the past two years indicate a lower excitation temperature for a given spectral class, and a substantially lower abundance of the metals than is found in population I, while photometric studies have revealed large differences between the two populations in the relation between total luminosity and surface temperature. In co-operation with the National Bureau of Standards, the United States Naval Observatory and the California Institute of Technology, the Institution is examining whether electronic image-conversion techniques offer a means of extending the range of large telescopes or increasing the utility of those of moderate size.

The Department of Terrestrial Magnetism reports considerable progress in our understanding of the structure of the atomic nuclei, based on the observation that most nuclei from fluorine to uranium can be made to radiate characteristic gamma-ray lines when bombarded by relatively low-speed helium ions from an electrostatic generator. About a hundred and fifty energy-states have been detected in some seventy nuclei examined at the Department by this 'Coulomb excitation' process. Experimental observations at the Geophysical Laboratory are gradually providing a quantitative basis for understanding the various assemblages of minerals found in the metamorphic rocks and have led to the synthesis of many minerals found in such rocks, including a series of micas and garnets, the ranges of stability of which as functions of temperature and pressure have been determined. Other studies have demonstrated that the recurrence of proteins in hard parts of recent creatures is widespread and that under favourable conditions fossils may contain amino-acids such as alanine, glycine, valine, leucine, aspartic acid and glutamic acid after 360 million years.

In the Department of Plant Biology, spectral changes of unidentified substances have been found in illuminated *Chlorella* suspensions. The work on grass this year has shown that environment may greatly influence the percentage of aberrant or 'off-type' plants that may appear in a stabilized, asexually reproduced strain. Under conditions of intense competition in unfavourable environments, the percentage of sexually produced variants may increase greatly in relation to the normally predominant asexual plants. The absolute absorption spectra of purified chlorophylls *c* and *d* and of bacteriochlorophyll have been determined, thus providing a means of determining these pigments in plants which use them for photosynthesis. Studies of forests on both sides of the Pacific suggest that the coast redwood was not a tree of the coast during much of its hundred-million-year history, but lived at higher elevations in the interior of North America.

Experiments on *Salmonella typhimurium* in the Department of Genetics indicate that a gene locus occupies a longitudinal section of the chromosome, and that changes occurring in different parts of the locus give rise to different new forms of the gene, that is, alleles. Recent work on the genetic mechanism of bacterial viruses indicates that viral nucleic acid controls viral inheritance, while studies of cell chemistry have focused attention on the importance of the nucleoprotein complex in vital cellular activi-

* Carnegie Institution of Washington. Report of the President for the Year ending June 30, 1954. Pp. 15. (Washington, D.C.: Carnegie Institution of Washington, 1954.)

ties. Notable progress has been made in the Department of Embryology in the analysis of the control of sex differentiation in the embryo by the action of sex-gland hormones; and a long-term study of the blood flow through the placenta, first in monkeys bred for the purpose, and afterwards on human placentas, points to physiological factors—that is to say, differences in blood pressure between the maternal arterial and venous blood and the blood within the placenta—as the chief directive agency of the maternal placental circulation, assisted by anatomical features of placental structure. Experiments on pregnant rhesus monkeys suggest that sugar metabolism in the primate placenta is not like that in sheep, at least with respect to glucose and fructose. The Department of Archæology continued its researches dealing with the preconquest history of Yucatan.

RELATIONSHIP OF SCIENCE AND RELIGION

IN his Rede Lecture for 1954 on "Science and Religion: a Changing Relationship", which has now been published*, Prof. C. A. Coulson, pointing out that Nature (by which he means the totality of our environment) and man are central both to science and religion, maintains that the division of our experiences into those labelled scientific and those labelled religious is wholly unsatisfactory and false to the true character both of science and religion. Science claims to give an account of all our environment, and he believes that the limits of science are only those which are presented by the words: if a question about Nature can be posed in scientific terms, then ultimately it will be susceptible of a scientific answer. In remarking that every scientific law is a new imaginative conception, Prof. Coulson suggests that, like the artist, the poet and the saint, the scientist is making sense out of that part of his experience which appears most amenable to his own selective understanding; he is looking for a pattern within them which will satisfy him as reasonable and consistent. Science is one kind of pattern, art is another.

Our loss of immediacy in our relation to Nature has, Prof. Coulson thinks, increased rather than diminished the contrast between conventional science and religion. Among the scientists of to-day there are respect and excitement, sometimes astonishment, but all too seldom reverence; and if we could recognize that man's total response to Nature must include not merely the making of a pattern that may be called true but also the recognition that God is mediated to him both in the experience and in the pattern, science would be recognized as one of the languages in which God is revealed, and the work of scientists would be seen as part of God's work. The sense of immediacy, which has largely been lost in modern scientific study, would be rediscovered. Our approach to the study of man is also changing, and here Prof. Coulson thinks science can help religion by forcing us to see and understand the sacramental value of Nature and the wholeness and unity of things. Science is also a powerful and insistent reminder of the worth of reason at a time when men's faith in the virtues of reason is wavering. A faith in rationality is central to the Christian tradition at its finest. Science is also affecting our view of the role of men within the whole pattern of Nature. Men and Nature are inextricably mixed, and Prof. Coulson believes that science has something to say about the very structure of human fulfilment, for which Christians have greater reasons for being grateful than they sometimes admit. There is a liberating quality about scientific thinking to-day, and yet a humility, which seems to him to augur well for a future complementary relation between science and religion.

In its methods of working, in its dependence upon the assumption of a spiritual wholeness about life, in its insistence upon the richness and variety of experience, and the inter-relatedness of all things within the role of a person, continued Prof. Coulson, the changing pattern of science has come back to something more like harmony with the Christian faith. In that new harmony there are new notes which would never have been sounded but for the patience, the integrity and the creative imagination of men of science. Lastly, all scientific beliefs are experimental in character, and the concepts of science acquire their validity only in experience. This is also true of the Christian faith, and it is one more debt which religion owes to science.

* Science and Religion: a Changing Relationship. (Rede Lecture for 1954.) Pp. 36. By Prof. C. A. Coulson. (Cambridge: At the University Press, 1955.) 2*s.* 6*d.* net.

BURSTS OF RADIO EMISSION

R. D. DAVIES has published a paper entitled "An Analysis of Bursts of Solar Radio Emission and their Association with Solar and Terrestrial Phenomena" (*Mon. Not. Roy. Astro. Soc.*, **114**, 1; 1954), which presents a detailed analysis of bursts of radio emission recorded at the Radiophysics Laboratory, Sydney, during January 1950–June 1951. This analysis includes a detailed study of the correlation of bursts with flares, sunspots, ionospheric fade-outs and magnetic crochets. While attempts to draw physical conclusions from the analysis have not been made in most cases, nevertheless certain results of immediate interest are briefly discussed. The radio data were obtained mostly from records at 200, 600, 1,200, 3,000 and 9,400 Mc./s., and in the latter part of the analysis these were extended to 62 and 98 Mc./s. All these came from the records taken at the Radiophysics Laboratory, Sydney, except the first, which came from records from the Commonwealth Observatory, Mt. Stromlo.

The analysis—in two parts—includes a number of histograms, and shows that many of the properties of bursts change with frequency (a burst is defined as "any clear-cut solar radio emission rising above the daily level"). A characteristic of bursts is their 'jaggedness', that is, short-duration rises and falls in intensity, and the degree of jaggedness decreases with increasing frequency. Tables, figures and histograms show that there are many interesting relations between the number of bursts and their frequencies, and also between bursts and sunspots, flares, fade-outs and crochets. As the frequency of bursts rises from 600 to 9,400 Mc./s., their average number per hour diminishes from 0·10 to 0·04, and the average interval between the bursts increases from 10 to 26 hr. A number of figures shows the distribution of the lifetime of the bursts at the different frequencies, the distribution of their decay times, the distribution of their intensities, etc.