through R Scuti[16] (an RV Tauri variable with period 140 days), SX Herculis[17] and R Virginis[18] and ends with Mira.

The period-lag relation can be explained in terms of increased time of travel of the compressional wave from the photosphere to the effective absorbing layer. In five-day Cepheids the absorption takes place close to the photosphere; in long-period variables it occurs possibly 8×10^7 kilometers above the photosphere. In a series of stars from the five-day Cepheids to the long-period variables, the radii of the stars increase from about 20 to 500 times that of the sun, and the acceleration due to gravity at the photosphere decreases from about 500 to 2 cm/sec^2. Correspondingly lower density and greater volume of atmosphere is to be expected about the larger stars.

From measures made near the time of light maximum in the spectra of a large number of long-period variables, Merrill[19] established a relation between the period and the amount of displacement of the emission lines towards the violet relative to the absorption spectra. With increased period of variation, the emission shows an increased difference of radial velocity, in the sense that it is approaching, relatively to the absorption. This effect also finds a plausible explanation in terms of the running wave theory and the Scott model of a long-period variable with the emitting layer far below the absorbing layer. In the long-period variables of shortest period (about 120 days), the distance between the emitting and absorbing layers is relatively small; the travel-time of the wave, the difference of phase, and hence the difference of velocity, will also be small at any instant. For the larger stars of longer period, the difference of phase and hence the difference of velocity at light maximum will increase. This is because the minimum of emission velocity comes shortly after maximum light, but the minimum of absorption velocity is delayed long after maximum. A fluctuation of the correlation near a period of 250 days remains unexplained.

The radiometric measures by Pettit and Nicholson and the infra-red photographic observations by Hetzler[20] showed a marked lag of the date of light maximum of long-period variables for long-wave radiation as compared with the curves for visible light. A similar effect has just been announced by Stebbins[21] for Delta Cephei; light curves measured in six wave-lengths show a progressive delay of maximum for the longer wave-lengths. These observations are entirely compatible with the present pulsation theory, at least qualitatively. At light maximum and for more than a quarter of its period thereafter, the variable star is expanding. After maximum it is cooling. Two opposing tendencies are then in operation: expansion tends to increase the brightness, but cooling tends to decrease it. The cooling is the more effective in all wave-lengths, so that the star fades. According to the Planckian law, the cooling causes the most rapid fading in the shorter wave-lengths; this has the effect of making the maximum earliest in the short wave-lengths, latest in the long.

The more detailed explanation of the forms of light and radial velocity curves of different variables is not so readily forthcoming. But it can now be said that the pulsation theory of stellar variation has reached such a stage of development and of agreement with observation that we no longer need apologize for its remaining shortcomings.

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THE PRESENCE OF ALLOXAN IN NORMAL LIVERS

ALLOXAN is readily prepared *in vitro* by the action of certain oxidizing agents on uric acid; since it is known to cause experimental diabetes in animals it was of interest to examine the organs of normal animals for its possible presence. To date, the only such observations, made many years ago, appear to be its detection in the gelatinous mucus from an intestinal catarrh[1] and in the urine of a heart patient.[2] In the vegetable kingdom it has been found (as the "half-reduced" form, alloxantin) in the hydrolysates from crude beet juice,[3] broad (fava) beans[4] and vetch seeds.[4]

A test which has been generally accepted for the identification of alloxan is based on the fact that on stepwise reduction it gives first alloxantin (a 1:1 compound of alloxan and dialuric acid) and then dialuric acid; if barium hydroxide is added to this reduction product, a purple color or purple precipitate is formed. Unfortunately, in the form described in the literature, this test is not well suited to the study of biological materials. We have now devised conditions under which, using as little as 1 cc of 0.01 per cent. alloxan monohydrate solution, this purple color is readily detectable by the naked eye; we have employed ascorbic acid or, preferably, cysteine hydrochloride as the reducing agent.

We next proceeded to examine a variety of animal

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4 H. Ritthausen, *Ber.*, 29: 894, 2106, 1896; H. J. Fisher and T. B. Johnson, *Jour. Am. Chem. Soc.*, 54: 2038, 1932.

and vegetable tissues and fluids; solid materials were extracted with 1 part of 10 per cent. trichloracetic acid by maceration or in the Waring Blendor; liquids were treated with one volume of the acid solution. A sample of the filtrate was then decolorized by shaking with charcoal, again filtered, and tested as described above.

We wish to report at this time that the purple color mentioned was obtained with such extracts of fresh, normal animal livers (beef, cat, calf, domestic fowl, guinea pig, lamb, rabbit and rat), suggesting the presence of alloxan in these materials. Experiments designed to test the validity of this tentative conclusion are in progress. However, we are disposed to believe that formation of the purple color is associated with the presence of alloxan for the following reason: the blood of normal, untreated rabbits does not respond to the color test, but the blood of treated rabbits (which have received alloxan in the alimentary canal) gives the color test at 5 minutes and at 2 hours after commencing administration. The purple color was not obtained with the fresh livers of shad, or sea perch ("croaker" fish).

Precise details for performing the test, observations made on other animal tissues and fluids, and the bearing of these results on the diabetes problem will be discussed in a forthcoming communication.

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ACHIEVING FULL EMPLOYMENT AFTER THE WAR

DR. MAYER'S recent article on how to achieve and maintain full employment after the war[1] deals ably with the problem of organizational approach to the immediate situation but fails to indicate how important *research* can be in building the foundations for a healthy and expanding economic order. This is an idea of great interest to scientists, but it has not been widely appreciated. Research is seldom stressed in the discussion of postwar plans.

Charles F. Kettering has said, "if we could get out of our minds the idea that we know a lot about everything and realize that the whole thing [research] is ahead of us, then we would have a shortage of labor in no time." The number of people directly concerned with research could be greatly increased, resulting in increased employment, but more important than this direct use of manpower, research creates new industries and new outlets for man's endeavors which furnish the basis for widespread employment.

[1] J. Mayer, SCIENCE, 101: 367, 1945.

Scientific research has been a very minor item of expense and effort in the life of Americans. Probably not more than one person in a thousand is engaged in research. Compared with what we put into war, research has been developed only to microscopic proportions. Yet it is trite to say that enormous industries—telephone, radio, electrical, aeronautical, glass, synthetic fibers and plastics, photographic, moving picture, dyestuff and food—all these and more have their foundations in the relatively small amount of scientific research which has been promoted.

The problem of unemployment is not merely that of finding something for people to do—it is finding *profitable* and *useful* pursuits. What holds more promise directly or indirectly than research? Research can delve into numerous fields and can unearth more treasures than the world dreams of. Every existing industry and means of livelihood will yield profitable findings, and on top of all this and perhaps fully as important, research about ourselves can furnish the key to vastly better health and adjustments—mental as well as physical.

From the standpoint of national safety research is second to nothing in importance. Our ability to hold our place and prevent war will depend more than anything else upon the strength of our science and technology—nothing whatever can take its place. Unfortunately the current handling of our manpower problem has been such as to leave us very shorthanded with respect to scientists in the postwar development ahead. For defense reasons, if for no other, we can afford to devote our efforts to a greatly expanded research program.

One method by which it should be possible to develop and encourage the research which must be at the basis of much of our future development would be to give corporations and individuals generous tax exemptions based upon the amounts which are spent on research. I am sure that many who have had experience in research will agree that a substantial amount of investigation should remain in private hands and that government-sponsored research is liable to become involved in red tape and organization to such an extent that it becomes sterile or nearly so. Research must be in the hands of competent leaders who can be replaced as needed by younger and more vigorous men.

If we should spend ten times as much for research as we do, it would be only a fraction of what we will spend for national defense, yet we would be laying a foundation for vast employment for many years to come.

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