that some of the excess of positive velocity in the B-type stars may be due also to contraction. Upon these hypotheses all the early-type activity can be accounted for, even the outstanding and discordant large radial velocities of the planetary nebulae which have been a stumbling-block to the proper location of these bodies in any otherwise logical course of change.

The course followed by these early-type objects, as indicated by the above conditions, may be summarized as follows:

Stellar (or perhaps other) bodies in the galactic regions where cosmical matter is sufficiently plentiful encounter such matter in the form of clouds of varying conditions as to size and motion.

The effects of such matter begin to be noticeable in the A type, and probably also as short-period variables in the F, G and K types which show a marked preference also for the galactic regions. These preferences become progressively stronger through the B-type stars until we find those of O type confined to a narrow belt along the plane of the galaxy.

These encounters will in general reduce the motions of the original stars due to the combination of different motions of the star and cloud and perhaps also to a general retardation by widely distributed matter which appears to have little or no system motion in many cases. This would account in part for the generally small motions of the early-type objects.

Strong evidence has recently been encountered, however, that the great brightness of the early B-type stars is due to a brightening up of stars whose proper motions were originally small, due probably largely to distance.

The sequences of change in both spectral type and temperature accord with increasing amounts of cosmical matter encountered which first produces an apparent excess of positive radial motion or contraction in the B-type spectrum which increases in the late O-type and then changes to negative or expansion when the emission appears in the early subdivisions.

The planetary and large extended gaseous nebulae are the results of encounters with single stars and groups respectively in which the climax appears to have been produced, resulting in gaseous nebulosity and probably radiations of shorter waves which are not observable with our present means.

Incidentally it may be pointed out that encounters of solid bodies with clouds of cosmical matter furnish an explanation of the large meteorites, these being the pieces of small solid bodies disrupted by the sudden heating of such encounters much as the meteorites themselves are disrupted in passing through the earth's atmosphere.

If such a course is the correct interpretation of the phenomena observed in these early-type objects the nebulosity is not being maintained by "excitation" of a central star or other source but is the *result* of the primitive originating encounter and is simply a stage more or less transitory in stellar evolution, broadly considered.

Indeed the phenomena of the novae and especially the planetary nebulae raise the question whether the secondary bodies of our solar system may not be the later stages of the outer portions of a planetary nebula. The physical appearance of these bodies which show predominating positive velocities is such as to suggest condensation.

As these objects and the novae all show strong preferences for the Milky Way the question naturally presents itself as to what causes the activity in them, activity which appears to increase from A- to B- and O-type and to culminate in gaseous nebulosity in the planetary and large irregular nebulae as well as the novae.

Here is where cosmical matter intrudes itself as outlined above. Together with gravitation it furnishes a natural and satisfactory explanation for this early-type activity, and so far it is the only one. I have hunted diligently for objections but thus far have found none. One object in raising the point is to invite discussion and to uncover contradictory evidence if it exists.

As yet this question is not one for mathematical formulas except incidentally but for broad common sense.

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PSITTACOSIS EPIDEMICS AND PLEOMORPHIC PROTOPLASM

THE note in the issue of March 7 on the etiology of parrot disease and the possibility of a filterable virus suggests that laboratory workers in New York State, and perhaps the scientific world generally, may be unfamiliar with the work done during the epidemic of 1917 in Pennsylvania. At that time, Dr. A. T. McClintock, a young Wilkes-Barre pathologist and diagnostician, trained in Vienna and Berlin, carried on extensive researches with cultures obtained from three affected parrots and from the bloods, sputa and feces of eleven patients. He used mice and rabbits for inoculation, checking his results through the experimental induction of similar disease pictures by means of cultures derived from the feces of normal parrots.

His tentative conclusions are suggestive, though in a dozen years laboratory technique has doubtless undergone manifold refinements. While identifying the epidemic as psittacosis, he failed to associate with it Nocard's bacillus (a stout motile Gram nega-

tive rod) as the causative factor. Nocard's findings (1892), he believed, represented a fixation of species, whereas the local epidemic (less virulent in form, with a mortality of only 5 per cent.) was apparently derived from a "generalized" bacterial protoplasm, often amorphous, residing in the intestines of the healthy parrot of this species in a harmless saprophytic guise. This more primitive form conceivably retained a plasticity which under the stimulus of abnormal conditions enabled it to undergo metamorphosis, assuming a number of different forms, rod-like or coccal, and displaying an affinity for a wide range of living tissues. The chilling of healthy birds and the resultant changes in intestinal exudates were surmised to serve, in natural surroundings, the same rôle as the bouillon extract which, in the laboratory, sufficed to provoke mutation and the development of pathogenic traits in the intestinal flora obtained from healthy birds.

It was found possible to induce the disease with material which had passed a filter, but in less virulent form, with slower course. In McClintock's opinion, the larger, centrifugible units were more effective. As in previous epidemics, there was an incubation period of from five to ten days, and there was lack of evidence of the transfer of infection from one human being to another. Three forms, influenzal, pneumonic and typhoidal, all accompanied by severe headache, were distinguishable in human patients, though the typical tests for pneumonia and typhoid were negative and agglutination variable. Post-mortems, however, revealed the hemorrhagic conditions characterizing the disease picture throughout the tissues, although most frequent in the lungs or intestines of the affected bird or animal. In spite of the mounting evidence of contact between sick birds and patients, the state authorities, so far as I recall, refused to identify the disease as psittacosis.

McClintock's preliminary findings were reported before the Luzerne County Medical Society on May 17, 1917. The detailed account of his researches, including his hypothesis relating the Wilkes-Barre epidemic to a more primitive, less differentiated form than that represented by Nocard's bacillus, lay in manuscript until 1926, owing to conditions peculiar to the war period. McClintock saw a possible connection between the etiology of psittacosis and that of trench fever, and rushed his monograph to conclusion outside the long hours absorbed by his private practice and his duties as pathologist at the city hospital, working over his results from 8 to 12 at night, writing from 5 to 8 A. M. In September, 1918, while hunting a publisher and making final arrangements for army service, he contracted the influenza then epidemic in a severe and all but fatal form, never regaining his health. Publication under the existing war conditions proved impracticable, and so far as I know he never touched his manuscript again. It was printed posthumously in 1926 as "Pleomorphism in Bacterial Protoplasm: A Study in Psittacosis," in a form which the author had hoped would render it useful as an introduction to pathogenic bacteriology —a field in which, his researches convinced him, a less dogmatic approach than the conventional one was desirable.

McClintock's view that psittacosis is not a simple disease entity, that the causative factors in different epidemics may be different and may, in certain instances at least, be derivable from a minute, unfixated protoplasmic form, harmless under normal conditions of the host, certainly merits wider dissemination among laboratory workers.

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ARTIFICIAL BACILLI

IN September, 1928,[1] I communicated to this journal a preliminary report on the discovery of living micro-organisms in certain Precambrian rocks. These investigations have been continued and have involved painstaking and laborious checking of the technique employed. While the indications are still as given in the earlier paper, a final statement with respect to them must await the completion of a little further work. A final report should be ready next summer. Meanwhile, conclusive evidence has been obtained to prove the existence of living micro-organisms in anthracite coal derived from mines in Wales and in Pennsylvania. The interpretation of these results does not accord with those of Schroeder, Galle, Potter and Lieske, who also worked with anthracite coal. I hope soon to furnish a report also on these investigations.

Incidental to the study of the bacterial flora of rocks, however, the attempt to work with strictly sterile media has led to a striking discovery which I present in this communication. When agar in the shredded or powdered form is mixed with tap water, sea water or other salt solutions in the cold, a microscopic examination shows only the irregular shapes and sizes of colloidal particles. When, however, it is heated in such solutions to a temperature of 45° C. or more, a microscopic examination of stained and unstained preparations thereof reveals a large number of perfectly shaped rods varying in length and thickness. These forms are practically always rod-shaped with rounded ends and most strikingly resemble bacilli. They even show diplo-bacillus forms

[1] SCIENCE, 68: 272–3, September 21, 1928.