exclusion of others equally important, and the inclusion of different grades of infra-specific rank, in the same category is misleading. The traditional methods employed in taxonomy must be supplemented for the study of infra-specific variations, and not until we know more of the categories to be dealt with can a satisfactory scheme of nomenclature be devised.

Dr. B. P. Uvarov expressed his belief that the recognition by entomologists of subspecies, in the sense of geographical races, has been of great practical convenience; it has enabled taxonomists to unite numerous minor forms into large species without losing sight of their individuality. Recent physiological, ecological and genetical work has revealed the existence of races which are indistinguishable by external characters. Between these incipient, deeply seated, internal changes and the appearance of external morphological characters there is probably a time lag; consequently even the smallest external differences, if not irregular and obviously casual, deserve the closest attention as representing quite an advanced stage in variation.

Prof. McClung remarked that the perfect taxonomy has been described as the summation of all biological knowledge; we have obviously not yet reached perfection and the present discontent shows a striving in the right direction.

Mr. C. E. Hubbard said that the terms subspecies and variety are used by systematic botanists to cover every grade from a slight variation in one character to a well-defined species. In the floras of large tropical areas there occur numerous polymorphic species which, in the absence of detailed knowledge, it seems best to lump together and note the polymorphism. Where variations are of economic importance, those that are well defined can be given binary names with the view of making reference easier.

Prof. F. E. Weiss agreed with the previous speakers that investigations of the taxonomic categories need further biological knowledge, especially genetical. Frequently genetical analysis can establish the status of a taxonomic group when the systematist is in doubt. A good example is seen in the pimpernels; of the two blue forms, one has proved to be a genetically stable species and the other, scarcely distinguishable by any other criteria, merely a mutation of the red species.

Dr. Julian Huxley emphasized that taxonomy deals with natural groups having a real existence. Discussing infra-specific variability, he pointed out that in the gradation between varieties, subspecies and species, the points of stability are more frequent than the intergrading zones. He dealt with various causes of discontinuity and mentioned especially isolation leading to non-adaptive variation, and the production of partial discontinuity by the formation of internally stable gene-complexes. For the description of more or less continuous variation he suggested the use of his 'cline' concept.

Dr. R. Melville pointed out that hybridization is much commoner in plants than in animals and that in certain groups the species can be arranged on an intergrading series corresponding to a 'cline' in Huxley's sense, but with no geographical basis. He suggested that new terminology should be used for forms constituting these series.

Prof. W. Garstang commented on the difficulties of genetical research on animals, and directed attention to the existence of 'clines' in fishes, particularly herrings and mackerel. In some instances, the 'clines' can be correlated with gradual environmental changes.

Interstellar Space

ON May 13, 1938, Prof. Charles Fabry delivered the George Darwin Lecture at the Royal Astronomical Society and dealt with the problem of the nature of the matter which exists in interstellar space (*Mon. Not. Roy. Astro. Soc.*, 98, 9, Supp. No., October 1938). The subject is so vast that it was possible for Prof. Fabry only to review briefly the different methods of investigation and the interpretation which has been placed upon what they reveal. As is well known, the Doppler effect has enabled the interstellar lines to be detected. The displacement of the lines in stellar spectra gives the radial velocity and this should be the same for all lines. If a line gives a velocity which differs from that derived from the displacements of other lines, the discrepancy must be due to matter situated between the star and ourselves—in other words, interstellar matter. In 1904, Hartmann observed the spectrum of δ Orionis, a star of variable radial velocity, and found that the velocity, measured on the hydrogen lines, varied between + 133 and − 66 km./sec., but the lines of ionized calcium showed a constant velocity of + 16 km./sec. This supplied the evidence for the existence of a cloud of ionized calcium between the star and ourselves. It seems remarkable that for fifteen years these ionized calcium lines were the only ones which were known with any certainty. In 1919, however, Miss Heger established without doubt the existence of neutral lines of sodium, and with improvements in spectroscopic methods more interstellar lines have been discovered. It is interesting to notice that the exploration of the ultra-violet lines of sodium by Adams and Dunham has been rendered possible by the use of aluminized mirrors and of gratings ruled on an aluminized layer. The discovery of other lines which cannot be identified has caused some speculation regarding their origin, and Prof. Fabry conjectures that microscopic crystals, perhaps giving absorption bands at the very low temperature, may be responsible for some of them.

Among some of the interesting results accomplished may be mentioned the estimate of the mean radial velocity of the interstellar matter between the star and ourselves, and it seems that the interstellar gas has the same mean rotation as the galaxy. Quite recently, however, Beals has shown that in some cases it is possible to detect masses of interposed gas which have different velocities. Important developments may be expected in this particular sphere.

It is impossible in the limited space to refer to more than a few of the points dealt with in the lecture.

One matter of some interest may be mentioned in conclusion. Cabannes and Dufay found in the light of the night sky a yellow line which they suspected to be sodium, and during the present year they have been able to show conclusively that sodium lines are present. Bernard showed that this sodium doublet is emitted by the very high layers of the atmosphere, the line being greatly intensified at twilight when the upper atmosphere is illuminated by the sun. What is the origin of this sodium ? Does it come from the earth where small crystals of sodium chloride exist in abundance, or is it interstellar sodium which the earth has picked up in its journey through space ? How are the sodium atoms excited ? Perhaps solar radiation may be able to produce this excitation, but this, like the other points, cannot be answered at the moment, and we must await future research for light on the subject.

Non-astronomers will find much of the lecture readable and they will be amply repaid for the time spent on studying the numerous matters of interest dealt with by Prof. Fabry.

H. T. de la Beche: Geologist and Business Man

By Dr. F. J. North, National Museum of Wales

FEBRUARY 16, 1839, was an important date in the history of the Geological Survey, for on that day Mr. (as he was then) H. T. de la Beche wrote a letter which eventually resulted in the Survey being changed from a one-man affair, with no settled headquarters, to a great organization with an office in London*. It was something to have persuaded the Government to make a grant of £300 for the purpose of colouring geologically a few sheets of the Ordnance Survey map, but a geological survey of the whole of England and Wales was quite another matter, and, like Oliver Twist, de la Beche was continually asking for more—money for instruments, a travelling allowance, and permission to extend the survey into other parts of the country. He was not only able to envisage a National Geological Survey but he had also the courage and perseverance to overcome official inertia in order to establish it.

It is the object of this note to illustrate, by reference to one of his campaigns for the expansion of his work, the kind of man he was and the debt which geology owes to him. It is based upon de la Beche manuscripts deposited by the late Colonel J. I. D. Nicholl in the Geological Department of the National Museum of Wales, and upon some old letter books of the Ordnance Survey, to which, by kind permission of the Director, I was given access.

When the geological mapping which de la Beche had been allowed to undertake in Devon, Cornwall and Somerset was nearing completion, he obtained permission to continue the survey in South Wales, where he found a willing voluntary collaborator in W. E. Logan, then a young man engaged in the copper smelting business, and also received help in the field from one of the Ordnance surveyors, Henry McLauchlan. This help was, however, local and occasional, and arguing that, on the basis of his work in Devon, he could not hope to cover the whole of England and Wales in less than twenty-one years, de la Beche decided to seek permission to secure constant assistance with the view of completing the map in about ten years, and in a letter to Colonel Colby, the director of the Ordnance Survey (February 16, 1839), he wrote :

"It being an object of importance that the Geological Survey should be rendered as efficient as the money granted for the service will permit, . . . I would respectfully suggest for the consideration of the Honourable Board of Ordnance that I should be permitted to hire such Geological Assistants as I may consider requisite for the proper execution of the work . . . such geological assistants to be chosen by myself and discharged by myself as may in my judgment appear reasonable and proper. . . . I would propose that I should not award any rates of pay exceeding ten shillings per day without special authority from the Honourable Board, and that I should send a quarterly return for the Honourable Board's information, showing the names and rates of pay of the persons so employed."

During the previous five years many letters concerning finance had passed between de la Beche and his employers, and his new application shows that he had profited by his experience. His opening remarks related to efficiency and economy, in his conclusion he disarmed criticism by offering to lay all his cards upon the table, whilst a condition that he knew from experience would be one of vital importance was inconspicuously inserted in the middle.

As usual, the Inspector General of Fortifications was cautious, and he endorsed the application as follows : "I know of no authority for the extensive view here taken of extending the Geological Research beyond the eight sheets of the Ordnance Survey authorized by the Master General's and Board's order of the 2nd May, 1832, and I should beg to submit the expediency of not proceeding . . . until something like an approximate estimate of the whole intended outlay be submitted to Parliament in the usual way."

The result of this endorsement was a letter to Colby stating that "The Master General and the Board are decidedly of opinion that it will never do to go on with this Geological Survey without some distinct rules by which the expense is to be governed. They are desirous of affording Mr. de la Beche every facility, but it must be on some express understanding as to the extent of work to be executed, and the length of time to be occupied. By reference to the original arrangement it will be seen that a most material departure has already taken place from what was then proposed, and . . . what is now asked for will lead to an unlimited expenditure of time and money."

De la Beche was asked to indicate how long the whole work would take, and how much it would cost,

* A brief account of the early history of the Geological Survey was given by Sir John Flett in "The First Hundred Years of the Geological Survey of Great Britain" (1937), which was reviewed in NATURE of November 27, 1937.