

of logarithmic tables was invented and drawn up almost contemporaneously with Napier's work by Jost Bürgi, a Swiss. A brief note dealing with Bürgi's work is contributed to the *Mitteilungen der naturforschenden Gesellschaft in Bern* for 1914 (p. 318) by Dr. A. Bohren. Bürgi was born at Lichtenstein, in Toggenburg, about the year 1552, but of his early life little is known. He was originally a clockmaker by trade, but developed a talent for astronomical work, and, under the patronage at first of the Landgraf Wilhelm of Hesse, and later of Rudolf II. of Bohemia, he not only invented new astronomical instruments, but greatly assisted Kepler with his observations. His treatise on logarithmic methods described under the title "Arithmetical and Geometrical Progression-Tables" first saw the light in 1620, but it is certain that the tables were calculated and used by him long before that date, and their publication had been delayed by the war in Bohemia. Probably for the same reason the instructions which were to accompany the tables were never published, and in consequence they failed to come into general use. Both Bürgi and Napier built up their tables by forming successive positive integral powers of a number differing from unity by a very small decimal, but Bürgi's tables are based on the relations $x=10n$, and $y=10^8 (1.0001)^n$, while Napier calculated his logarithms from the successive powers of $1-10^{-7}$. It would thus appear probable that Bürgi was the first to use a base greater than unity, and so to obtain a scale more suitable for use with integral numbers. Whether Napier was acquainted with Bürgi's work is considered doubtful. Possibly Napier may have got the idea from Bürgi, and his choice of a system the base of which is less than unity may have been intended as an improvement to facilitate the use of the tables in trigonometry.

CIRCULAR No. 58 of the Bureau of Standards contains much valuable information as to the properties of invar and related nickel steels. Invar is a nickel steel containing about 36 per cent. of nickel, together with small amounts of carbon and manganese, and metallurgically negligible amounts of sulphur, phosphorus, and other elements. It melts sharply at about 1425° C. Above 200° C. to its melting point it may be considered to consist of a homogeneous solid solution of the above elements. Below 200° C., and at a temperature dependent on its history and exact composition, it undergoes a reversible transformation of such a nature that for any sample the transformation may be incomplete. This condition of thermochemical instability gives rise to both slowly and quickly changing values of its physical properties—changes which are particularly manifested in the expansion. It can be rolled, forged, turned, filed, and drawn into wires, and it takes a beautiful polish, giving an excellent surface on which fine lines may be ruled. It will withstand without spotting the corrosive action of water, even when immersed for several days. Its electrical resistivity is about eight times that of pure iron, and its temperature-coefficient of electrical resistance about 0.0012 per degree Centigrade. It is ferromagnetic, but becomes paramagnetic in the neighbourhood of 165° C. The mean coefficient of linear expansion between 0° and 40° C. is for ordinary invar of the order of one millionth, and samples have been prepared with even small negative coefficients; the amounts of carbon and manganese appear to exercise considerable influence on the expansion. Above 200° C. its expansion is nearly the same as that of ordinary Bessemer steel. It is subject to changes in length due to "after effects" following cooling from a high temperature, and even following slight alterations in temperature. A mathematical formula,

$\Delta h/h = -0.00325 \cdot 10^{-6} t^2$, holds for temperatures between 0° and 100° C.

THE results of the measurements of the rate of vaporisation of platinum vessels raised to high temperatures which have been made at the U.S. Bureau of Standards by Messrs. Burgess and Waltenberg are given in Scientific Paper No. 280, recently issued by the bureau. At temperatures below 900° C. there is no appreciable vaporisation, whatever be the composition of the platinum alloy of which the vessel is made. At 1000° C., however, the loss from 100 sq. cm. of a vessel of pure platinum is 0.08, and at 1200° C. 0.81 milligram per hour. For an alloy containing 1 per cent. iridium the corresponding rates are at 1000° C. 0.30, and at 1200° C. 1.2 milligrams per hour. For a 2.5 per cent. iridium alloy they are at 1000° C. 0.57, and at 1200° C. 2.5 milligrams per hour. Rhodium alloys, on the contrary, vaporise at lower rates. For an 8 per cent. rhodium alloy the rates of loss are at 1000° C. 0.07, and at 1200° C. 0.54 milligram per hour.

SINCE the appearance three years ago of the last edition of Prof. G. Lunge's "The Manufacture of Sulphuric Acid and Alkali," vol. i., many additions to the subjects treated of have been made. To deal with the new developments, Prof. Lunge has prepared a supplementary volume, which Messrs. Gurney and Jackson announce for publication this autumn.

MR. F. EDWARDS, of High Street, Marylebone, announces for early publication "The Fauna and Ethnology of New Guinea," being the official records of the collections formed by the British Ornithologists' Union Expedition, 1909-11, and the Wollaston Expedition, 1912-13, in Dutch New Guinea. The work will be in two volumes, and the edition limited to 150 copies.

OUR ASTRONOMICAL COLUMN.

THE ASTRONOMICAL COMPASS.—The utilisation of the heavenly bodies as a means of determining direction has attracted considerable attention since the outbreak of war, and various attempts to simplify the problem for general use have been made. Simplified azimuth tables, in conjunction with maps of the stars, have mostly been employed, but it is evident that such tables may be replaced by graphical projections of the circles of the celestial sphere. Under the title of the "Rev. William Hall's Visible Astronomical Compass," an arrangement for the direct solution of the chief problems depending upon the diurnal motion of the heavens has been published by Mr. J. D. Potter, 145 Minorities, E.C. (price 1s. net, post free). A circle 6 in. in diameter, on a card 10 in. x 8 in., contains a stereographic projection on the plane of the horizon, for latitude 50° N., showing the circles of each even degree of declination, and hour circles at intervals of ten minutes. Circles of azimuth and altitude are not drawn, but the outer edge of the horizon circle is graduated for true bearings, and altitudes may be read off on a scale provided, after measurement with dividers along a travelling thread fixed at the zenith point. Given the time, or an approximate measurement of altitude, the bearing of any object is, of course, readily determined, and the "compass" can then be adjusted so as to show true directions. No new principle is involved, but the arrangement provides a stereographic projection in a convenient form, and the necessary instructions for its use are given. It should be understood, however, that a star map and an almanac are also requisite, and that some means of measuring altitudes would greatly extend the usefulness of the projection.

EFFECT OF HAZE ON SOLAR ROTATION MEASURES.—The extensive determinations of the sun's rotation which have been made by the spectroscopic method have shown remarkable variations, even among results obtained at the same observatory at different times. Thus the values for the equatorial velocity range from 1.86 to 2.11 km. per sec., and observers have not agreed as to the inequality of the values obtained from different lines at the same time. Again, while some observers have found values of the rate of rotation progressively increasing with the wave-length, many other observations have not shown this effect. A valuable contribution towards tracing the source of such discordances has been made by R. E. De Lury, of the Dominion Observatory, Ottawa, in a careful investigation of the effects of haze on the spectroscopic measurements (*Journ. R.A.S. Canada*, vol. x., p. 345). The effect of terrestrial atmospheric haze is obviously to superpose a weakened solar spectrum, coming mainly from the centre of the sun's disc and showing no displacements at all, upon the limb spectra. The measured displacements of the blended lines at the limb would then be too small, and would vary from line to line, according to the character of the line at the limb as compared with the centre. Correction for the haze effect can be made by correlating accurate determinations of the relative strengths of haze and limb spectrum with displacements of groups of lines of different intensities. Further investigations may be necessary, but Mr. De Lury appears to be already convinced that variations hitherto ascribed to the sun are mainly due to variations in haze.

THE MASSES OF VISUAL BINARY STARS.—Mr. R. T. A. Innes has been led to some remarkable conclusions by a discussion of data relating to binary stars (*South African Journ. Sci.*, vol. xii., p. 453). All close pairs of stars, with few exceptions, are apparently to be regarded as binaries, whether they show relative motion or not. On the assumption that a binary has the same brightness as the sun, Mr. Innes calculates its distance from the apparent magnitude, and thence the mass, if the period be known. When no orbit has been computed, he proceeds in a similar manner, and calculates the annual angular motion at the distance of the companion which would be produced if the primary had the same mass as the sun. The calculated motion is mostly much in excess of that observed, and Mr. Innes concludes that very few double stars have a mass, or "gravitative power," as he prefers to call it, equal to that of the sun. He has been led to suppose that gravitative power is small in stars of types B and A, moderate in F, and large in G and K stars; in types Oe and M it appears to be absent altogether. The A type is considered to be poorly represented among binaries, because stars of this class have but little effective gravitative power, notwithstanding their great brilliancy. There appears to be a limiting distance below which double stars cannot exist, and for solar-type stars this is apparently about five times the earth's distance from the sun. It is suggested that light-pressure may partly or wholly neutralise gravitative power in stars of small density and great luminosity.

MUTATION AND EVOLUTION.

PROF. ARTHUR DENDY'S presidential address, delivered in February last, before the members of the Quekett Microscopical Club appears in the journal of the club for April, and will probably be much discussed, inasmuch as it is devoted to an analysis of the relation of mutation to the evolution theory, the arguments being based on data drawn from the sponges. The phenomena of mutation, it is con-

tended, is more a chemico-physical than a biological phenomenon. Mutations, such as are observable in sponge spicules, in his opinion, strongly suggest the existence of definite factors in the germ plasm. The factorial hypothesis, he considers, is further supported by evidence which is accumulating as to the general course of evolution followed by the Tetraxonida. On the whole this evolution seems to have been progressive, accompanied by increasing complexity of structure, manifested especially in the skeleton. Along certain lines of descent, however, it appears that the culminating point has been passed, and regressive evolution is taking place, resulting in simplification of structure, by the dropping out of certain types of spicule. This loss cannot be regarded as an adaptive modification, nor can it be explained as due to mechanical necessities. Prof. Dendy concludes, therefore, that it is due to some change in the germ-plasm, affecting the power of the sponge to produce the particular spicules in question.

How can we reconcile these facts, it is asked, with the belief that evolution has taken place, in the main, by slow, successive modifications, rather than by sudden mutations? The conception of factors is intimately bound up with that of mutations, and the existence of the one would seem to imply the occurrence of the other.

As to which set of characters is to be regarded as the more important from the point of view of the student of progressive evolution Prof. Dendy holds there can be little doubt, but how far the division into adaptive and non-adaptive corresponds to the distinction between fluctuating variation and mutation is a different question. Certainly the chances are greatly against a mutation, when it first appears, having any adaptive significance. The evidence seems to him to show that the slow, successive variations of the Darwinian theory have had far more to do with the evolution of sponges than the process of mutation, and are mainly responsible, under the guidance of natural selection, for adaptive modifications.

It is not easy to follow Prof. Dendy in his attempt to discriminate between, and apportion the value of, adaptive and non-adaptive characters. It would seem, however, that he would regard the former as directly affecting viability, in proportion to their responsiveness to the demands of natural selection. They are characters which are of necessity immediately and continuously functional. The latter seem to be regarded as accretions or fortuitous variations, tolerated until they acquire survival value—that is to say, until they come under the sway of natural selection. If this is so, then all non-adaptive characters are potentially adaptive. They afford the basis for further evolutionary phases, or, in other words, the material which will determine the trend of future development and the fate of the organism for good or ill.

W. P. P.

SOME PROBLEMS IN EUGENICS.

STUDENTS of human heredity from the sociological point of view are indebted to the American Eugenics Record Office (Long Island, N.Y.). Its last-issued Bulletin (No. 15) contains the study of a family indicated by the pseudonym of "Dack," showing markedly a "hereditary lack of emotional control." The author of the bulletin is Mrs. A. W. Finlayson, and Prof. C. B. Davenport contributes a preface in which he emphasises the importance of such "eugenics field-work." Mrs. Finlayson has collected data with regard to 150 descendants of the pair of "Dacks" who emigrated from Ireland to Pennsylvania