ment and lateral movement, sometimes excessively intense, giving indications of their being carried either to the right or to the left of the picture by horizontal currents.

Such then is a first preliminary survey of the method of observing the chemistry of the sun, not as a whole, but of each particular little bit of the sun, chosen here and there, and brought upon the slit of the spectroscope.

J. NORMAN LOCKYER

SOME OBSERVATIONS ON THE MIGRATION OF BIRDS¹

WHILE showing some friends the astronomical observatory and accessories connected with the College of New Jersey at Princeton, on the night of October 19, 1880, after looking at a number of objects through the 9½-inch equatorial, we were shown the moon, then a few days past its full phase. While viewing this object my attention was at once arrested by numbers of small birds more or less plainly seen passing across the field of observation. They were in many cases very clearly defined against the bright background; the movements of the wings were plainly to be seen, as well as the entire action of flight. In the same way the shape of the head and the tail were conspicuous, when the bird was well focussed. As the moon had not been very long above the horizon the direction of observation was consequently toward the east, and the majority of the birds observed were flying almost at right angles to the direction in which the glass was pointed.

Here then was opportunity for the determination of two points—the kind of birds that were flying, and the general direction in which they were moving. Respecting the first, it was comparatively easy to decide as to what families the species belonged. This point was gained by observing the general shape of the birds, their relative size, the motion of their wings, and their manner of flying; that is, whether the flight was direct or undulating, by continuous strokes of the wings or by an intermittent motion of those members.

Most of the birds seen were the smaller land birds, among which were plainly recognised warblers, finches, woodpeckers, and blackbirds; the relative numbers being in the order of kinds above named. Among the finches I would particularly mention *Chrysomitris tristis*, which has a very characteristic flight; and the blackbirds were conspicuous by the peculiar shape of the tail, from which characteristic I feel most positive in my identification of *Quiscalus purpureus*. I mention such details to explain just how observations were made and conclusions arrived at.

In regard to the second point, with rare exceptions the birds were found to be flying from north-west to south-east. I do not mean that this was absolutely the direction, but that it was the approximate and general one.

It is not within the scope of the present paper to do more than give details on two other points, namely, the estimated number of birds passing through a given space during a given time, and the height at which the birds were most abundant. For the basis of the first of these points it was necessary to note, first, how many birds passed through the field of observation per minute, and second, how near or how far distant from the glass the birds would have to be in order to be seen at all, that is to be in focus.

The height of the moon above the horizon in degrees and the two limits of the area of observation—that is how near or how far the birds noted were from the glass—supply the data for determining how high the birds seen were flying, and this, combined with the number noted as passing per minute through the field of observation, gives the basis for computing how many birds were passing through a square mile in a given time.

In this connection it may be well to specify how the two limits of observation were defined. The inferior limit, that is, the nearest point where objects could be seen with distinctness, was easily determined by the power of the glass; this is about one mile distant. The superior limit, or the most distant point, is provisionally assumed to be not more than about four miles away, on the hypothesis that the birds would not fly at a greater height than ten thousand feet. It may appear, as future observations are made, that this last limit is not correct, but the reasons for assuming such a height as the superior limit are sufficient to warrant its use in this case, for birds were observed on this same night at a late hour when the height of the moon above the

horizon would make the point at which the birds were noted almost at this great elevation, viz. ten thousand feet.

I am greatly indebted to Prof. Charles A. Young for assistance in these observations, and with his aid have arrived at the conclusion that the average number of birds passing through the field of observation per minute was four and a half. Prof. Young has also kindly assisted me with the details of the problem in regard to the limits and area of the field; and the following diagram and computations are from his study of the matter.

Moon's altitude = 30°; moon's semi-diameter = 15' 05". The area of observation is a flat triangle = B, A, C. From this must be deducted the small triangle b, A, c, the area within a mile of the glass. The flight of the birds is thought to be nearly at right angles to the field of observation.

Area of triangle B, A, C = 0.07020 miles.

Area of triangle b, A, c = 0.00439 miles.

Therefore b, B, C, c = 0.06581 = 1 1/8 mile.

Distance from A to B = four miles.

Number of birds seen per minute = 4½.

Number of birds per square mile per minute = 68.

W. E. D. SCOTT

[Mr. Scott's novel and important observations definitely establish on a scientific basis several points in relation to the migration of birds that have heretofore rested almost wholly on conjecture and probability.

We have, first, the fact that the nearest birds seen through the telescope must have been at least one mile above the earth, and may have ranged in elevation from one mile to four miles. It has been held that birds when migrating may fly at a sufficient height to be able to distinguish such prominent features of the landscape as coast lines, the principal watercourses, and mountain chains over a wide area. Of this, thanks to Mr. Scott, we now have proof. It therefore follows that during clear nights birds are not without guidance during their long migratory journeys, while the state of bewilderment they exhibit during dark nights and thick weather becomes explainable on the ground of their inability to discern their usual landmarks—points that have been assumed as probable, but heretofore not actually proven.

These observations further indicate that many of our smaller birds migrate not only at night but at a considerable elevation—far beyond recognition by ordinary means of observation. A promising field is here opened up, in which it is to be hoped investigation will be further pushed, not only by Mr. Scott but by others who may have opportunity therefor.—J. A. ALLEN.]

ON THE EQUIVALENTS OF THE ELEMENTARY BODIES CONSIDERED AS REPRESENTING AN ARITHMETICAL PROGRESSION DEDUCIBLE FROM MENDELEEFF'S TABLES

THE relatively quick succession of new elementary bodies which has marked the last decade of scientific progress and which must be considered as the result of chemical research, pioneered and guided by spectroscopic study, has brought very prominently into notice Mendeleeff's most remarkable law of the periodicity of the chemical elements.

Originally published in Russian in 1871, his memoir has since been translated and reprinted by the author in the *Moniteur Scientifique* (July, 1879), and thence has been translated into some of the English journals.

¹ From the *Bulletin* of the Nuttall Ornithological Club for April.

difference, the law of proportionality being thus still observed. Now taking the simple arithmetical progression having for difference $\pi = 3$, 1416, it furnished a series of terms which markedly concord with the series of the atomic weights or equivalents as presented by Mendeleeff's Tables, and the successive blanks occurring in the series established by him in his Tables are very approximately filled up by the succession of the terms of this progression both as regards numerical values and order of succession.

To demonstrate this Mendeleeff's Tables have been drawn out, with the addition opposite each equivalent of the corresponding approximate value in terms of the progression π .

In Table I., containing his grouping into *Typical* and *Great Periods*, there is shown the succession of the elementary bodies and their equivalents, as also the comparative concordant succession of the terms of the progression π with approximate values mostly in terms of $\frac{1}{3}\pi$.

In the Table II., or of *Periodic Series*, the blanks existing in these series as indicated by Mendeleeff are shown to be very approximately filled up by corresponding terms, in value and order of succession, of the progression π . This is markedly the case as regards the gap existing between the series 8 and 10, where are wanting *twelve terms*, which, being filled up by successive terms of the progression π , the thirteenth term, corresponding to the equivalent of Lanthanum = 180 (?) is represented in the progression π by the value $57\frac{1}{3}\pi = 180$, 1164, or approximately by the value $57\pi = 179$, 0712.

Considering this progression of terms of π it will be found that of the sixty-five elementary bodies given in Mendeleeff's Tables the following corresponding equivalents are represented, with an approximation of less than a unit, by terms of the progression :—

H	=	1	...	$\frac{1}{3}\pi$	=	1, 0472
Be	=	9, 4	...	3 π	=	9, 4248
C	=	12	...	4 π	=	12, 5664
O	=	16	...	5 π	=	15, 7080
Fl	=	19	...	6 π	=	18, 8496
Si	=	28	...	9 π	=	28, 2744
Ph	=	31	...	10 π	=	31, 4159
Ca	=	40	...	13 π	=	40, 8404
Ta	=	48 ?	...	15 π	=	47, 1240
Va	=	51	...	16 π	=	50, 2656
Fe	=	56	...	18 π	=	56, 5488
Ni	=	59	...	19 π	=	59, 6904
Co	=	59	...	"	"	"
Cu	=	63	...	20 π	=	62, 8313
Zn	=	65	...	21 π	=	65, 9736
(Gallium ?	=	69.1	...	22 π	=	69, 1150)
(Norwegium ?	=	72	...	23 π	=	72, 2566)
As	=	75	...	24 π	=	75, 3984
Se	=	78	...	25 π	=	78, 5400
Rb	=	85	...	27 π	=	84, 8232
Yt	=	88	...	28 π	=	87, 9648
Zr	=	90	...	29 π	=	91, 1064
Nb	=	94	...	30 π	=	94, 2477
(Terbium ?	=	99	...	32 π	=	100, 5312)
Ru	=	104	...	33 π	=	103, 6725
Rh	=	104	...	"	"	"
Pd	=	106	...	34 π	=	106, 8144
In	=	113	...	36 π	=	113, 0976
Sb	=	122	...	39 π	=	122, 5224
Te	=	125	...	40 π	=	125, 6636
Cs	=	133	...	42 π	=	131, 9472
Di	=	138 ?	...	44 π	=	138, 2300
Ce	=	140-141	...	45 π	=	141, 3720
(Davyum ?	=	153	...	49 π	=	153, 9384)
(Decipium ?	=	157	...	50 π	=	157, 0795)
Er	=	178 ?	...	57 π	=	179, 0712
La	=	180 ?	...	58 π	=	182, 2128
Ta	=	182	...	62 π	=	194, 7786
Os	=	195	...	63 π	=	197, 9208
Ir	=	197	...	64 π	=	201, 0624
Pt	=	198	...	65 π	=	204, 2040
Hg	=	200	...	66 π	=	207, 3450
Tl	=	204	...			
Pb	=	207	...			

Such a concordance must be taken as some proof of the reality of a certain correspondence between the values of the equivalents and those of the terms of the progression π .

It is fully admitted that the equivalents are but relative, both

as regards their number and their numerical values, to the forces which the present state of chemical analysis can bring to bear on matter, and admitting the existence of a law of progression by which the equivalents may be connected, such a progression should as a matter of necessity differ both as regards the number of representative terms and their values from the present received succession and numerical values of the equivalents, and consequently show discordances in certain places and approximate concordances in others; such is shown by the terms of the progression π .

J. P. O'REILLY

May, 1880

BIRDS OF THE SOLOMON ISLANDS

IN a paper "On the Birds of the Solomon Islands," by E. P. Ramsay, F.L.S., &c., Curator of the Australian Museum, Sydney, read before the Linnean Society of New South Wales, February 23, 1881, the following new birds were described :—

1. *Graucalus elegans*, sp. nov.—A species allied to *G. hypoleucus* of Gould, but differing in its smaller size, whiter under-surface, broad jet black band on loreal region, extending below the eye, and in having ashy grey shoulders.

2. *Picrorhynchus Richardsii*, sp. nov.—A remarkably distinct species, with the body and the wings and tail above black, ossified nape, and hind neck white, head and throat black, chest and remainder of the under surface chestnut; this species comes from the Island of Nyi, and has been named in compliment to Lieut. Richards, R.N.

3. *Myzomela Tristrami*, sp. nov.—A jet black myzomela of large size, the bill strong and yellow, with end black, bases of the inner webs of the quills below ashy. This species is allied to, but distinct from, *M. nigra*, *M. Forbesii*, and *M. pamelana*.

4. *Myzomela pulcherrima*, sp. nov.—This fine species has the whole of the head, neck, chest, breast, and sides of the body and flanks, the interscapular region, rump, and upper tail coverts of a rich deep crimson, the remainder of the plumage black. The extent of the scarlet on the flanks and breast is greater than in either of the allied species *M. cardinalis* and *M. nigrirostris*.

5. *Zosterops (Tephros) olivaceus*, sp. nov.—In this genus there is no trace of white round the eye, and the bill has quite a different contour than that of any species of the genus *Zosterops*. The first and sixth primary quills in this species are equal, and the third is equal in length to the fourth. The general colour above is a uniform dull brown washed with olive, inclining to smoky brown on the head, inner webs of the quills below margined with white, under surface light ashy brown, almost white on the abdomen, length about five inches.

6. *Nasitera fuschii*, sp. nov.—A very distinct species of a uniform grass-green tint, paler on the abdomen, under tail coverts yellow, length 3.8 inches.

The paper contains notes on six or eight other species of interest and a fine collection of Solomon Island birds were exhibited—about fifty species.

OUR ASTRONOMICAL COLUMN

THE VARIABLE STAR χ CYGNI.—A maximum of this variable should now be close at hand. Prof. Winnecke assigns it to July 31, rather later than the average period of the last few years would give it. Its brightness at maximum has varied during the present century from 4m. to a very little above 7m. In vol. vi. of the Bonn Observations, Argelander has given nine observations of the position of this star, about which there has been so much and unnecessary confusion. Its place for 1880.0 is in right ascension 19h. 45m. 57.33s., declination $32^{\circ} 36' 42''$. A comparison of Lalande's observation in 1793 with Argelander's shows that there is no appreciable proper motion. The variability of χ Cygni was discovered in 1686 by Kirch, whose first observed maximum is dated November 28, 1687.

COMET 1881 b.—It appears this comet was detected at Sydney as early as May 22, so that we may yet receive observations from the Australian observatories made nearly a week before the first of those made at Rio Janeiro. The orbit, founded upon post-perihelion places, which we published last week, gives the comet's place on May 22 at 10 p.m. at Sydney in right ascension 4h. 58.5m., declination $35^{\circ} 33' S.$, and at this time the comet was distant from the earth 0.772 of the earth's mean distance from the sun. M. Cruls' first position, deduced from the observations at Rio is as follows :—