



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>



The Intellectual observer

H. Nat. 336 h

Observer



THE INTELLECTUAL OBSERVER

REVIEW OF NATURAL HISTORY, MICROSCOPIC RESEARCH,
AND
RECREATIVE SCIENCE.

AUGUST, 1866.

CONTENTS.

	PAGE		PAGE
ALGINES AS A WINTER RESIDENCE. By M. BETHAM EDWARDS. (<i>With a Coloured Plate</i>).....	1	THE PLANET SATURN (<i>continued</i>). By the Rev. T. W. WEBB, A.M., F.R.A.S.	49
MODERN JEWELLERY AND ART. By WILLIAM DUTHIE.....	7	ROSS'S FOUR-TENTHS CONDENSER	59
CHACORNAC'S SOLAR THEORIES	15	LARTET ON THE ASPHALT OF THE DEAD SEA	62
PHOTOGRAPHY AS A FINE ART.....	19	RESULTS OF METEOROLOGICAL OBSER- VATIONS MADE AT THE KEW OBSER- VATORY. By G. M. WHIPPLE.....	66
DECEPTIVE FIGURES, WITH REMARKS ON SATURN'S "SQUARE-SHOULDERED" PHASE. By R. A. PROCTOR, B.A., F.R.A.S.....	23	ARCHÆOLOGIA	72
ASCENT OF CADEE IDRIS. By D. MACKINTOSH, F.G.S. (<i>With a Coloured Plate</i>).....	27	PROGRESS OF INVENTION.....	73
NOTES ON FUNGI. No. VI. By the Rev. M. J. BERKELEY, M.A., F.L.S.	32	NOTES AND MEMORANDA:—	
THE COMING METEOR SHOWER.—THE SPECTRA OF METEORS	38	The Dhurmasalla Meteoric Stone	78
DR. CURTIS'S PROCESS OF PHOTO-MI- CROGRAPHY. By R. L. MADDOX, M.D.	41	New Marine Worm	78
ANIMAL LIFE IN SOUTH AFRICA. By H. CHICHESTER, ESQ.	42	Iodine Dissolves Gold	79
		Size and Life of a Mammoth Tree ...	79
		Volcanic Emanations and Disease ...	79
		The Zodiacal Light	79
		Effects of Increase of Sun's Mass ...	79
		Prisms and Silvered Flats for Tele- scopes	80
		Fungus in a Tree	80
		Strange Effect of Lightning.....	80
		Achromatic Eye-pieces for Telescopes	80



LONDON:

GROOMBRIDGE AND SONS, 5, PATERNOSTER ROW.
DUBLIN: M^CGLASHAN AND GILL. EDINBURGH: J. MENZIES.

Agent for the Continent,
ALPHONS DÜRR, LEIPZIG.

NEW MAGAZINE.

CHRISTIAN SOCIETY:

A MONTHLY MAGAZINE

OF

RELIGIOUS LITERATURE, INFORMATION, & BIOGRAPHY.

At first it was proposed to let this be a Magazine without a Prospectus, for the title pretty clearly indicates what the Public may expect. But a very few words may be useful as to the spirit in which the labourers associated with this new Monthly set about their work—the scope of the Magazine, and the distinctive features which will mark it out and give it, as the Projectors hope, a definite place amongst Religious Periodicals.

To do this in the shortest possible way, it may be said that the aim will be to present a *Literature of Christian Fellowship*—quiet, pleasant, and elevating.

“CHRISTIAN SOCIETY” will strive to become to its readers, as far as a book can, a *Christian friend*—calm and true, open and fearless, but always hopeful and comforting. It will be a Miscellany for the quiet hours of earnest, educated, thinking men and women—for such hours as Sunday afternoon and Sunday evening, or for those week-day hours in which the wisely active retreat for a little time, for mental refreshment, from the glare and hurry of the world.

“CHRISTIAN SOCIETY” will seek to be both reflective and practical—sedulous in cultivating that higher literature which breathes the free air of the spiritual heights, and aids the nurture of the inner life; at the same time it will be attentive to whatever is most interesting and instructive, either in the records or the present aspects of practical Christianity. In particular, an endeavour will be made to examine the nature and force of the social influences which surround us, the opportunities which they present, and the hindrances which they offer to religious growth.

It will seek the *common ground* of all Christians—eschewing questions of Church government and such topics as those upon which there may be a difference of opinion without injury to the sound faith and sound doctrine which are the anchors of the soul. In a day like this, of mental unrest, of eager and often arrogant speculation, coupled with a tendency, in some quarters, to demolish the old spiritual landmarks, and to relax immoderately the ancient standards, “CHRISTIAN SOCIETY” will be emphatically a Magazine for those who, after calm thought, honest inquiry, and ripened experience, desire to tread in the “old paths:”—for those who feel assured that all the cardinal elements of the Christian faith are matters untouched by criticism, historical investigation, or the gradual extension of knowledge in any department of science.

It may be guessed, therefore, that the intention is to mingle the gentler influence of soothing Christian thought and experience with a recognition of all practical forms of Christian effort, which may be useful as lessons of Energy, of Patience, of Hope, or of Charity.

Christian Biography will thus hold no mean place in the Contents. That great department can furnish much which, when truly studied and tenderly handled, yields not only most attractive reading, but reading of the kind which brings peace to the mind and gives fibre to the character.

The readers will be left to judge the contributions according to intrinsic worth—free from the accidents of reputation or any latent prejudice of party distinction, *for the Authors' names will not be given.*

At the same time it may be stated that the list of those who rally round this enterprise to aid it by their pen, includes many whose voices are familiar in the pulpits of the land; of laymen who have won distinction in the more earnest literature of the day; and some of those whose devotion to specific forms of Christian work entitle them to speak with the authority of hard-won experience.

In a word, those who enter on this work will try to make “CHRISTIAN SOCIETY” a pleasant and profitable book,—one worthy of a place in God-fearing English homes.

PUBLISHED MONTHLY, PRICE ONE SHILLING.

The First Number will appear on October 1, 1866.

Intending Subscribers are requested to give early notice to the Booksellers.

All communications from those who may desire to contribute should be addressed to the Editor, and books for Review sent to the care of the Publishers.

GROOMBRIDGE & SONS, 5, PATERNOSTER ROW;
And Sold by all Booksellers.

THE
INTELLECTUAL OBSERVER

REVIEW OF NATURAL HISTORY

MICROSCOPIC RESEARCH

AND

RECREATIVE SCIENCE

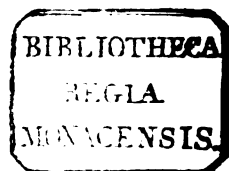
VOLUME X.

ILLUSTRATED WITH PLATES IN COLOURS AND TINTS, AND NUMEROUS
ENGRAVINGS ON WOOD



LONDON
GROOMBRIDGE AND SONS
PATERNOSTER ROW

MDCCCLXVII.



CONTENTS.

	PAGE
ALGIERS AS A WINTER RESIDENCE. By M. BETHAM EDWARDS. <i>With a Coloured Plate</i>	1
MODERN JEWELLERY AND ART. By WILLIAM DUTHIE.....	7
CHACORNAC'S SOLAR THEORIES	15
PHOTOGRAPHY AS A FINE ART	19
DECEPTIVE FIGURES; WITH REMARKS ON SATURN'S "SQUARE-SHOULDERED" PHASE. By R. A. PROCTOR, B.A., F.R.A.S.	23
ASCENT OF CADER IDRIS. By D. MACKINTOSH, F.G.S. <i>With a Coloured Plate</i>	27
NOTES ON FUNGI—No. VI. By the Rev. M. J. BERKELEY, M.A., F.L.S. .	32
THE COMING METEOR SHOWER.—THE SPECTRA OF METEORS	38
DR. CURTIS'S PROCESS OF PHOTO-MICROGRAPHY. By R. L. MADDOX, M.D.	41
ANIMAL LIFE IN SOUTH AFRICA. By H. CHICHESTER, Esq.	42
THE PLANET SATURN (<i>Continued</i>). By the Rev. T. W. WEBB, A.M., F.R.A.S.	49
ROSS'S FOUR-TENTHS CONDENSER	59
LARTET ON THE ASPHALT OF THE DEAD SEA	62
RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY. By G. M. WHIPPLE	66
LADIES' SLIPPERS. By SHIRLEY HIBBERD. <i>With Coloured Plate of Cypripedium Veitchianum.</i>	81
HYPOTHETICAL CONTINENTS. By H. M. JENKINS, F.G.S.	88
THE PERSISTENCE OF LUMINOUS IMPRESSIONS. By the Abbé LABORDE ..	98
GOSSIP ABOUT FISH	99
LARGE BRITISH OAKS	107
ON THE GENUS FIGUS. By JOHN R. JACKSON. <i>With a Tinted Plate</i>	112
RED STARS.....	119
HIGHLAND INSECTS. By E. C. RYE	124
PLANS FOR IMPROVING LONDON	136
THE PLANET SATURN (<i>Continued</i>). By the Rev. T. W. WEBB, A.M., F.R.A.S.	142
THE LAKE-DWELLERS OF SWITZERLAND	149
PRISMATIC SPECTRA OF THE AUGUST METEORS, 1866. By A. S. HERSCHEL. <i>With a Coloured Plate.</i>	161
THE LINEATED PHEASANT OF BURMAH. By CAPTAIN R. C. BEAUVAN	170
THE STREET ARCHITECTURE OF LONDON	174
THE BLACK POPULATION OF THE BRITISH COLONY OF NATAL, SOUTH AFRICA. By JAMES MANN, M.D., F.R.A.S. <i>With a Tinted Plate.</i> ..	184
THE PLANET SATURN (<i>Continued</i>). By Rev. T. W. WEBB, A.M., F.R.A.S.	194
THE FLORA OF IRELAND	202

	PAGE
CHACORNAC ON COMETS	209
A STRANGE PLACE FOR ROTIFERS. By HENRY J. SLACK, F.G.S.	211
FAMILY LIFE OF THE MIDDLE CLASS	213
THE STONE AGE IN CHINA. By M. CHEVREUL	221
OBSCURATIONS OF THE SUN. By M. ED. ROCHE	223
ON THE FORM, GROWTH, AND CONSTRUCTION OF SHELLS. By the late Dr. S. P. WOODWARD, F.G.S. <i>With two Plates, one Coloured and one Plain</i>	241
NOTES ON THE HABITS OF SOME LEPIDOPTEROUS LARVÆ. By the Rev. D. C. TIMINS, M.A., M.E.S., Lond. et Oxon	253
IRON AND STEEL IN THE CONSTRUCTION OF SHIPS AND BRIDGES, THEIR AD- VANTAGES AND DISADVANTAGES. By Professor MCGAULEY.....	257
DINOCHARIS COLLINSII; A ROTIFERON NEW TO SCIENCE. By PHILIP HENRY GOSSE, F.R.S. <i>With a Coloured Plate</i>	269
FROM KURRACHEE TO MOOLTAN. By FRANKLIN FOX	272
COMETARY LIGHT—NEBULÆ—OCCULTATIONS. By the Rev. T. W. WEBB, A.M., F.R.A.S.	281
WILD KAFFIR LIFE AND WILD KAFFIR INTELLIGENCE. By ROBERT JAMES MANN, M.D., F.R.A.S.	289
AIDS TO MICROSCOPIC INQUIRY.—No. VIII.—ORGANIC SUBSTANCES AND FORMATIONS	298
RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVA- TORY. By G. M. WHIPPLE.....	304
THE NEBULAR HYPOTHESIS OF LAPLACE EXPLAINED BY DELAUNAY	310
OBSERVATIONS OF THE CHANGES OF COLOUR AND MODES OF TAKING FOOD IN THE CHAMELEON. By JONATHAN COUCH, F.L.S. <i>With a Coloured Plate</i>	321
ON THE VARIATIONS OF CERTAIN CRUSTACEA IN RELATION TO THE THEORY OF THE ORIGIN OF SPECIES BY NATURAL MODIFICATION. By GEORGE S. BRADY, M.R.C.S., C.M.Z.S.	327
A NEW CHAIR FROM BRITISH COLUMBIA. By JOHN KEAST LORD, F.Z.S. . .	338
PARASITICAL PLANTS—BALANOPHORACEA. By JOHN R. JACKSON. <i>With a</i> <i>Tinted Plate</i>	348
PHASES IN THE DEVELOPMENTAL HISTORY OF INFUSORIAL ANIMAL LIFE. By JABEZ HOGG, F.L.S., F.R.M.S., etc.	356
THE NOVEMBER METEORS. By HENRY J. SLACK, F.G.S.	373
FATIO ON THE FORMS AND COLOURS OF PLUMAGE.....	377
NEBULAR AND STELLAR SPECTRA—SOLAR OBSERVATIONS—RED STAR— PLANETS—OCCULTATIONS. By the Rev. T. W. WEBB, A.M., F.R.A.S. . .	386
ON SILK PRODUCED BY DIURNAL LEPIDOPTERA. By PHILIP HENRY GOSSE, F.R.S.	393
THE BELL-BIRDS OF AMERICA. By P. L. SCLATER, M.A., PH. D., F.R.S. <i>With a Coloured Plate</i>	401
PARASITIC BEETLES. By E. C. RYE	409
BUDDHISM AND ITS LEGENDS.....	421
KAFFIR PROMISE AND CAPABILITY. By Dr. MANN, F.R.A.S., F.R.G.S., F.E.S.L., etc. <i>With a Tinted Plate</i>	428
LUNAR DETAILS—OCCULTATIONS. By the Rev. T. W. WEBB, A.M., F.R.A.S.	441
OBSCURATION OF A LUNAR CRATER. By W. R. BIRT, F.R.S.....	444
SCHMIDT ON THE LUNAR CRATER "LINNE" AND ON THE NOVEMBER METEORS	448
THE NOVEMBER SHOOTING STARS. By the Hon. Mrs. WARD. <i>With an</i> <i>Illustration</i>	449

Contents.

v

	PAGE
THE NOVEMBER METEOR-SHOWER AT GLASGOW. By A. S. HERSCHEL, B.A. <i>With an Illustration</i>	459
THE PLANET MARS. By RICHARD A. PROCTOR, B.A., F.R.A.S. <i>With an Illustration</i>	466
ARCHÆOLOGIA	72, 225, 394
LITERARY NOTICES.—“Charles Waterton; His Home, Habits, and Handi- work,” 227; “On Force; Its Mental and Moral Correllates,” 229; “Tapeworms; Entozoa,” 231; “Electricity” 231; “Dictionary of Science, Literature, and Art,” 231 and 316; “Anthropological Review,” 231; “Date Stones,” 231; “Wayside Flora,” 232; “Handbook of the Stars,” 232; “Elementary Treatise on Physics,” 233; “Birds of Mid- dlesex,” 233; “Reliquiæ Aquitanicæ,” 315; “Brief Account of Scholar- ships and Exhibitions at Cambridge,” 316; “Scientific and Literary Treasury,” 316; “Chart of the Characteristic Tertiary Fossils,” 316; “Benedicite,” 476; “Origin of Species by means of Natural Selection,” 477; “Elementary Treatise on Heat,” 478; “Easy Introduction to the higher treatises of Conic Sections”	478
PROGRESS OF INVENTION	73, 156, 234, 317, 473
PROCEEDINGS OF LEARNED SOCIETIES	317, 396
NOTES AND MEMORANDA	71, 159, 239, 318, 398, 479

ILLUSTRATIONS.

ILLUSTRATIONS IN COLOURS.

	PAGE		PAGE
Scene from Algeria, Evening Prayer	1	Recent Shell Forms	241
Ascent of Cader Iris	27	Dinorcharis Collinsii	272
Cypripedium Veitchianum	81	Chameleon	321
Prismatic Spectra of August Meteors	161	Naked-Throated Cotinga	401

TINTED PLATES.

Genus Ficus	112	Balanophoraceæ	353
Zulu Chiefs	185	Zulu Kaffirs	432

ENGRAVINGS ON WOOD.

Diagram of Deceptive Figures	23	Dog Whelk	247
Diagram of Herschel-Browning's Meteor Spectroscope	38	Common Whelk	248
Ross's Four-Tenths Condenser	59	Fresh Water Mussels and Melanias	248-9
Longicorn, Astinomus œdilis	129	Portion of Shell Wall	251
Bust of Kaffir	190	Cometary Light, Diagrams	282
Planet Saturn, Diagrams	197, 200	Head of Bell-Bird	401
Chiton Piceus	242	Lunar Details, Diagram	441
Diceras arietinum	243	Mars Serenitatis	447
Requienia Lonsdalei	243	Earth's Passage through the Stream of Meteors	456
Testacella	244	Ursa Major	463
Opercula and Sections of Spiral Shells	245	Tracks of Shooting Stars	464
Carychium minimum	247	Diagrams of Planet Mars	468
Cyclostoma elegans	247		

THE
GARDEN ORACLE
For 1867.

CONDUCTED BY **SHIRLEY HIBBERD, ESQ., F.R.H.S.**

CONTAINS :

LIST OF 500 VARIETIES OF USEFUL FRUITS, WITH DESCRIPTIONS, NOTES ON CULTIVATION, MARKET VALUE, AND DOMESTIC USE.

DESCRIPTIONS OF ALL THE NEW PLANTS, NEW FLOWERS, NEW VEGETABLES, &c., &c., RECENTLY INTRODUCED.

SELECTIONS OF THE BEST FLOWERS, FRUITS, &c., &c., IN EVERY DEPARTMENT, AND INNUMERABLE HINTS TO CULTIVATORS, FOR INCREASING THE PRODUCTIONS OF THE EARTH, AND FOR MULTIPLYING ITS FLORAL ATTRACTIONS.

LONDON : GEORGE BROS. & SONS, 5, PATERNOSTER ROW ; and of all Booksellers, Nursery and Seedsmen.

CHEAP & USEFUL HAND BOOKS.

Each Book sent post free, at the price marked.

CHILDREN AND HOW TO MANAGE THEM. By Mrs. Pullan.

Price 6d., post free for six stamps. "Every mother should possess this little book—eminently practical and useful."—*Lady's Newspaper*.

HOW TO CUT AND CONTRIVE CHILDREN'S CLOTHES at

Small Cost, with Explanatory Engravings. By Mrs. PULLAN. Price 6d., post free for six stamps.

ILLNESS PREVENTED, OR SPEEDILY CURED by Simple

Means. A code of Health for Popular Use. Price 6d., post free for six stamps.

HOW TO DETECT ADULTERATION IN OUR DAILY FOOD

AND DRINK: A complete Analysis of the Frauds and Deceptions practised upon Articles of Domestic Consumption, with full directions to detect genuine from spurious by simple and inexpensive means. Price 6d., post free for six stamps.

HOW TO EKE OUT A SMALL INCOME, and insure Happiness

and Plenty with a Moderate Scale of Expenditure. Price 6d., post free for six stamps.

BLUNDERS IN BEHAVIOUR CORRECTED. A Concise Code of

Deportment for both sexes. By an Observer of Men and Things. Illustrating the maxim that it is a man's manners that make his fortune. Price 6d., post free for six stamps.

SINGING MADE EASIER FOR AMATEURS, explaining the

pure Italian Method of Producing and Cultivating the Voice; the Management of the Breath; the best way of improving the ear; with much other valuable information equally useful to Professional Singers and Amateurs. Price 6d., post free for six stamps.

THE BERRIES AND FRUIT KNITTING BOOK; or, the Art of

Knitting Imitations of Natural Fruit and Berries, comprising instructions for making the Holly and its Berries—Mistletoe and its Berries—Yew and its Berries—Acorn and Oak Leaves—Apple and Orange—Pear, Strawberry, and its leaf. Price 6d., post free for six stamps.

MIND YOUR STOPS. Principles of Punctuation—Comma—Semi-

colon—Colon—Period—Dash—Stopped Dash—Long Dash—Hyphen—Note of Interrogation—Note of Admiration—Marks of Quotation—Parenthesis. Price 6d., post free on receipt of six stamps.

HARD WORDS MADE EASY. Errors in the Use of Vowels. Errors

in the Use of Consonants—Principle of Pronunciation—Accent—Proper Names—Greek, Latin, and Scripture Proper Names—Foreign Names of Persons and Places—Phrases used in conversation, Public Speaking and Newspaper Articles. Price 6d., post free for six stamps.

DICTIONARY OF TWO THOUSAND ABBREVIATIONS.—

Literary—Scientific—Commercial—Ecclesiastical—Military—Naval—Legal, and Medical. By E. C. COURTENAY. Price 6d., post free for six stamps.

TALKING AND DEBATING. A Handbook of Conversation.

Contents: Laws of Conversation—The Matter and the Manner—Proper Subjects—Objectionable Subjects—Wit and Humour—Public Speaking—How to make a Speech—Stammering and Hesitating—Written Speeches—Temper and Personalities. Price 6d., post free for six stamps.

LETTER WRITING SIMPLIFIED. A Guide to Friendly, Affec-

tionate, Commercial, and Complimentary Correspondence—Examples—Spelling—Punctuation—Complimentary Note—Friendly Letter—Business Letter—Style of Address, etc. Price 6d., post free for six stamps.

FRENCH IN A FORTNIGHT. In Fifteen easy Lessons on

Accent, Grammar and Pronunciation. Price 6d., post free for six stamps.

FIVE HUNDRED FRENCH PHRASES. A Companion to

"French in a Fortnight." Price 6d., post free for six stamps.

FIVE THOUSAND FRENCH WORDS AT A GLANCE; each

word being its own translation into English upon a simple plan, particularly adapted for the Adult Learner, and of immense assistance to all desirous of readily acquiring a Conversational knowledge of the French Language. By GEORGE WHITE, M. C. P. Price 6d., post free for six stamps.

LONDON: GROOMBRIDGE & SONS, 5, PATERNOSTER ROW.



SCENE FROM ALGERIA—EVENING PRAYER.

From a sketch by Mrs. F. Lee Budell.

THE INTELLECTUAL OBSERVER.

AUGUST, 1866.

ALGIERS AS A WINTER RESIDENCE.

BY M. BETHAM EDWARDS.

(With a Coloured Plate.)

VERY few people are aware of the riches and beauty of the French colony that lies only two days' journey from Marseilles. To the artist, Algiers offers quite an unrivalled field for picturesqueness of costume and gorgeousness of colour; to the tourist, a diversified and wonderful country peopled by distinct races, each having a historic and romantic interest; and to the invalid, a climate which without any extravagance, may be called perfect during six months of the year.

The journey from London to Algiers is pleasant enough, occupying four or five days. To those who are fortunate enough not to suffer from *mal de mer*, nothing can be more agreeable than to skim across the blue Mediterranean in the light *Messagerie* steamer. One generally finds a company of talkative, genial French officers on board, and from them learns something in advance, of the country which has suddenly become the most interesting of all others. It is easy to see that Algeria is not a strong point in national vanity, and that by universal opinion the colony has no brilliant future before it. The country is fertile to a fable, the climate is superb, the situation of the port could not be better; yet all these advantages are as nothing weighed against such grievances as undue taxation, Arab incendiaries, the want of good roads, and so on, *ad infinitum*. It is, therefore with some sort of preconceived sympathy that one sees the first silhouette of the Libyan coast, thinking less of Dido and her story as we scanned it in our schoolboy days than of Abd-el-Kader, marauding Arabs, and French families striving to get a scanty living in the once-famed granary of Europe.

§ The first view of Algiers is sufficiently striking. Built upon a hill, its sunny green terraces of Moorish houses glisten

as if of marble against the bright blue sky. To the left of the city stretches a chain of olive-clad hills, plentifully dotted with white villas; whilst beyond, so pale in outline as almost to be mistaken for clouds, lie the far-off snow-peaks of the lesser Atlas.

Hotels are not too plentiful in Algiers; and for travellers who are spirited enough to venture upon oriental housekeeping, it is advisable to take one of the pretty furnished villas in the suburbs. Once established, the traveller will find ample distraction in wandering among the narrow streets of the old city, and studying the unalloyed element of oriental life that still prevails there. We see scene after scene out of the *Arabian Nights*—here a youthful Aladdin in crimson fez and orange-coloured vest, truanting with idle companions—there a dark-cheeked Morgiana bound on some special behest—now some veiled princess, accompanied by her negresses bound to the bath—or a gloomy door is opened by some grave Moor, and you catch glimpses of an airy court, planted with bananas, and having a fountain in the midst.

In the ugly French arcades which have been built upon the site of picturesque old streets are to be found all the civilizations of modern life, such as omnibuses, shops, and cab-stands. Indeed, but for the stately Arabs passing by, and the bronze skins of the negroes shining in the sun, you might fancy yourself in some small town of the provinces.

In the country, the two elements, French and Arab, are mixed in about the same proportion. You meet group after group of handsome, tawny-skinned fellows driving in donkeys laden with wood, oranges, or poultry; or a stately, well-mounted caid, leaning back in his embroidered saddle; or a camel from the interior, ridden by a wild-looking Ishmael, wrapped in white burnouse. It would be hard to say whether the town or the country offers most interesting matter for observation; both to the student of Arab or colonist life, the field is large and varied.

Alike striking and impressive is the spectacle of Mahometan worship, whether seen as we saw it, in the lighted Mosque during the Rhamadan, or out in the fields at sunrise, where a couple of solitary worshippers raise their hands towards the east, "out of which cometh our help."

The coloured plate prefixed to this article is from a sketch by Mrs. F. Le Bridell, and represents a scene of evening prayer.

Again, there are the ceremonies of the Mahometan Sabbath, when all the women betake themselves to the cemeteries, and pray to the souls of the dead. Nothing can be more oriental and picturesque than the groups of white-robed

figures among the palmetto shrubs. And whether the ceremonial has become one of mere custom or not, one can hardly help associating some sort of solemnity with it. Then there are religious festivals among the negroes by the sea-shore, which, for weird effect and wonderful show, surpass anything we have ever seen—dances of exorcists, sacrifices of calves, and cocks to the ginns, or evil spirits, celebrations in honour of Eysona, a lesser Mahomet, and, in fine, sufficient matter for speculation to all interested in the present and future of Islamism.

No one can refrain from a feeling of sympathy with French colonist life. As one travels from one French port to another, and rests for refreshment at little oases of civilization on the way, it is easy to learn a great deal both as regards the past, present, and future of the settlers. Things are certainly not promising; rich as is the country in natural resources, admirably as it is placed with regard to the mother country, and much as the Government has affected to take its interests to heart, Algeria offers no El Dorado for the poor or enterprising of the French people. And something is to be laid to the door of the people themselves. The French do not make good colonists. They do not carry their Lares and Penates with them, with the intention of founding a Latium, having lost Troy. They come over to Algiers with the hope of making a speedy fortune, and then returning to France.

Of course this sort of view has a deteriorating influence upon the moral and material influence of the colony, and upon the colonists also. They do not build and plant for posterity, but for the day, and having little interest in the adopted country except as a sponge to suck money from, it is hardly likely that they will serve her interests save as they fall in with their own. Yet we might apply Sidney Smith's speech regarding Australia to Algeria, "But tickle the soil with a hoe, and it laughs into a harvest." Anything, everything, can be done with it. And besides the sources of cereal wealth, are an infinity of others, as yet unworked and offering quite a new field for enterprise.

We are by no means disposed to overlook counterbalancing difficulties. The incendiaries of the Arabs alone have ruined many a hard-working farmer, and we, have only to glance at the *Rapport de la Commission d'Enquête* on this subject, published in Paris last year, to be sensible of the fatal antagonism still existent between Arab and Frank, Mussulman and Roumi.

Not entering upon this intricate and interminable subject, however, we will say a few words about Algeria from a tourist's point of view, and then speak more especially of the climate.

Place yourself within a day or two's journey from Algiers, and you are as completely out of the world as the most *blasé* tourist could desire. If you are a sportsman, there is plenty of game from the plover to the panther; quails, partridges, hares, gazelles, jackals, hyenas, filling the space between the Alpha and Omega of the list. To catch sight of the panther, one must travel a hundred and fifty miles from Algiers, and there having reached the snow-tipped Atlas Mountains, may, perhaps, find a lion too, if benighted in the cedar forests.

For an artist, there is such inland scenery as few people ever associate with "Afric's burning plains," as Bishop Heber has it; delicious orange gardens, sunny plains sprinkled with wild flowers, gorges of almost Alpine grandeur, olive-groves glossy green, rivers wandering amid a flame of oleander blossoms, mountain scenery vivid and varied as only African skies can make it; and lastly, the ever-picturesque element of Eastern life. Of course, we cannot enjoy such a feast of nature without some hardships. The traveller must make up his mind to ride over very rough roads, to sleep in caravansaries or in tents as the case may be, and not always in clean beds, to eat any dish that comes in the way, without too much inquiry as to the matter or manner of it, and not to expect much intelligence from such Arab guides as he may have to deal with.

With regard to the Algerian climate, there is not a doubt that it is in some respects incomparable from October till May. The air is soft and moist, and slightly bracing. When the sun would otherwise be too hot, there are refreshing breezes blown off the sea, and the nights are invariably clear and cool. On the hills, too—we are now speaking of the suburban part of Algiers—the weather is uniformly fresh and invigorating even when the summer is advanced, and the inhabitants of the town are suffering from the heat. Never shall we forget spending last Christmas-day in a Moorish villa at Mustapha Supérieure, one of the prettiest, healthiest, and most elevated spots within an hour's walk of the city. The skies were bright and cloudless, the hill sides were clothed with foliage and flowers, and ladies were plucking roses and violets in their gardens bareheaded. It was, in fact, a June day. And with the exception of rains, the winter of Algiers is uniformly mild, though every day is not, of course, like that just recorded. At night, one is glad of a little wood fire, and especially in the airy country houses, which are admirably built for coolness and air. In fine, we should say that for diseases of the chest and lungs, the climate of Algiers offers all the advantages without the drawbacks of other and more popular resorts. The fresh sea-breeze, the elasticity of the air, the absence of any depressing atmo-

spheric influences, are certainly arguments in favour of this statement, and there are other minor considerations not to be overlooked. The charming scenery, the agreeable English society, the moderate price of hotels, and the practicability of conducting a *ménage* on one's own account, the abundance of fresh vegetables and delicate game wherewith to tempt dainty appetites—all these things are so many items necessary to an invalid's comfort.

We only hope that any words of ours may induce those to whom east winds are emissaries of destruction, and fogs poisons deadly as Socrates' draught, to escape from both, and wing their way southwards with the nightingales and swallows. It is not pleasant to all to cross the Mediterranean, and not practicable to many, to quit England for six months in the year, but those who make the effort for health's sake will not do it in vain.

And we can hardly imagine any clouds that could not be dispersed from the mental horizon by a little sojourn in so lovely a land. Southern skies, oriental associations, majestic cedar-forests, sunny plains, snow-tipped mountains, and gold-green valleys—surely such combinations as these are seldom found outside the charmed circle of Algeria?

And the best of all is that as yet these things are unknown.

[NOTE BY THE EDITOR.]—A very interesting collection of pictures of Algeria, by Mrs. F. Le Bridell, and Madame Bodichon, was recently on view at the German Gallery, Bond Street, where, we believe, a few of them still remain. Mrs. Bridell supplied a series of figure pieces, and Madame Bodichon illustrated the landscape scenery of the French colony. Two pieces by Mrs. Bridell, one in water-colour, and another on a larger scale, in oil, illustrated one of the most pathetic and pleasing of Mahometan superstitions, and which is alluded to in the preceding article. It is believed that the spirits of the dead visit their tombs on the Sabbath (Friday), and are able to hold commune with their relatives and friends, who resort to the cemeteries for this purpose. In one of her pictures Mrs. Bridell represents with much beauty of drawing and colouring, and with a depth of expression rarely equalled, a young girl at the tomb of a relative, and addressing a departed spirit; while in the companion piece, the same girl is in an attitude of reverential attention listening to the answers which the spirit is believed to give. The figure-drawing in these pictures is excellent, and the landscape accessories bear the impress of fidelity, and harmonize admirably with the sentiment of the subject.

Amongst the other pictures by Mrs. Bridell, an "Arab Girl at an Embroidery Frame," the "Head of an Arab Girl, her hair Dyed with Henna," "Arab Musicians Chanting a Benediction on the House of a Bride," "Sidi Ben Cassim taking Coffee," and an "Arab Woman by the Sea Shore," possess a high degree of merit, and are likewise valuable as illustrating picturesque forms of life. By a resolute perseverance in overcoming difficulties, and with the friendly aid of the Duchess of Magenta, who highly appreciated her labours, Mrs. Bridell saw Arab and negro life in Algeria to an extent permitted to very few strangers, and she succeeded in obtaining sitters in cases where most artists who have made the attempt have failed. The result is that she has returned from Algeria with materials for very striking pictures, which our readers will no doubt find opportunities of seeing. Sacred and secular associations—the Bible and the Arabian Nights—give an undying charm to good delineations of Eastern life, and in Mrs. Bridell's pictures we see that combination of the actual with the ideal which proves the artist to have felt and understood her theme. Madame Bodichon's landscapes transport the spectator to the beautiful scenery of Algeria, and amongst many of much merit, one especially, a twilight scene, with a heron amongst tall rushes, is remarkable for its harmonious colouring, and its exquisite sensation of calmness and repose. In another piece, dark, weird-looking cedars stand in a rolling sea of rising mist, with very picturesque effect; while other sketches show us "Algiers from the Sea Shore," a wild romantic scene in Kabylia, etc. The coast of Algiers, with its red rocks, bears some resemblance to parts of South Devon, but a peculiar and striking character is given to the landscape by palms, cactuses, and other plants foreign to the English eye.

MODERN JEWELLERY AND ART.

BY WILLIAM DUTHIE.

ALTHOUGH the associations which connect jewellery with art are very strong, it does not necessarily follow that the connection itself is an intimate one. These associations are in part traditional, and in part the result of the charm which the materials of jewellery in themselves, by their natural beauty, exert over the mind in an æsthetic sense. Gems, gold, and silver suggest ornament, and ornament implies art, but the union between the two things—the harmonious blending of form and material—is often sadly imperfect. Perhaps no workman, in modern times, has employed the materials placed at his hand to so little advantage, in an artistic sense, as the jeweller. What art has done within the last quarter of a century in stone and wood, and the coarser, cheaper metals, is something admirable. It has moved the architect, the sculptor, the wood-carver, the modeller and founder in brass and iron, to efforts and results which will assuredly be remembered in future days ; and has helped on the nation in its great course of æsthetic progress and refinement. But nothing of this kind can be said of the jeweller, who has been content to produce lame, mongrel copies of ancient art productions ; has dealt in the slang and vulgarities, as it were, of daily life, epitomised into gold, and garnished with gems to serve as pin or brooch ; or who has gone to the ironmonger and the brass-founder for his newest patterns.

It is surely time that this cause of reproach should be removed. Something has already been done in the way of improvement in design in jewellery—not a word of fault-finding should be said as to execution—and it is only necessary to arouse the public themselves to the deficiencies of this branch of art, to ensure their correction. It is, in fact, the public who are chiefly to blame for the monstrosities which disfigure the jewellers' show-windows, and with which they, the public, esteem themselves to be adorned. The artizan must, as a matter of necessity, produce that which will sell, or the shopkeeper will not accept of it ; and the shopkeeper's chief art is to discover the idiosyncrasies of taste of his customers, and this he does with a wonderful aptitude. The jeweller may appear in some cases to lead the public taste, but he can only do so by pleasing it ; and if he make what in commercial phrase is a "hit," in the production of some grotesque article of jewellery—grotesque in its attempted originality, or vulgar in its imitation of something in ordinary use—it is the taste of

the customer which rules the market, and not that of the shopkeeper, who has simply detected the weak points of his patron's fancy.

It is not here asserted that the jewellery daily exposed for sale, or made to order, is not showy, pretty, and even handsome in one point of view; or that there are not meritorious efforts made to produce works of artistic skill, sometimes with considerable success. The better class of shopkeepers would not admit within their show-rooms the paltry, meretricious class of jewellery, upon the sale of which others again chiefly live; and it is by this better class, who claim to have a style of their own, and who do indeed collect together excellent specimens of tasteful combination and workmanship, that anything like a state of art is maintained in the manufacture of articles of personal ornament. But it is contended that there is an absence of real art, and of that knowledge of first principles upon which all true art is based, among those whose business it is, and whose assumption it is, to be the interpreters of æsthetic outseekings in the domains of personal adornment, in gems and in the precious metals. Great advances have doubtless been made in the general effect of the jewellery produced of later years, as compared with that of the times of the Georges, but this effect is attributable to other causes than artistic beauty of form, or even combinations of colour, and in too many cases the effect is a false one.

If we seek for examples of the styles of art produced at different periods since the mediæval ages, what do we find? Coarse, plump, and awkward outlines; little discrimination in the mingling of colours; and very inferior workmanship. Indeed, in our own country, since the reign of Elizabeth, there is scarcely a specimen of jewellery proper extant, which can serve as a model to us of the present day. There has been much good embossing and chasing throughout that period, and occasionally the enameller gives us glimpses of the best efforts of his art; but there are few works in which a unity and completeness of design, a refreshing contrast in the colours of the gems or enamels employed, and a harmoniousness of effect in details, which make up the perfect specimen, to win our praise or excite our emulation. There are not wanting, here and there, isolated details which are charming; as if all the materials for a perfect work were at hand, but that there failed the master-mind to select and mould them together. There are no evidences of the controlling taste of a Benvenuto Cellini, the tracings of a Holbein, or the minuteness and perfection of finish of the Brothers Müller, shown in many an example in the Grüne Gewölbe of the Zwinger at Dresden. Even on the continent, during this period, there is not very

much to boast of; and the best specimens of jewellery there, as at home, take the shape of pure diamond-work.

As was naturally to be expected, it was in the arrangement and manufacture of diamond *parure* that the best display of really artistic progress was shown. There the draughtsman and the modeller were thrown back upon their own resources; for, seeing that little was to be effected, as a rule, by contrast of colour, so much more devolved upon grace of form and boldness of relief, for ultimate effect. The diamond-workers were always a better trained, and better paid class of men, than the goldsmiths, and the costly material upon which they were employed permitted an outlay, and demanded a degree of attention, which the labours of the goldsmith could dispense with. But even the diamond-work made on the continent from the beginning of the sixteenth century, down to within the last fifty years, was heavy, inartistic, and, considering its value, ineffective. Perhaps the Venetian diamond-work was the best, and much of this excellence resulted from the manner in which the gems were cut, viz., rectangular, with deep, single facets, and a broad flat table. Venice then led the way in most of the arts, and it is not surprising that her diamond jewellery should excel that of all other countries. In England, till within the last half century, diamond ornaments, in common with all kinds of jewellery, were simply execrable. Perfectly flat, and although usually imitative of some kind of foliage, with no more relief or modelling (*movement*, the French call it), than a platter, the jewel was rather a rude mass of silver, in which diamonds were here and there set, than a piece of work with any traceable design. It was usually a cast block with a rounded back to each stone, and no gold whatever upon it beyond what was necessary as a means of fastening it to the dress. Where the pattern was not clearly floral, it was a mere jumble of grotesque shapes, not traceable to any original on the earth, or in the heavens.

The first real improvement in the design of diamond-work originated in Vienna, and from its very character led to new and more artistic development. It began in a *parure* of slender grass leaves, from which were pendent small stars, or dew-drops, and its best feature was a conscientious desire to follow closely upon nature. For a long time the simple field flowers and long grasses were the ruling models of diamond-work in the Austrian capital. The new fashion soon spread from Vienna to Paris, and thence, through French and German workmen, to London. At this time what is technically called "thread setting" was little used in London. The English workman prided himself upon his "grain setting," i.e., his work, whether leaf, flower, or nondescript orna-

ment, was pared away on the edges, leaving long round-topped grains between, and on the side facets of the stones. All ornaments alike were subjected to this treatment, which gave a rounded appearance to the work, and destroyed all outline. This style of setting is described as "cut down," from the manner in which it is effected, and the Englishman was proud of his "cutting down." "Thread setting," on the contrary, preserves a fine *fillet*, or line of silver on the outer edge of the portion of the leaf or flower, the sharp outline of which it is desired to preserve, and by a judicious use of the two methods, an admirable degree of relief is given to the whole ornament.

The advance of the Viennese in their search for art in the footsteps of nature led to most important results. The simple grass leaves were succeeded by foliage of a more ornate character; flowers of most complex construction were made the prominent features in the tiara, the brooch, or the stomacher, till no object was considered too difficult of imitation in the plastic silver, to be afterwards encrusted with diamonds so thickly as to leave little but a shell or skin of the original material to bind them together. It may truly be said that jewellery, in its employment of the diamond chiefly, attained perfection in these floral ornaments. The taste of the draughtsman and the modeller, and the skill of the workman, were combined to produce them, and the result was the creation of works of true art. Many of the best specimens of this class of workmanship were made in London, but, it must also be said, by foreign artizans, chiefly French and German. The style of the present day is no longer the same, but the skill and the taste remain, although scarcely employed so advantageously. The fashion of the moment runs in favour of a species of Arabesque or Byzantine interlaced work, to which it would be very difficult to give a name, but which is effective in so far that it allows of the massing of stones on a rounded surface, broken up by narrow interstices, and a few gems are made to produce the dazzling effect of many. Diamond-work finds a further development in simple five-pointed stars, placed at intervals on an interlaced band.

There is little to be said for the goldsmith's handicraft from the time of Elizabeth to within the last half century. The old skill and artistic aptitude of the workman, derived from Italy, and developed under the Tudors, did not immediately die out in England, but it was not likely to gain an accession of strength in the more prosaic and unsettled times of James and of the Charleses. There was doubtless plenty of work to be done for both jeweller and goldsmith in the latter part of the reign of Charles II., but it was more showy than

artistic, and has not lived. What did live, however, and give repeated signs of healthy vitality, was the art of chasing and embossing—in its result more often called *repoussé-work*—and many fine specimens of the art, executed at this and at a later period, are to be found. But *repoussé-work* is scarcely applicable to jewellery proper, and was chiefly employed on *tazzas* and other silver plate, but oftener still on the gold cases of watches, and the principal portions of *chatelaines*.

The eighteenth century was the age of snuff-boxes, *etui-cases*, *bonbonnières*, scent-bottle mounts, and a host of similar productions, in which great cleverness and some taste was displayed; and of paste waist-clasps, and shoe-buckles. What is more to our purpose, however, is the fact that at this period several kinds of finger rings of great taste, and very careful workmanship, were made. One kind is called the "*Giar-dinetti*" ring, and consisted of a sprig of leaves and flowers, formed of diamonds and garnets, the latter set to imitate rubies, but among which other stones are very often introduced. These rings are in endless variety, and often have an ease and grace which make them deservedly prized. There were also what are commonly called Queen Ann's rings, made of a single stone, an amethyst, a topaz, or a table diamond, in a close cramp setting, with a peculiarly light scroll shank, and an exquisitely fluted gold back. The double scroll on the shoulder of the ring was sometimes of silver, and held in its folds a small square cut gem, usually a ruby or a diamond. Then there were the crystal memorial rings, in which a single crystal, with a narrow faceted edge, was set over a gum-plait of hair, in the centre of which was a minute cipher made of twisted gold wire. The crystal was cut with a broad *culasse*, which rested directly upon the cipher, and allowed it to be seen clearly through. It must be especially noted that the pride of the setter at this period was that his work, whether of real gems or paste imitations, should be "*sound*," that is, capable of excluding air and water; which is much more than can be said of the setting of the present day. Some of the paste ornaments, in imitation of diamond work, of this time, although utterly devoid of beauty of design, were wonderful specimens of clean, close workmanship, and often retain their lustre untarnished after the lapse of a hundred years.

At the latter half of the eighteenth century, engine-turning was much employed to ornament large surfaces, and was made available as the ground-work for the enameller whereon to place his translucent glasses. The enamelled work of this period is very good, more especially the dead white and the purple, and a kind of dark puce (*pieuse*?) which has since been called *mauve*. Engine-turning was brought to great

excellence, but has now fallen into comparative disuse, together with another kind of machine tooling, at one time in great request for rings and ornamental edgings, called *nerling*. This *nerling* was the pressing of a pattern engraved on a small steel wheel, by means of a lathe, on to any metal wire or edge prepared to receive it. Then we come upon what may be called the garnet period, a distinct era in the history of jewellery, and which was of long duration. So far as design went, nothing could be more bald and tasteless than the single rows of round or oval garnets, or the occasional jumbling together of several stones in a cluster to give variety to the pattern. By this time the jeweller's art, as implying a knowledge of drawing, and the moulding of his materials into relief, was at its lowest ebb; but his garnets were of the finest claret colour, were carefully cut, and set and foiled to perfection. The diamond-jeweller still maintained his supremacy, and although his designs were flat and meagre in spirit, he managed to display considerable cleverness in small works, as in rings—*la bague marchise*, for example—and in ciphers; but here again the effect was in a great measure marred by the use of the cramp, or “cut down” setting, instead of the “thread,” which did not permit of the modelling, so to speak, of the letters. The garnet period only gave way to the period of filagree work, and the substitution for the garnet of the pink and yellow topaz, the jacinth, the chrysolite, the chrysoprase, the use of the zircon, or jargoon, instead of rose diamonds; the introduction of stone-cameos, set, in imitation of Roman work, in bright red gold, with yellow nerled edges; and last, though not least, the amethyst.

The filagree work which now came into fashion was simply a revival, under modifications; for this use of twisted and screwed wire dates from the oldest times. But it was a vigorous revival, and held its ground for some years. When at length it yielded it was to the superior attractions of a spurious Elizabethan, and an equally spurious Renaissance, scroll work. That taste dying out, there was awakened a passion, puffed into flame by a wind from Germany, for turquoise *pavé*, in balls, half balls, oval and round excrescences, perched upon and dropped into all kinds of uncomfortable places where they had no business to be. Conjointly with the turquoise *pavé*, came the fashion for large plain wire work—a sort of golden macaroni, involved and knotted, but to what end no mortal could tell. Sometimes this wire work took the shape of simple round or oval rings, inexplicably interlaced, like a conjuror's puzzle; at other times it resembled most a huddling of earth-worms. The turquoise *pavé* and the plain wire work have still their admirers; and the latter was but the precursor

of a series of monstrosities. Among them came the horse-shoes, the straps and buckles, the jockey caps and whips, the screw-heads, the folded copies of *Bell's Life*, the padlocks, door-plates, bolts and bars, and cups and balls, which have long been the fashion. The jeweller's art in short fell among the pots, pans, and kettles of every day life, and, to a great extent, it is among them still. There has been, it is true, in the mean time, a Roman revival, here and there decidedly successful; and an Anglo-Saxon revival, which has somehow made rock crystal its principal medium of interpretation, and which has some very good features joined to its natural plumpness and heaviness; and a partial mediæval revival of a monkish character, which speaks in monograms and alphabetical puzzles. A great deal of good may be said for all these revivifications, unfaithful copies as they are of their quaint originals, but for the sporting, and what may be called the poker and shovel jewellery, there is only one word—it is simply despicable.

But cannot something really original be designed in our personal ornaments? Or, if we must be copyists, can we not choose good models, and copy faithfully and conscientiously? Is there no leaf or flower that may serve to give us new ideas of form or combinations of colours? It would appear as if the baser the material, the more was the artist drawn to rescue it from oblivion by his genius; and the more precious the matter to be dealt with, the less care was needed to embellish it. Our schools of design produce draughtsmen who furnish admirable patterns to be woven in wool and cotton; models to be executed in wood and stone, in iron and brass; elaborate compositions to be worked out in glass, and common potter's clay; and is there no cunning hand to devise forms of symmetry and beauty for the employment of gems, of gold, and of silver? What the sculptor has done, what the wood-carver has done, what the weaver and spinner have done, for their art, cannot the jeweller do for his? There are exceptions to every rule, of course, but we do not want the exceptions to monopolize the place of the rule; and that is practically the case with regard to the taste in composition of the most part of modern jewellery. A new pattern is simply a matter arising hap-hazard from something already in existence; it is scarcely ever an original conception; and the most commonplace objects are generally chosen as the base of the design, or as fit models, *purs et simple*, for illustration.

The fact is, the modern jeweller has allowed himself to be dazzled by the very materials among which he labours. With him all is gold that glitters. When the precious metals were scarce, and gems were rare, a Cellini could be found

who would build up a fairy fabric of graceful proportions and magic colours, to embalm jewels which were more prized for their names than for their beauty; or a Holbein to trace symmetrical outlines, and mingle brilliant colours in softening harmony, for the jeweller's behoof. But now that gold abounds, and gems were never so abundant or so beautiful, the artistic element is neglected, or allowed to fall through altogether; and the jeweller entrenches himself behind his dazzling store, and flashes their unassisted rays in the eyes of his customers. There is more skill, more talent, more appreciation of the beautiful even, among workmen now than at any time within the last century, if it were only turned to proper account. A true piece of jewellery should be as much a work of art as a picture, or a figure sculptured in marble; and there is no possible reason why it should not be so. There is no want of lovers of ornament, or of wealth to devote to its study; it is only necessary to place the fact clearly before one, viz., that the most beautiful materials for ornament in creation are only half utilized for their best purpose, or are degraded into meretricious imitations of commonplace objects. It is not so with the silversmith. All that refined art and delicate manipulative skill can perform is lavished upon our race-cups, our épergnes, our centre-pieces, our candelabras, to the delight of all beholders, and the permanent advancement of art itself. The material is comparatively valueless; it is the spirit breathed into it, the wonderful skill of execution which gives the vase, or the group of figures, its value. Whereas, in the case of a piece of jewellery, it is usually the cost of the gems, not the beauty of the design nor the delicacy of the workmanship, which is the subject of admiration.

The fault of this comparative lack of art conception in jewellery rests greatly with the public. So long as the taste of the public lies in horse-shoes, and straps and buckles, the jeweller is not likely to strive to anything much higher. The public should be the real teachers, not the slavish pupils of the manufacturer; and if gentlemen would devote the same study, and the same natural taste, to their family jewels—not necessarily in a spirit of costly outlay—as they do to the building of their mansions, the furnishing of their halls and studies, or the laying out of their grounds, the jeweller would be found an apt and willing scholar. A piece of jewellery would then become a real work of art, as it was in days long gone by; a series of models for cheaper ornaments being created, the general taste would be improved; and eventually the abortions and apish vagaries of modern jewellery would disappear, to the great comfort of all true lovers of art.

CHACORNAC'S SOLAR THEORIES.*

IN addition to the series of lithographed "*bulletins*" from the observatory of Ville-urbaine, M. Chacornac has just issued what appears to be the first part of an important essay, in which he arranges the facts which he has observed, so as to exhibit the theories he has formed.

He states, that an examination of the sun with a good telescope, even of small dimensions, enables the observer to see that the shining surface is not smooth, like that of a substance in liquid fusion; but that it is made up of luminous elements, matted together like meshes in a network composed of a viscous material, and not analogous to anything existing on the earth; although to a certain extent the appearances may be compared with threads of metal or melted glass, in a sufficiently viscous condition to solder them close together, to change their shape, and to enable them to disperse or assemble, like snow-crystals, under the influence of atmospheric currents. Conceiving the analogy between these solar phenomena and those of crystallization to be very strong, M. Chacornac speaks of "photospheric crystals," and defines the photosphere by saying that "it is composed of innumerable photospheric crystals united together." The shape of these crystals is not, as was supposed, uniform; and, though more often threadlike, they will be found to exhibit all the imaginable figures that a paste in a state of violent fermentation might be expected to offer.†

According to the definition given, the solar photosphere is not continuous, and behind (au travers des) the photospheric crystals a dark background is seen, on which all the strata of the envelope project themselves (un fond obscur sur lequel se projettent toutes les formes des strates de cette enveloppe).

Observation also shows that the vast agglomerations of photospheric crystals move independently of the fundamental stratum, as if the upper portions floated in an atmosphere, as clouds do in the air.

In the month of April, 1850, M. Chacornac states that he discovered that the spots or cavities in the photosphere were only formed by the dispersion of the photospheric crystals, and by a partial swallowing up or engulfing of the photo-

* "*Notice sur la Constitution Physique du Soleil.*" Par M. Chacornac.

† Many observers will not agree with M. Chacornac in considering that the photospheric bodies bear an analogy to *crystals*, and there is little resemblance between forms produced in paste by violent fermentation and those which result from crystallization.

sphere. At that time he observed, and has since been confirmed in the opinion, that at certain points the photosphere seems to melt, and become like ice on the surface of a lake, which, under the influence of a considerable weight, slides obliquely into the liquid. In this way enormous photospheric fragments are engulfed while preserving their form, but losing their brightness as they sink. On the 3rd of December, 1858, he observed a luminous avalanche, larger than our earth, engulfed in this manner. During the interval between these meltings (effondrements) of the photosphere, he has observed a contrary action, like a condensation of the exterior atmosphere into luminous masses. This appearance he considers analogous to the formation of the "crystalline clouds," which we name *cirrus*.

As a provisional conclusion, M. Chacornac regards the sun as "a liquid incandescent mass, surrounded by a thick atmosphere, imperfectly transparent; and whose ultimate limits extend to great distances beyond the central body." This atmosphere he considers to extend not less than two or three times the length of the solar radius, and to its attracting power is due the difference in tint and splendour of the centre and margin of the disk. This immense atmosphere increases in density in its lower layers, which are near the surface of the liquid ignited mass. "After a series of photometric measures of the light of the penumbra, compared with the most considerable extinction of light which the photosphere experiences when it plunges by narrow isthmuses into the depth of the cavities, we come, with the help of depression measured in the *penumbra*, to the conclusion that the central body is situated at a depth about ten times greater than this depression." The lower layers of the solar atmosphere must acquire an immense temperature through contact with the incandescent mass, and the great pressure they experience; and from variations in their temperature perpetual movements arise. The liquid surface of the sun must vary in temperature from a variety of causes, such as ascending and descending currents, and variations in the diathermancy, or heat-transmitting power, of different portions of the atmosphere. A rapid and constant evaporation goes on from the liquid surface supplying the matter, which is precipitated in a crystalline form.

"When we examine the sidereal universe with reference to the probabilities which determine the incandescence of stars, we are convinced that the principal cause is the condensation of agglomerated masses of cosmical matter." M. Chacornac points out that, with a given pressure and temperature, vapours will have a density little below that of a liquid; and it is, therefore, reasonable to suppose that, at a certain distance

from the limit of the mass of solar vapours, they condense themselves into fluids at high temperatures, in which the laws of cohesion approach those of bodies in fusion. In admitting that temperature and pressure increase with depth, we may conceive that the central solar mass finally acquires the perfect condition of a body in fusion.

When solar vapours at high temperatures leave the surface, they rapidly ascend to a region in which radiation is energetic, and in the exterior regions of the solar atmosphere they are acted upon by the cold of celestial space. Under these circumstances condensation and crystallization occur, accompanied with the emission of light.

M. Chacornac calls particular attention to the fact, that in the phenomena of spots the gas that seems to escape from the central body dissolves the engulfed portions of the photosphere, just as crystals dissolve in a liquid; but "in certain cases, when the gaseous central emanations cease to disperse the photospheric matter, and to enlarge the openings in it, it may be seen that engulfed fragments of photospheric matter are augmented in volume, with loss of their incandescence, as if the luminous crystals had become transformed into nebulous vapour, reflecting only the light of the photosphere."

The gases of the absorbent atmosphere above the incandescent zone, or those which form aureoles during an eclipse, are not very luminous, as they reflect a large portion of polarized light. The incandescent zone limiting the photosphere presents an accumulation of incandescent matters in ignition, and terminating in flames like those proceeding from terrestrial substances burning in air.

During the eclipse of July 18, 1860, the first objects which M. Chacornac observed beyond the lunar disk were jets of vapour, like those represented by Mr. Poulet Scroope, but with this difference, that instead of exhibiting ascending masses of a globular form, they run like bands with luminous streaks, like *bouquets d'artifice*, and which spread out in their upper portions as if they had arrived rapidly in a lighter atmosphere. "These vaporous jets corresponded specially with groups of acute cones of incandescent matter, which constituted the purple zone surrounding the photosphere."

M. Chacornac regards the bodies he terms photospheric crystals as continually forming at certain elevations, and being recondensed into liquids, falling back on the sun as they descend below certain limits of pressure. He also considers that the central liquid mass of the sun, in addition to the emission of vapours, absorbs gases just as melted metals absorb oxygen or oxide of carbon, and that a sudden crystalliza-

tion of the incandescent matter is accompanied by explosive emissions of gas.*

To account for the appearance of spots, exceptionally, in the equatorial regions, M. Chacornac remarks that evaporation is most rapid when the atmosphere in which it takes place is least dense, and that the quicker it takes place the greater the local loss of heat. At the sun's equator, gravity being less than at any part of his surface, the pressure of his atmosphere is less than at the poles, and thus phenomena like our trade-winds must arise. Evaporation would be very rapid at the equator, and the rarefaction of the atmosphere would favour radiation. "If the liquid, incandescent surface cools itself more rapidly at the equator than in other zones, it must give rise to currents, as the difference of temperature in our seas between surface and depths occasions superficial and deep currents in opposite directions. If the cooled layers have a tendency to descend into the interior mass, the adjacent layers make a descending rush to fill up the void. This then is a superficial current, tending to carry matter from the poles to the equator. We mark also that this current transports fluid masses animated with a movement of rotation less rapid than that of the zones which they enter, and in virtue of this retardation, they seem to lag behind when compared with the fluid masses moving in zones of less latitude."

The currents resembling our trade-winds acting in a direction opposite to the accelerated movement of the external mass—for at the equator vapours rise more rapidly than at the poles—it results, from the combination of these opposite currents, that the central mass appears to have a movement of rotation more rapid than that of his photosphere. This difference of movement occasions the particular arrangement of spots, and the formation of groups elongated in a direction often parallel.

Referring to the "magnificent work of Mr. Carington," showing, amongst other things, that the velocity of rotation of solar spots is a function of latitude, M. Chacornac remarks that it will be interesting to ascertain if a variation in the phenomenon of evaporation occasions deviations from this law.

In 1857, M. Chacornac states that he remarked a coincidence between the period of a revolution of Jupiter and two consecutive returns to a minimum of solar spots, as noticed by M. Schwabe, of Dessau, and he conceived a connection between the minima of the *radii vectories* of Jupiter and those of the

* M. Chacornac makes frequent reference to the theories of "surfusion and dissociation," by which M. Fournet and others have explained certain appearances in terrestrial geology, but we have not thought it necessary to cite these passages in detail.

solar spots. He considers the action of Jupiter in this matter to be established ; and as we are now in the epoch of minimum spots, he asks whether we can recognize any influence analogous to that which M. Alexis Perrey, of Dijon, attributes to the moon over the volcanic eruptions of our planet. He thinks it probable, considering the immense mass of Jupiter, that he may cause an accumulation of solar atmosphere at the equator, augment its density and absorbing power, and thus lessen the rapid cooling actions which ordinarily take place in that zone. He likewise suggests that planetary attraction may collect some of the cosmical matter of the zodiacal light in the plane of the sun's equator, and thus mitigate both radiation and evaporation. M. Chacornac considers that the line of research followed by Messrs. Warren De la Rue, Balfour Stewart, and Loewy, is calculated to settle these questions.

In a note M. Chacornac says that since the text of his paper was written, other observations make him believe "that a central body may be clothed with an incandescent ocean, and that penumbra are craters of elevation." Our present object is not to criticise, but simply to give an account of the most generally interesting portions of M. Chacornac's important publication.

PHOTOGRAPHY AS A FINE ART.

Those who considered that the function of the artist was merely to copy natural objects with accuracy and fidelity, were (though erroneously) prepared to be satisfied with the operations of photography as soon as they were conducted with a sufficient amount of technical skill. There are certain cases in which art realizes all the conditions of deceptive imitation, and it is not very difficult to paint a butterfly, or a deal shaving so that a spectator might actually expect to be able to catch the pretended insect, or pick up the thin curly slice of wood.

When this mechanical fidelity is realized, there are many persons who conceive that nothing more is to be desired, and they form in their own minds a rude and inaccurate mode of estimating pictures according to the amount of realism which they exhibit.

A little more acquaintance with the facts of nature and the possibilities of art soon lead to the conclusion that realistic imitation is only possible to a very limited extent, and that in the main what may be called the imitative part of the artist's work consists in transposing, according to natural laws, the

facts of nature into the technical language of art. The painter can make no real imitation of the light which streams from the sun or the artificial fire, and his scale of light, shade, and colour is not only much lower, but in many respects different from that of nature. Only to a slight extent and under favourable circumstances can he, with any success, make the slightest attempt to imitate the strength of white light as seen in nature, and the art of the colourist is shown in his power of *transposing* what nature has composed in keys of actual light into corresponding, but not resembling, keys, such as his pigments enable him to provide.

The eye, as a living organism, does not remain in one and the same condition during any considerable portion of time in which an object is contemplated. Thus, if an object consists of parts in different planes, rapid focussing changes will occur in the eye, and the impression of vision is not the simple result of any one of these focussings, but a sort of average resulting from all. The perception of colour is not a simple affair. According to original sensitiveness and cultivation, the sensation of a colour is followed by another sensation of its complementary hue, and when two or more colours are simultaneously presented to the eye, very slight differences in the direction of that organ, and in the attention which the mind pays to its indications determine the precise result that is produced. The brightness of natural objects seen in full lights not being imitable by the artist, it follows that his productions cannot have the same power of summoning up complementary tints. Again, natural objects are more or less in motion, and more or less affected by motions of light and shade upon them, and the artist has to select and stereotype one out of many successive appearances presented to his view.

A few considerations of this kind will show how soon the limits of realistic imitation are reached, and it must also be remembered that even if accurate imitation were possible, it would not satisfy the human mind, which demands imagination, sentiment, emotion, as well as beauty in works of art. But it is generally supposed that photography comes to us with something like a perfection of imitative capacity. This is not the case. Instead of photography being necessarily right, imitatively considered, it is necessarily wrong. In the first place its focussing is a compromise, and if we take one of the best specimens of photographic landscape, its treatment of foreground, middle distance, background and greater distance, will never be found conformable either to nature, or to the impressions which, through the eye, the scene depicted makes upon the mind. In nature yellow light is the next in point of brightness to white light. Photographic machinery turns it into black.

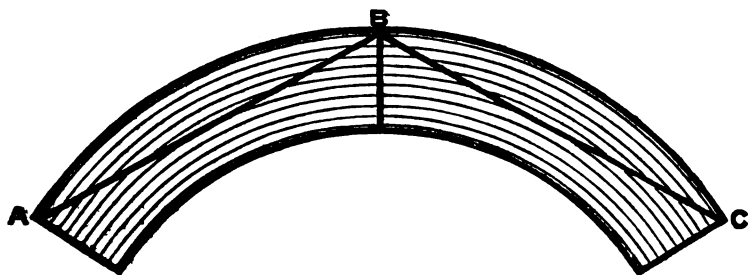
The natural scale of brightness as connected with colour is constantly at war with the photographic scale; and the results of this conflict are seen in all photographic works which attempt to give a black and white version of a polychromatic object or scene.

The rise amongst us of the pre-Raphaelite school, and the modifications which that school, as represented by its leading artists, has undergone, has familiarized most minds with questions pertaining to detail or generalization. To paint a number of leaves and branches correctly, according to imitative notions, is not to paint a tree as any mortal ever saw it or could see it, when he looked at it as a whole. Too much detail for the conditions of a picture damage its verisimilitude as well as its art. Too vague a generalization is still more fatal, because it is wanting in particular truth. A drawing of a particular man so generalized as to be as much like any other man of the same race and clothing, would be an absurdity if it could be produced, and the true artist has to consider how far he is to generalize, and how far he must particularize in order to produce the best result—one of truth combined with beauty and with suggestive power.

If a number of good and bad photographs are examined, it will soon be found that, in addition to their merits or demerits, as attempts at imitation, they will vary in approaching to or receding from the kind of delineation which great artists delight to give. The artist imitates the appearance of nature in which delicately graduated lights and shades indicate the forms of objects seen in and surrounded by an atmosphere. Photography has a constant tendency to the child's blunder of making hard firm outlines where nature avoids them. The best of the orthodox school of photographers mitigate this mischief, but we are not aware that any one besides Mrs. Cameron has fairly attacked and vanquished it, and thus established a connecting link far stronger than any which previously existed between photography and fine arts. Mrs. Cameron has been engaged for several years in this labour, and her productions have been for some time before the public; but some of her most recent works have been the most remarkable, and have called forth from artists of the highest eminence a very enthusiastic, and, as we think, richly deserved praise. Mrs. Cameron has especially devoted her talents to two objects, both usually neglected in photography. The first is the realization of a method of focussing by which the delineations of the camera are made to correspond with the method of drawing employed by the great Italian artists. The second has been the introduction of an ideal pictorial element, by selecting good models and calling forth the kind of expression

which a judicious artist would desire to enshrine in his work. The results of Mrs. Cameron's labours may be seen at Colnaghi's, in a large collection of photographs, varying considerably in merit and interest, but all bearing testimony to originality of purpose and artistic skill. Here we have the head of a boy, full of fire and expression, simple and grand as a sketch by Correggio, which it closely resembles. There is no dead mechanism of mere photography here, but emphatically a work of art, instinct with life and motion. The hair flows freely, as if the breeze had caught it, the outlines are soft and melting, the play of light on the blooming features marvellous to behold. In another piece the same boy figures as *Love in Idleness*, a handsome mischievous urchin playing with his bow. An exceedingly well-managed group represents *May Day*; two other portraits are combined into an artistic and effective *Prospero and Miranda*. Other subjects of Mrs. Cameron's skill give us *Esther and Ahasuerus*, *Friar Laurence and Juliet*; while single figures, remarkably like drawings by great artists, are named, *The Mountain Nymph*, *Sweet Liberty*, *Adriana*, *Sappho*, *Clio*, *Christabel*, etc., etc.

In some of these cases we do not find ourselves able to follow the suggestions given by Mrs. Cameron in naming her pieces, the Greek ones especially seem to us, as a rule, to have much more of the character of mediæval Italy; but no one, free from professional photographic prejudice, can see them without being struck with the high degree of artistic merit which they possess, and the contemplation of works so original and so beautiful, leads to the conviction that photography need not remain in the lower stages of a mere imitative craft. Mrs. Cameron not only claims for it, but wins for it, the dignified position of a fine art, and we are glad to notice that copies of her works are offered for sale at very moderate prices. It is good for artists as well as amateurs that there should be this sort of competition. Ladies, like Mrs. Cameron, who break through the conventional nonsense which attempts to scorn industry the moment it seeks for profit, are doing good service in their day and generation. It is probably not of the slightest consequence to her whether she gains or loses by photographic pursuits, but, as her works are substantially good, and capable of multiplication, she is morally right in letting the public have the benefit of them, and economically right in accepting whatever legitimate profit they may produce.



DECEPTIVE FIGURES;

WITH REMARKS ON SATURN'S "SQUARE-SHOULDERED" PHASE.

BY R. A. PROCTOR, B.A., F.R.A.S.

IN the April number of the *INTELLECTUAL OBSERVER*, p. 224, instances have been given of an optical illusion affecting our estimate of the relative *size* of figures placed in particular positions with respect to each other. In the figure accompanying this article a somewhat similar illusion affecting *shape* is illustrated; the lines A B and B C, which appear to have a decided curvature, being in reality straight lines.

In figures constructed on a larger scale, and with concentric circles closer together (in proportion), the deception is still greater; and it is remarkable that the illusion is increased by drawing equidistant lines radiating from the centre of the concentric circles. I notice, also, that a want of symmetry in the drawing seems to destroy the illusion.

The deception struck me as remarkably perfect in the case in which I first observed it. I had drawn the meridians and parallels for a polar star-map on the equidistant projection, to the scale of an 18-inch globe—the parallels to every degree, and the meridians, from the 20th parallel of N. P. D. to the bounding parallel (N. P. D. $37^{\circ} 23'$) of the map, also to every degree. Thus the map formed a circle $11\frac{1}{4}$ inches in radius, with 37 concentric circles crossed by 360 radiating lines, drawn with as much uniformity as possible. Now before marking in stars, I wished, as a matter of curiosity, to determine the exact figure on the *equidistant* projection of the spherical pentagon, which in my *gnomonic* maps appears as a true pentagon. I accordingly drew in, in pencil, first the inscribed pentagon, and then (through points determined by their known R. A.'s and N. P. D.'s) the five curved sides of the figure I required. Thus the sides of the true pentagon formed chords of the five sides of a curvilinear pentagon

outside the true one. But now I could scarcely persuade myself that I had not by mistake drawn the convexities of the curves the wrong way; in other words, that the curvilinear pentagon I had drawn was not a true pentagon, and its sides the chords of a curvilinear pentagon *inside* the true one. I had, in fact, to take a tracing of the curvilinear pentagon before I could form a satisfactory conception of its real shape.

This illusion seems to have a direct bearing on the question of the *square-shouldered* figure sometimes assumed by Saturn. We see that a series of concentric, similar, and symmetrically disposed curved lines, give to a straight line crossing them an appearance of curvature in a direction opposite to that of the curved lines. Hence a line drawn with a certain slight curvature in the same direction as the curvature of the concentric lines would appear straight, and a line with a greater curvature would appear to have its curvature diminished. Further, if such a line were continued beyond the concentric lines, the alteration of curvature would disappear at a short distance from the concentric lines. Hence H's observation of the flattening of Saturn's equator, and his determination of a maximum diameter and curvature at latitude 43° (not far from the apparent intersection of the ring's outer boundary with the outline of the disc) seems to be satisfactorily explained. Yet it cannot be denied that there are grave objections to the optical explanation of the phenomenon. One would expect that the illusion would be perceptible in pictures of Saturn; that it would be always observable, or, if it be supposed to depend on the extent to which the rings are open; that it would always be noticed when the rings are open to a particular extent; that it would disappear when the rings are closed; that it would not affect micrometrical measurement—or, if it affected such measurement in one case, that it would do so in all cases. A perusal of Mr. Webb's review of the evidence (pp. 250–252 of the May number of the *INTELLECTUAL OBSERVER*) will suffice to show that not one of these conditions is fulfilled.

I venture with great diffidence to offer some considerations which seem to point to a different solution of the difficulty.

If we assumed, either that the atmospheres bear any proportion to the masses of planets, or that any provision is made by increased depth of atmosphere for diminution of solar heat, we might fairly suppose that the height of Saturn's atmosphere is nine or ten times as great as that of our own atmosphere. Now the earth's atmosphere has been supposed to extend to a height of from 100 to 150 miles (Nichol's *Cyclopædia of the Physical Sciences*, Art. "Atmosphere"); but taking the more moderate estimate of 50 miles, the height of Saturn's atmo-

sphere might be assumed to be from 450 to 500 miles.* Our positive evidence is not, perhaps, very strong. The circumstance that the constitution of an atmosphere so far removed admits of determination by spectrum-analysis seems to indicate that the height of the atmosphere must be considerable. Mr. Grover's observation of a penumbra surrounding the planet's shadow on the ring (*Astronomical Register* for August, 1865, p. 212), "always noticed" even with the moderate telescopic power applied by this observer, also points to the existence of a strongly refractive atmosphere. Herschel's observation of a remarkable retardation of the occultations of Mimas and Enceladus has not been confirmed; but, perhaps, this is hardly to be wondered at. There are not ten telescopes in the world capable of following these two satellites up to the moment of their disappearance, and since the date of Herschel's observation there have only been five intervals, each of a few weeks only, during which the observation has been possible. It is true that where the further part of the ring appears to meet the disc at an acute angle, its outline should be distorted if the planet have a refractive atmosphere; but it is easy to see that the distortion would scarcely be appreciable even with the most powerful instruments, and Mr. Grover's observation above recorded is sufficient to show, that details observable with very moderate powers may for a long time escape observation. It will presently be seen that I am not here losing sight of the evidence pointing to a reflective power possessed at times and in certain latitudes by Saturn's atmosphere.

Now it has been observed by Professor Challis,† that the atmospheres of planets must have certain definite limits, since "the density continually decreasing with the height, a point must at length be reached at which the upward repulsive force of an atmospheric stratum is just equal to the force of gravity; in which case there can be no downward repulsive force, and therefore no further extension of the atmosphere." And he considers, that the effect of an atmosphere on our estimate of a planet's diameter will depend on "the relation between the gradation of density of the atmospheric strata and the curvature of the globe." This relation may be such that a ray would "pass *through* the atmosphere in a course which grazes, or is a tangent to, the interior globe;" or else, that rays could not reach "the surface of the globe in a direction making with it an angle less than" a certain limiting angle. In the first case

* Schröter estimated the height of the atmosphere of Ceres at 668 miles (!); a result which can hardly be considered as established.

† In an article on the "Indications, by Phenomena, of Atmospheres to the Sun, Moon, and Planets," *Notices of the Astronomical Society*, vol. xxiii, pp. 230—238.

the apparent diameter would "most probably not be sensibly increased;" in the second, "the increase would be the angle which the whole height of the atmosphere subtends at the earth." Now it is clearly possible that the atmosphere of a planet might in general exhibit one of these relations, but for a season might present the other, either over the whole planet or in certain latitudes only; and we have distinct evidence that Saturn's atmosphere is of variable refractive power, for whereas in nearly all pictures of Saturn, and notably in Mr. De la Rue's admirable engravings, the disc is darker at the edges than at the centre, so that this may be supposed to be the general appearance of the planet, the contrary appearance was presented in one instance to Bond II., and in another to Chacornac. Now it is perfectly clear, that if for a season the atmosphere over certain latitudes assumed the second state described by Professor Challis, while the remaining part was in the former—which we may perhaps be justified in calling the *normal* state—an apparent irregularity of figure would result. The outline of the disk would correspond in the former latitude to the upper limits of the atmosphere, in the latter to the limit of the interior globe; and we may suppose that in the intermediate latitudes the outline would pass from one limit to the other by indefinite gradations. There are reasons also for supposing that the "reflective state" would be more commonly assumed in Saturn's temperate zones than near his equator or poles. For the causes to which our trade-winds are due are exaggerated in the case of Saturn. Now Sir J. Herschel thus describes the circulation of our atmosphere:—"In each hemisphere inferior currents of air run in on both sides towards the equator, and superior ones set outwards, all around the globe, from the equator towards the poles. It is quite clear that neither near the poles nor near the equator, from or towards which these opposite currents tend, is it likely that there will be that tendency to stratification of the atmosphere into layers of variable density which favours the "reflective state." On the other hand, this state may be expected to occur—not commonly, indeed, but occasionally—in the temperate zones, where these currents attain their greatest velocity and steadiness of motion.

It need scarcely be remarked, that an apparent difference of level of 500 or 600 miles in latitude 40° or 45° , would be fully sufficient to account for Saturn's "square-shouldered" figure; but there are reasons for supposing that the height of Saturn's atmosphere in these latitudes exceeds the mean height. For it is found that barometric pressure attains its greatest value in the temperate zones; and although this phenomenon has never been fully accounted for, it appears highly

probable that it is due to the rotation and figure of the earth; and therefore it seems probable that, in a planet of the figure, dimensions, and rapid axial rotation of Saturn, the excess of atmospheric pressure in the temperate zones would be still more marked.

It would be interesting to examine whether the square-shouldered figure seems to be connected with the occurrence of changes in the configuration of the Saturnian belts, or whether it is only assumed when the belts have remained for a long time in the same, or nearly the same position.

ASCENT OF CADER IDRIS.

BY D. MACKINTOSH, F.G.S.

(*With a Coloured Plate.*)

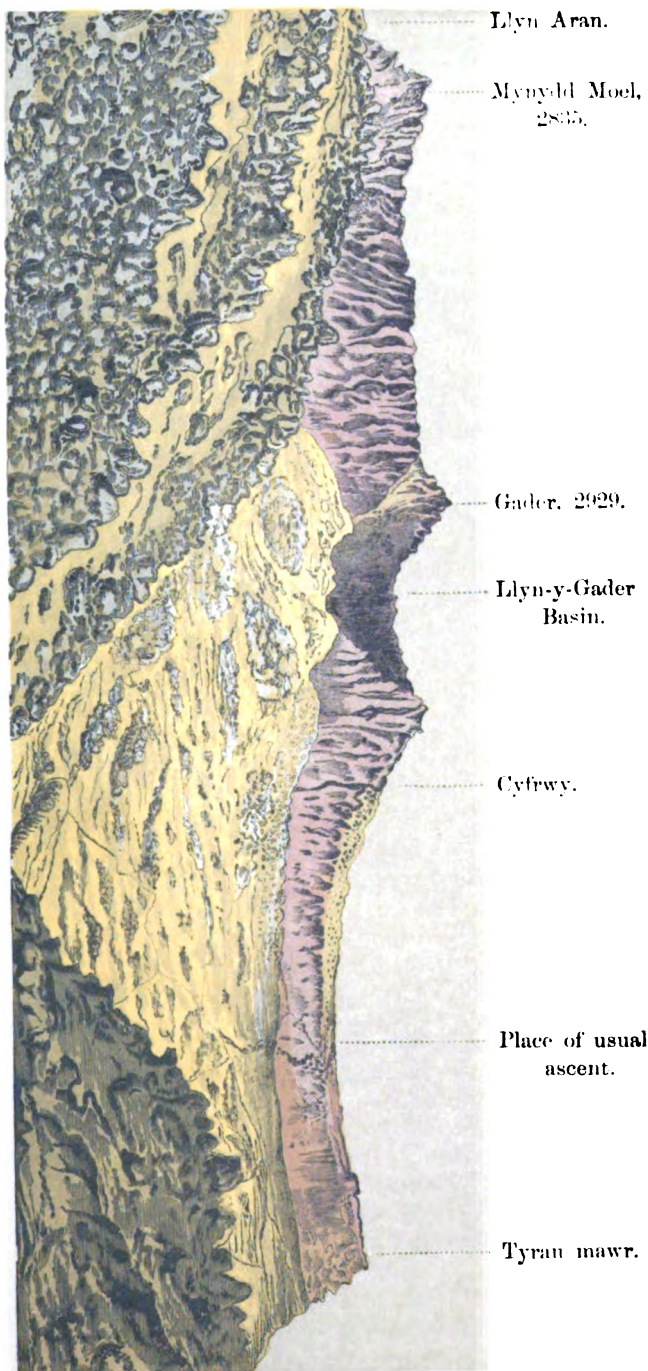
It is to be regretted that guide-book writers, in describing Cader Idris, should copy and perpetuate the errors of one another, so as to leave the tourist in ignorance of what he may really expect on making the ascent of this mountain. To supply, in some measure, this defect, I made a brief survey of the topography and surface-geology of Cader Idris in May last; and it is but doing justice to the mountain to state that my expectations were far more than realized. If the attractiveness of a mountain is to be estimated by the number of abrupt and striking inequalities compressed within a small compass, Cader Idris is perhaps equal to any elevation in Britain; and in the extent of its rocky cliffs and precipices it is certainly superior to Snowdon. It may be described as a long table-land, narrowing towards its eastern termination, and irregularly sloping towards the south. On each side of this table-land there is a range of rocky cliffs, which must strike the most ignorant observer as very similar to what may be seen on many sea-coasts. On the south-eastern, or Tal-y-llyn side, the cliffs are very picturesque, and often grotesquely shaped; but, as this side is not likely to be very much visited in future,* and as one side is sufficient for a whole article, I shall at present confine attention to its northern front, and the neighbourhood of the peak.

The northern or Dolgelley side of Cader Idris is a continuous escarpment, extending like a rampart for a distance of at least eight miles; the principal and most rocky part of this escarpment is about four miles in length. It commences on

* I was informed at Dolgelley that, owing to the completion of the Welsh Coast Railway as far as Penmaen Pool, the Machynlleth coach will in future be discontinued.

the west with a bold and striking headland called Tyrau Mawr. For some distance, in an easterly direction, it consists of a steep grass-covered slope, with frequent rocky projections. On the surface of a large flat stone on the side of this slope I noticed a distinct series of ice-grooves, only a little roughened by the weather during the time that has elapsed since they were imprinted. Further on, the escarpment graduates into a line of bare rocky cliffs, with debris or "scree" strewn along their bases. These cliffs are deeply indented with vertical rents and passages, which often ramify backwards so as to leave detached pillars. On approaching Llyn-y-Gader the cliffs become more massive, and rise to an almost appalling height. Here their bases are buried in scree, which run down into the transparent waters of the llyn. On the east, a continuous wall of rock extends to the headland which frowns over the town of Dolgelley; this headland terminates abruptly in a *cwm*, or inland cove, on the southern side of which it sends off a spur in the direction of the Arran range of mountains.

The principal scree are to be seen in the neighbourhood, and to the west of Llyn-y-Gader. They are partly derived from the breaking down of the cliffs, and here and there a large block has evidently very recently fallen; but a distinction must be made between debris, strictly so called, and the immense accumulations of stones to be found both at the base and on the summit of the mountain. The ridge-like buttresses, consisting of loose fragments, which, in many places, may be seen underlying large fissures in the cliffs, are chiefly the result of cataracts of stones which have tumbled down, not from the cliffs themselves, but from the heaps of loose fragments on the summit. These heaps, in many places several yards in depth, have been scattered, piled on each other, and apparently forced up the acclivity of the saddle-shaped eminence called Cyfrwy. They are generally columnar and pentagonal in shape, and are frequently made use of as gate-posts, lintels, etc. The number of stones on this part of Cader Idris would probably be sufficient to build a good-sized town. They are to be found in smaller quantities on other parts of the mountain. How these stones came there cannot be easily explained, even in the present advanced state of geological theory. The agency of land-ice is not applicable to a high and narrow table-land where no ice-shed could have existed. The action of the sea, assisted by ice-floes and coast-ice, at the time when the summit of Cader Idris was slowly sinking beneath or rising above the sea-level, would appear to offer the most probable explanation; and to this agency we may likewise attribute the stupendous accumulation of stones found lying beneath the mountain, in positions where they could not have fallen from the neigh-



bouring cliffs. A scramble over the latter to the lake (Llyn-y-Gader) of which they form the western barrier, is about as severe an exercise for a pedestrian as can well be imagined; though the only real danger to be apprehended is a sprained ankle.

The small, round, and deep lake-basins form the most remarkable feature of the scenery of Cader Idris. The two best known are Llyn-y-Gader and Llyn Cae. The first may be found on the north side of the mountain, immediately under the Gader peak. It embraces about half a circle, and is bounded by high cliffs. The lake is dammed in by a ridge of stones, beneath which, in all probability, there is a solid rocky barrier, so as to give this hollow the character of a true rock basin. The water has no visible egress, though there can be little doubt that it percolates through the outer part of the stony barrier. It is not surprising that early travellers should have looked upon this basin as a volcanic crater formed by explosion, and that the neighbouring accumulations of stones, already mentioned, were the effects of the explosion. It is, however, to be regretted that the most modern guide-book writers should borrow their geology from the days of Pennant, and speak of pumice-stone, and other subaërial volcanic products, as being found on Cader Idris. In a certain extensively-circulated guide-book not only is this error perpetuated, but Llyn Gwernan, two miles from Dolgelley on the old Towyn road, is called Llyn-y-Gader, and the latter is left without a name; while Wilson is represented as having painted Llyn-y-Gader, whereas it is well known that Llyn Cae was the subject of his celebrated picture. It is a pity that guide-book writers should not take the trouble to visit the spots they attempt to describe. No geologist would now regard Llyn-y-Gader as a volcanic crater. It has evidently been scooped out of the alternating slaty and submarine volcanic rocks of which the mountain consists; but the cause of the excavation admits of difference of opinion. This basin, as well as Llyn Cae, may certainly have been deepened by ice, but its situation would appear to preclude the idea of a glacier having formed the whole of the crateriform hollow. The undermining action of a tidal current, at the time or times when the rocky rampart of Cader Idris was a sea-cliff, would appear to be the explanation most in accordance with our knowledge of the effects of recent geological causes. During the glacial submergence the excavation may have been completed, if not principally effected, and the sea may have been powerfully assisted by the action of coast-ice.

On proceeding along the usual route, and before you arrive at the base of the Gader peak, you suddenly behold the

black profile of the inner cliff of Llyn Cae, forming the gable end of a grass-covered ridge. The top of the cliff is almost perpendicular (that is, overhanging, in the phraseology of guide-book writers, but really at an angle of about 85°), and as you see the basin gradually deepen underneath, and the cliff assuming the shape of a peak, an impression never to be effaced is left on the mind. The rocky edge of this peak is so extremely sharp as to suggest the idea that it has buffeted the tempest and the waterspout since the sea last undermined its base.

There it remains, dark emblem of decay,
Revealing silently the wondrous way
In which the icy tide's tumultuous flow
Wore out the awful gulf that yawns below!

On making the ascent of Cader Idris, it is usual to proceed for about two miles along the old road from Dolgelley to Towyn. This road at first rises gradually to the level of an irregular terrace, which extends along the base of a high rocky outlier of Cader. You pass Llyn Gwernan, and soon leave the main road. You then take one of the zig-zag paths which act as torrent-channels in winter and pony-tracks in summer. You reach the summit of the Cyfrwy, or Saddle, with little difficulty, and then proceed in an easterly direction, skirting, and sometimes encountering, the accumulation of columnar stones already described, until you arrive at the base of the peak. This peak is a mass of solid rock, with projections, pillars, and intervening loose fragments. It is precipitous on *all* sides, and in this respect is superior to the summit of Snowdon. The tourist may here amuse himself in trying to make out the part of the mountain which mythologists have dignified as the chair of Idris. Do they suppose the giant to have reposed in the basin of Llyn-y-Gader, with his feet dangling down into Llyn-Gafr, and his head leaning back against the Gader peak? Or do they place him sitting in the more secure caldron of Llyn Cae, the inner cliff of which resembles the back of some of our old wooden arm-chairs? Or, contented with regarding him as approaching the size of an ordinary mortal, do they suppose a likeness between a chair and a certain rocky hollow near the summit of the peak? The latter would seem to be the true solution of the problem.

You have no sooner commenced the ascent of the peak than you begin to be struck and overawed with what at first seems an illusion, but is not long in being realized, namely, a gulf on each side of unseen profundity. You find yourself on a narrow ridge of fantastically-shaped rocks, between two precipices which slant down into apparently

bottomless pits. You can throw a stone with either hand over both precipices without stirring from the spot. The breadth of this isthmus (for an isthmus between two rolling seas at one time it must have been), from brink to brink of the two lake basins, is certainly not more than two hundred yards. By deviating a little to the right or left, and grasping a rocky projection, to give a sense of security and prevent a giddiness few can resist, you are enabled to see the water—on one side pellucid, on the other (Llyn Cae) dark and dismal—at an appalling depth below.* On reaching the apex, and leaning against the pillar of stones erected by the Ordnance surveyors, any previous sense of terror becomes replaced by delight on seeing Snowdon rearing its counterpart peak on the distant horizon, the hills on the opposite side of Cardigan Bay, the Breiddon Hills in Shropshire, the Black Mountains of South Wales, and (if the day be unusually fine) the distant coast of Ireland. After this the task of descending does not appear so hazardous. You take a last look at Llyn Cae, in its gloomy horror never to be forgotten; you proceed on your way rejoicing that you have made the ascent of the most remarkable, if not the highest mountain in Wales, and you soon find yourself among the habitations of mankind. Courageous and hardy pedestrians ascend and descend Cader Idris by a steep track almost immediately under the peak, and to the east of Llyn-y-Gader, and this is the only route mentioned in Black's *Picturesque Guide*; but it may be well to warn the majority of tourists against attempting this route, which, leaving danger out of the question, will be found to be more fatiguing than the one usually chosen.†

* The level of the waters of Llyn Cae must be at least a thousand feet below the apex of the peak.

† On the 28th of last month (May), the body of Mr. James Smith, of Newport, Monmouthshire, was found at the base of the precipice on the Llyn-y-Gader side of the peak. His skull was fractured, neck dislocated, and one foot detached from the body. At the inquest held at Dolgelly it was agreed that he must have fallen from the summit. He had been missing since the 20th September last.

NOTES ON FUNGI.—No. VI.

BY THE REV. M. J. BEEKELEY, M.A., F.L.S.

BLACKISH PURPLE, OR BROWN-SPORED MUSHROOMS, TOGETHER
WITH THE BLACK-SPORED SPECIES.

THE first division, *Pratelli*, consisting of six subgenera, *Psalliota*, *Pilosuice*, *Stropharia*, *Hypholoma*, *Psilocybe*, and *Psathyra*, contains our more important esculent Agarics. Many of the species are small and unimportant, while some in the first subgenus are amongst the largest and most noble Agarics. The spores in the more typical species are of a dark blackish purple, but in others they are of a dark or ferruginous brown. In some instances from imperfect development, they never acquire their proper colour, while in others the gills are absolutely barren, and in consequence assume a very abnormal appearance, a circumstance which occurs also amongst the dung Agarics or *Coprini*.

Psalliota (from ψάλλιον, a collar) is distinguished by the hymenium being absolutely distinct from the stem, the gills being rounded behind and free, and also by the presence of a ring. All the species grow upon ground more or less richly manured, and in some the spores seem to require to pass through the stomach of some graminivorous animal, to facilitate their germination, a circumstance which accounts for the occurrence of the common mushroom wherever horse manure is present.

It is difficult in this subgenus to say what is a species, what a variety, but some forms at least seem to stand out more especially above the rest.

Perhaps the most beautiful of British Agarics is one which occurred in Flintshire two years since, and which, from growing in the district of Elwy, was named *A. elvensis*. The pileus, which is six inches across, is fibrillose, and broken up into large persistent brown scales, the disk areolate, and the margin covered with pyramidal warts, and from its pleasant taste and smell is undoubtedly esculent. *A. cretaceus*, of whose esculent qualities little is known, is remarkable for the stem being deeply sunk into the flesh of the pileus, as in *Agaricus procerus*, and for the very pale gills and spores, in consequence of which, some doubt has occasionally been entertained as to its real affinities; and it has been sought for either in *Lepiota* or *Pluteus*. It occurs occasionally in hot-houses and about cultivated grounds, but generally in very small quantities, and is often solitary.

A. arvensis, the horse mushroom, or incorrectly, St. George's mushroom, is a large coarse species, in general occurring in rings, but sometimes in scattered groups, and is known at once from the true mushroom by its tendency to become yellow, and sometimes intensely yellow, when bruised, and its paler and at length more dingy gills. In its more normal state it is of a pure white, hemispherical and very fleshy, with a ring which looks as if it were made up of two, one within the other. Small conical varieties, however, occur, and others which are scaly and of a tawny yellow tint, as in *A. augustus*. To this, perhaps, the variety called *A. villaticus* in the *Outlines of British Fungology*, is referable, rather than to *A. campestris*.* Most of the varieties are wholesome, and while in Italy *A. campestris* is rejected, this has obtained the name of *A. exquisitus*, while in France it is well known under the name of *Boule de Neige*. Great prejudice exists in many parts of the kingdom against this species, which is rejected by most professed cooks and housekeepers on account of its turning yellow; but in some parts of England it is highly esteemed, while in London it forms far the greater part of the mushrooms which appear in the market. It is, however, almost universally used for ketchup, for which purpose it is far superior to many of the doubtful if not dangerous species which enter into that frequently questionable condiment. There is a variety mentioned by Mrs. Hussey, as the hedge mushroom, which grows in tufts under hedges, and though innocuous in ketchup, produces, when eaten, violent sickness. This never has the least tinge of yellow, and the pileus is regularly covered with small brown scales. Another form—much like it—mentioned by Mrs. Hussey, which grows on the borders of woods, and which turns of a yellow red when bruised, is, on the contrary, very highly valued. This, however, was considered by Dr. Badham, a form of *A. campestris*, and I am inclined to subscribe to his opinion. It was probably on this variety that a village schoolmaster, in Northamptonshire, who found it for many weeks in succession in an open plantation, nearly kept his family, without their experiencing the slightest inconvenience. I am not able to speak positively as to the species, as I never saw an individual, but his description and the locality pointed in this direction.

Of the merits of *A. campestris*, it is not necessary to say much, as every one, in this country at least, is pretty well satis-

* Dr. Badham writes respecting it:—"Do you meet with this scaly form of *A. exquisitus* in Northamptonshire? it is the first time I have seen it here, and but for the yellow tinge exuding from it when cut, and the grey gills, I should have supposed it a scaly specimen of *A. campestris*, which is often coated with similar brown scales." Brondeau's *A. villaticus* is vinous when bruised, in which character alone it differs from that of Dr. Badham.

fied on the subject. Variable as it is in colour, form, size, and sculpture, the peculiar pink gills, and the tendency to be pink when bruised if any change takes place, are in general distinctive characteristics. Many varieties of this occur both in the field and under cultivation, and it is a mistake to suppose that the brown pilose form is the only one that occurs in artificial beds. Several varieties were figured some years since in the *Gardeners' Chronicle*, and one at least, from its prolific nature, would have been an acquisition could it have been kept distinct.* The artificial formation of mushroom spawn was once considered a great mystery, and a powerful argument in favour of spontaneous generation, but the key to the mystery has been given above. At Belvoir Castle, where there is a great riding-school, the comminuted straw, which is collected from the pavement, when heaped up and occasionally turned, is used with complete success for the growth of mushrooms, without any artificial spawn. The stove mushroom, which is cultivated in enormous quantities in the catacombs at Paris, is almost the only one which is admitted into the Paris markets. A mode of cultivating the mushroom from the spores, by making them vegetate on glass under the influence of saltpetre, and then removing the young brood into artificial beds, was, a few years since, much talked of at Paris, and raised great expectations from the quickness of growth and the size of the supposed produce. The whole, however, came to nothing.

Mushrooms are subject to disease like other plants when cultivated. Not only do they become deformed without any apparent reason, but they are sometimes attacked by a minute fungus belonging to the genus *Hypomyces*, which obliterates the gills altogether, and entirely alters the texture. It would not be safe to consume such individuals, even in an early stage of growth without great caution, supposing their aroma not to be affected. It is scarcely necessary to add that such maladies are quite beyond control. In one instance, instead of mushrooms, a crop of shapeless dark bodies appeared, one of which, when coaxed into its complete development, proved to be an undescribed fungus of the genus *Xylaria*. A figure of this has lately been published in the *Transactions of the Linnæan Society*.

It is not easy to conceive why such a prejudice against *A. campestris* should exist in Italy. If the supposed cases of poisoning are really due to the species, and not to something mixed with it, which has sometimes happened in this country, we can only imagine that a larger quantity of amanitine is

* Some spawn which was prepared at Belvoir and sent to me by Mr. Ingram, produced exclusively a long stalked, pure white, nearly smooth variety of excellent quality.

formed in it than with us. There is not, however, the slightest evidence to show that this is the case, and we must wait for better information. *A. campestris* occurs in all parts of the world, and Mr. Drummond reported that a variety occurs in Australia which as far exceeds any European form in quality as our improved peas surpass those which were formerly in cultivation. He sent over samples of the spawn, but though great pains were taken by Mr. Henderson, the late talented gardener of Earl Fitzwilliam, it would not run. In addition to the distinctive characters given above of *A. arvensis* and *A. campestris*, a more subtle one, but one not liable to deceive a practised mushroom-gatherer, exists in the peculiar smell of the former, which is also possessed by the very abundant and deeply penetrating mycelium. I have seen in recently ploughed-up pastures, where rings of *A. arvensis* were abundant, large tracts of mould perfectly white with the spawn, and at once proclaiming what it was at some distance by its odour.

The quantity of mushrooms collected every year for ketchup is enormous. The ketchup is seldom made by the gatherers, who are not very particular what they put in their baskets so long as it yields a brown liquor; and as the contents are at once salted bad kinds cannot in general be detected by the mushroom merchant, if he is inclined to be scrupulous. They command from a penny to fourpence a pound, or very seldom a trifle more. The merchant does not always prepare the ketchup directly, but sometimes keeps the salted fungi in barrels for months. Good ketchup may be prepared from morels, *A. procerus*, *A. gambosus*, *A. prunulus*, *Marasmius oreades*, and some others, but all do not yield an equal quantity of juice. Mrs. Hussey recommends a way of preparing it without boiling—the clear juice, free from all sediment, being placed in small bottles and filled up to the shoulder, the remainder being filled with proof spirits, in which the requisite spices have been steeped. She adds, “all who try this plan fairly will acknowledge they never tasted ketchup before.” Ketchup made from the *Marasmius* is exceedingly strong, and like garlic requires to be used with caution.

It would not be right to leave this subject without mentioning *A. silvaticus*, which is not uncommon in woods, and which, though in some respects agreeing with *A. campestris*, has not the same pleasant odour, and is distinguished easily by the stem being stuffed with delicate threads. It is a species which should certainly be used with caution if not altogether rejected.

It remains only to notice a single species belonging to the subgenus, on account of its singularity, but certainly without any respect for its intrinsic value. *A. echinatus*, remarkable

for its dingy pileus, covered with smoke-coloured meal, and its blood-red gills which often yield only effete spores, occurs now and then upon peat in gardens. In all the species there is a universal veil, though not always distinct from the partial veil. In *A. echinatus* this is represented by the copious meal.

It is not necessary to dwell on the subgenus *Pilosace* (from *πῶλος*, a hat, and *σάκος*, a shield), which is distinguished from *Psalliota* by the absence of a ring, as we have no British representative.

The subgenus *Stropharia* (from *στροφήιον*, a girdle) was formerly included in *Psalliota*, but has been very properly separated on account of its gills not being decidedly free as in *Lepiota*, *Volvaria*, *Pluteus*, and *Psalliota*. It does not seem to contain a single esculent species, though one has the reputation of being extremely poisonous. *A. æruginosus* is sometimes a beautiful object when fresh from its verdigris-green pileus, clothed with white floccose scales. Both the green tint and scales, however, vanish with the first shower, and the beauty is gone. It has a peculiar smell like that of cerate, and is in all probability poisonous. *A. albo-cyaneus*, of which a figure (No. 3) is given in our second coloured plate of Fungi, published in the INTELLECTUAL OBSERVER, October, 1865, p. 184, occurs occasionally in meadows, and is distinguished by its more elegant form, and livid rather than green tint when young, in addition to other characters.

A. semiglobatus is one of the most common species, occurring everywhere on horse dung. Whether this or some other species was the cause of several deaths at Battersea when Sowerby was publishing the latter portion of his Fungi is not very clear, though he gave it, by way of indicating its supposed evil qualities, the name of *A. virosus*. It is, however, a species which could only be eaten by mistake, though it is very probable that it often gets with other dangerous species into the mushroom basket. Though in some cases the deleterious qualities of fungi may be diminished by evaporation and the free use of the salt in ketchup, there are cases on record where it has been fatal.

It will not be necessary to dwell long on the remaining subgenera.

Hypholoma (from *ὕψη*, a web, and *λῆμα*, a veil) is distinguished by the veil being woven into a fugacious web, which often adheres in fragments to the margin of the pileus. It does not form a ring upon the stem as in *Psalliota*. The species are mostly of a tolerable size, and are densely tufted. Either the taste of the primary species is bitter, or the texture tough, or the two bad qualities are combined so as to make them ineligible for food. *A. velutinus* is more tender, and is

sometimes an ingredient in ketchup. A large basket was once sent to me as a present, on the supposition that it was wholesome, but it is scarcely necessary to say that it was at once rejected.

A. sublateritius is often a great ornament in woods about the trunks of trees from its brilliant colours, but it is not always easily distinguished from similar species, and especially from the bitter *A. fascicularis*, which in its turn may be confounded with other kinds if attention is not paid to the spores. *A. capnoides* is at once distinguished by its mild smell and taste, but it is of too suspicious affinity to induce a trial of its esculent character, did it occur in sufficient abundance. *A. appendiculatus* (No. 4 in our second coloured plate),* which is a very abundant species, is readily distinguished by the abundant white fragments of the veil.

Psilocybe (from *ψιλός*, naked, and *κέφαλη*, a head), as the name implies, is destitute of a veil, except in one or two species, which grow on dung, while its incurved margin distinguishes it from *Psathyra* (*ψαθυρός*, brittle), in which the margin is straight. In either subgenus the species are, for the most part, insignificant, and often difficult to distinguish from the fugitive character of their colouring. We have given a figure of *A. bullaceus* (No. 5) in our second coloured plate,* more because it is interesting than from its being a very typical species.

The concluding division, *Coprinarii*, containing the species with black spores, consists of two subgenera only, *Panæolus* and *Psathyrella*. The former, *Panæolus* (from *παναιολός*, variegated), is distinguished by its rather fleshy pileus, which is never striate, and the margin extending beyond the gills, which are mottled. The species grow chiefly on dung, *A. separatus* being often very conspicuous from its shining, smooth, semi-ovate pileus and straight stem. *A. fimiputris* is often an extremely pretty object, from the edge of the pileus being adorned with little appendages which look like eyelet holes. None of the species are esculent, though they often enter into the composition of ketchup in consequence of their dark spores.

The remaining subgenus *Psathyrella* (a diminutive of *Psathyra*) has a membranaceous pileus, and the margin does not reach beyond the gills. The most abundant species is *A. disseminatus*, which springs up wherever wood is buried or on the wood itself in myriads, fading away almost as unexpectedly as it makes its appearance. This sometimes grows on plaster walls, and then springs from a dense mycelium.

The genus *Agaricus* comprises now at least 400 British

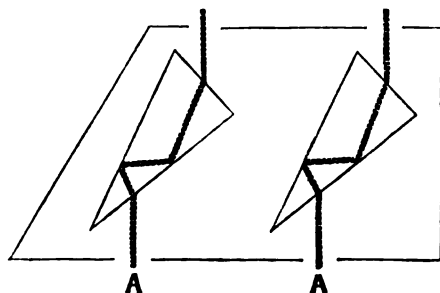
* October, 1865, p. 184.

species, to which undoubtedly many additions will be made. The present season has afforded several novelties. The study is undoubtedly involved in much difficulty, but this will be greatly diminished by a careful study of some typical species in each subgenus, for the determination of which good figures are absolutely necessary. Without some such previous discipline, it will be almost impossible to ascertain a species satisfactorily; and it is to facilitate this that the present series of notices has been prepared.

THE COMING METEOR SHOWER.—THE SPECTRA OF METEORS.

GREAT interest attaches to the composition of meteors, and though chemical analysis of the ordinary kind can lend its aid to the examination of meteoric stones, which fall in considerable masses upon the earth, it cannot avail with regard to the much more numerous class of shooting stars and bolides, which blaze for a moment in our atmosphere, and then disappear entirely, or leave for a few seconds the transitory traces of a luminous smoke. To learn something of the composition of these bodies, Mr. Alexander Herschel proposed the employment of a binocular direct vision spectroscope, fitted up with peculiar prisms designed by himself. This plan, which presents considerable difficulties of optical construction, has been very ably carried out by Mr. Browning; and the British Association Committee have ordered four of the instruments with a view to their employment in the coming November showers, when a maximum number of meteors may be expected.

The nature of Mr. Herschel's plan will be obvious from the following diagram. The thick dotted lines represent the path



THE HERSCHEL-BROWNING METEOR SPECTROSCOPE.

of the light rays through the prism. When a pencil of light enters the prism, it is *refracted*, and then continues its course until it meets one side of the prism, which it strikes at such an angle that it cannot get out. It is therefore *reflected* to another side, also at an angle which prevents its egress; and accordingly it undergoes a second reflection, after which it is permitted to emerge in a position opposite, and parallel to, its line of entry.

In employing an ordinary spectroscope, it is necessary to limit the admission of light by a *slit*. But if the source of light took the shape of a fine line, no slit would be required, because the mass of light would not exceed the quantity with which the spectroscope could advantageously deal. With shooting stars and ordinary meteors this is the case, and hence the Meteor Spectroscope requires no slit. Observers furnished with the new instrument will direct it like an opera-glass to the part of the sky most favourable for the observation of the November shower, and as a shooting star makes a line of light in the sky, it will give one or more lines of light in the spectroscope. If, for example, we had a sodium meteor, it would give a yellow line in the sky, and a yellow line, occupying the sodium line place, in the spectroscope. If silver were present together with sodium, the meteor train would have a greenish tinge, and *three* lines would appear in the spectroscope—yellow, green, and blue.

Those who intend to take part in these highly curious inquiries should provide themselves in time with Meteor Spectroscopes, and should, with the help of an ordinary spectroscope, study in advance the spectra of the metals and other substances most likely to be seen when the meteors are in the field.

The study of meteors is already highly indebted to Mr. Alexander Herschel, whose labours are recognized as of the highest value by every physicist of eminence; and we have no doubt that his "Meteor Spectroscope" will contribute efficiently to the progress of our knowledge of shooting stars. To Mr. Browning belongs the credit of carrying Mr. Herschel's plans most successfully into operation, by the construction of prisms with an accuracy of angle and surface extremely difficult to obtain.

Mr. Alexander Herschel recently gave a lecture at the Royal Institution, "On the Shooting Stars of the year 1865—66, and on the Probability of the Cosmical Theory of their Origin." He commenced by adverting to the probability established by Professor Newton, of Yale College, U.S., "that in the current year, 1866, a prodigious flight of meteors, the most imposing of its kind, and visible over a large area of the

earth's surface, will make its appearance—perhaps for the last time in the present century—either on the morning of the 13th, or on the 14th November.”

The meteors should be especially looked for between midnight and sunrise, and may be expected in greatest abundance between three and four A.M. “They proceed, with few exceptions, from a common centre in some part of the Constellation Leo.” Mr. Herschel observes that “between the 13th of October and the 12th of November, during the years from A.D. 903 to 1833, not less than thirteen great star showers have been recorded. They are separated from each other by the third part of a century, or by some multiple of this period, and are periodical reappearances of one grand meteoric shower, viz., that seen by Humboldt in 1799, and by Olmsted in 1833, the star shower expected to return in the present year, and known by the name of the “great November shower.” Its contact with the earth takes place one day in the year at each of its principal returns. According to the exact calculations of Professor Newton, “the next passage of the earth through the centre of the meteoric group will take place two hours after sunrise at Greenwich on the morning of the 14th of November, 1866.” A watch on the morning of the 13th is recommended, “as the moment of greatest brightness may fall one day before the predicted time.” On the 13th of November, 1865, first-class meteors were seen at Greenwich at the rate of 250 per hour, and the “maximum display of the November meteors expected in 1866 is several hundred times greater than that observed at Greenwich on the 13th of November, 1865. Two hundred and forty thousand meteors are computed by Arago to have been visible above the horizon of Boston on the morning of the 13th of November, 1833.”

The average height of shooting stars at the middle of their apparent paths is not quite sixty miles above the earth.

Mr. Herschel points out a singular difference in the behaviour of shooting stars and aerolites, or meteoric stones. The meteoric stones most frequently fall after mid-day, between noon and nine P.M., while the shooting stars are most abundant after midnight; and only one stone has been known to fall on the 10th of August or the 13th of November, when shooting stars are most numerous.

A point of importance to be ascertained by means of the “Meteor Spectroscope” is, whether shooting stars and their luminous trains are composed of porous matter, or of solid matter, perhaps in a finely divided state, as is presumed.

The anticipated splendour of the November shower should not be permitted to divert attention from the smaller shower expected on the night of August 10.

DR. CURTIS'S PROCESS OF PHOTO-MICROGRAPHY.

BY R. L. MADDOX, M.D.

THE beautiful specimens of photo-micrography, tracings of which we were enabled, by the kindness of Dr. Maddox, to lay before our readers in our July number, have excited so much interest, that we are sure the following letter from Dr. M. explaining the process will be highly appreciated:—

"Through the kindness of Dr. J. J. Woodward, who has charge of the Medical and Microscopical Department in the Army Medical Museum, U.S., I am enabled to offer for the pages of your valuable journal a brief description of the plan adopted in taking the photo-micrographs alluded to, and published in your July number, and which becomes of more interest, as Dr. Woodward shows by a further number of prints of various objects, taken both by sun and artificial light, the excellency of the method.

"The difference in sharpness given to the $\frac{1}{50}$ th over the $\frac{1}{4}$ th, and achromatic concave amplifier, is attributed by him to the chemical process employed in rendering the albumen negative intense. The smaller prints were from the original negatives, and in the enlargement from these the solar camera was not employed.

"The diatom *Pleurosigma angulatum* was simply a dry mounted specimen, adhering to the cover of an ordinary slide, which was removed, turned, and then covered by the thin glass necessary for the $\frac{1}{50}$ th. The part alluded to as possibly a sun spot, was only due to a particle of adherent dust.

"The following plan is adopted by Dr. Curtis at the laboratory of the Museum—the lenses of the objectives in use being corrected for the violet ray, and the formula furnished by Mr. Lewis Rutherford, so well known for his astronomical photography; but in the $\frac{1}{50}$ th, the difference between the visual and actinic foci is so small as not to be noticed in the correction:—

"Outside the window is placed a Silbermann's Heliostat, which reflects the rays from a plane mirror, duly centred, through a brass tube, at the orifice of which hangs a large cell, with parallel sides of plate glass, filled with a saturated solution of the ammonio sulphate of copper, the other arrangements of the apparatus being properly disposed in a dark room, instead of using a camera: thus practically violet monochromatic light is employed. The sensitized albumenized plates being, in this case, placed about three feet from the object for the $\frac{1}{50}$ th, rather less for the $\frac{1}{4}$ th and amplifier, and seven minutes' exposure allowed. The condenser used was a pair of plano-convex lenses of about one inch combined focal length,

a large central stop being placed over the flat surface of the one nearest the object, thus illuminating it with only the oblique pencils. These lenses were not achromatic, as monochromatic light was employed. The value of these details will, I trust, prove a sufficient apology for again trespassing on your space !”

ANIMAL LIFE IN SOUTH AFRICA.

BY H. CHICHESTER, ESQ.

ALTHOUGH narratives of travel and of sporting adventure in Africa have of late become so numerous, the amount of information to be acquired through their medium respecting the peculiarities of the animal world in these regions, still beyond doubt the finest game countries of the older continent, is (with one or two exceptions) scanty indeed. We propose in the following pages to notice a few among the many points thus generally overlooked.

Commencing with the hugest specimen of nature's handiwork, the elephant, we have generally found two curious points overlooked or ignored by writers—one is the rapid and noiseless movements of this animal in the thickest cover; the other, his capabilities of passing over ground for him apparently utterly unfeasible. The elastic noiseless footfall of the elephant has been frequently referred to by writers on Indian subjects, and has been rightly asserted to be the most agreeable feature in journeying on elephant-back. This peculiarity may be easily explained by an examination of the structure of the animal's foot; but the silent stealthy way in which he will pass through the densest thicket, literally "*slipping away*," when his acute senses of smell or hearing warn him of danger, has been generally overlooked, and appears to us somewhat difficult of explanation. Let any one unskilled in the mysteries of "bush ranging," attempt to move even a few paces in an ordinary fox-covert without noise, and he will form some idea of the difficulties presented to the passage of so huge an animal as the elephant through the dense tangled undergrowth of a South African "bush." Yet that the animal, despite his enormous bulk, will "draw off," when within a few yards of his pursuer, without the slightest noise, and with the greatest rapidity, even in the thickest cover, is undeniable. We may, however, remark that this faculty or by whatever other term it may be described, is not peculiar to the elephant alone, for it has been observed to a marked extent in the moose or cariboo of North America.

Again, his powers of passing over difficult ground are often underrated even by hunters. When experiments were first made* in India in training elephants to draw the guns, it was observed with surprise that the animal's powers of ascending steep and rugged ground were far greater than had been anticipated. The gun, a light six-pounder, with which the trial was first made, was drawn up a slope so steep as to require the animal to crawl upon its four knees, without hesitation. On the other hand, hampered by the gun and harness, the elephant (a small female) showed unusual dread of soft and swampy ground. In Africa, marshes do not seem to possess the same terror for these animals in their wild state, for if they offer tempting pools, however uncertain the footing may be, the elephants appear to find a track across them.† In the river courses too, deepened as they are by the torrents of the rainy season many yards below the surface of the surrounding country, and having banks nearly perpendicular, small shady pools close sheltered from the sun's rays, often remain in the hot season when the rest of the stream has disappeared, and to these, should no other way be open, may be found tracts of the animals, leaving no doubt they have reached the coveted water by slipping down on their posteriors. In what position the hinder legs are placed during this operation we cannot tell, but the "spoor" leaves no doubt of its having been repeatedly adopted in places apparently inaccessible.

The elephants generally remain in the thickest part of the forest during day, making for the water, to which they often go long distances, shortly before midnight, and returning to cover some hours before dawn. We may here remark, that although these animals, owing no doubt to their acute sense of hearing and of scent, have never been surprised in a recumbent position, there is ample proof that the bulls at any rate, usually rest lying on their sides. The late Mr. Gordon Cumming was, we believe, the first to note this fact, which we can ourselves confirm. He remarked that the sides of the enormous ant heaps so common in this region, were apparently preferred, and that the ground was often distinctly marked with the impression of the under tusk as well as of the animal's body.

The influence of the particular tract of country in which they are found upon these animals, and the influence which

* About thirty years ago by a committee of Indian Artillery officers. Elephants, we may remark, had been previously used in assisting the gun teams by pushing with their heads, and aiding with their trunks, and not by drawing in harness.

† Elephants, like the generality of wild animals, take the water readily and swim well. Even baboons, though unwilling to do so, will on emergencies, swim with strength and rapidity, although with a queer and somewhat ludicrous action.

they, in their turn, like all other living creatures, exercise on their habitat, should not escape a short notice.

On the borders of the Cape Colony and Natal, we find the few elephants that remain large in size, but with comparatively small tusks of inferior ivory. As we approach the equator, although food is far more plentiful, we find the animals smaller in size, having far larger tusks, the latter too being of an ivory far superior in hardness and closeness of grain. Indeed, although naturalists have not recognized more than one species of the African elephant, the varieties of ivory exported from the north, west, south-west, south-east coast, and the Cape, have each marked differences of quality by which they are easily recognizable. The animals in their turn, however, likewise affect the economy of the country they inhabit. The damage done even by a single elephant in a very short time to a patch of cultivated ground is truly frightful, and having been once seen, would lead one to imagine that when these animals are herded together in vast troops such as the one seen by Dr. Livingstone on the banks of the Zambesi, consisting of over eight hundred, covering an extent of two miles of country, their course would be marked by utter desolation. The havoc thus caused is not however perceptible, a fact which that observant traveller has attributed, no doubt rightly, to the care shown by the elephants in the *selection* of their food—a point, as he justly remarks, often overlooked in estimating the *quantity* of food required by the larger animals.

Again, all these animals, rhinoceri and hippopotami included, are, as M. Krapf observed, the true pioneers, “the real pathmakers of the tropical forest, which without their tracks would be often utterly impenetrable to man.” Further, these paths leading as they most frequently do, to water, are often the *only* open channels for the surface-flow of the heavy rainfalls, and thus materially contribute to the continuance of the water supply of the district, to the very existence of which they owe their formation. While the elephant does not thus destroy vegetation which would ruin the shelter which appears indispensable to him, on the other hand he directly assists the production of new growths by his habit of searching for the many succulent bulbs to be found below the surface of the soil in every open space.

Mr. Gordon Cumming, in whose time elephants were more plentiful in the neighbourhood of the colonial frontier, than they are at the present, described large patches of many acres each in extent, as being thus ploughed up to a depth of several inches by the tusks of the elephants in quest of roots and bulbs; thus doubtless bringing to the surface germs of a fresh vegetation which would otherwise lie dormant. It is

curious to remark that Pliny was acquainted with this habit (generally overlooked by modern writers) and he describes the "Indians" (?) as sowing their corn in the furrows thus provided for them by the elephants.

We have already alluded to the influence of locality on the size of the elephant, and the same remark appears to hold good with other animals. Many of the so-called varieties of antelope are asserted by Dr. Livingstone in a note to his last work to be but local variations of other species already known. The same remark applies to the carnivora; the varieties of lion, the yellow and black, as they are styled by the colonists, thus appear to be one and the same animal at different ages and under the influence of different localities; the darker colour coming with age, and the thickness of the coat and the shagginess of the mane being apparently in a great measure dependent on the nature of the cover frequented by the animal.

Mr. Frank Buckland, in his interesting *Curiosities of Natural History*, Second Series, relates two curious circumstances showing the subtle occult influences of locality on animals when in confinement. Animals in travelling menageries, he informs us are, as a general rule, more healthy than those confined to one spot, as in the Regent's Park collection. This, too, is shown especially during gestation and parturition. Again, of several pairs of lions (from different places and kept always apart) which were successively placed in one particular cage in the Zoological Society's Collection, the lionesses in each case produced cubs with a singular malformation of the palate of the mouth, the cause being, it is needless to say, inexplicable.

We may here briefly refer to the effects instanced in the case of those two formidable foes of domestic animals the "fly," or tsetse, and the lung sickness or peripneumonia of South Africa, both of which appear so dependent on locality. The "tsetse" is a small active bee-like insect found in certain regions only, which sucks, in mosquito fashion, the blood of every creature it comes across. Its bite is harmless to man (even to the smallest children), to the mule, ass, and goat, to calves while sucking, and to all wild animals; yet it is certain death to the horse, ox, and dog; the symptoms, which last for months, pointing apparently to a strong poison introduced into the system. The localities in which this formidable pest is found are very circumscribed. Dr. Livingstone relates that although the south bank of the river Souta was a noted "fly" district, he found on the north bank the plague was unknown, the river being scarcely fifty yards wide, and tsetse being frequently carried across on the bodies of dead game by the natives.

Again, peripneumonia, known as "lung sickness" when it attacks the oxen, and "horse sickness" when it affects the horse, which is in fact the rinderpest of which we have of late had so much bitter experience, and which is equally fatal to domestic cattle and to the bovine antelopes and quaggas, appears unaccountably to be restricted to certain localities. In some parts of the Cape Colony there are very limited tracts of moderate elevation which appear to procure for horses while kept there a perfect immunity from the attacks of the disease from which they have acquired from the Dutch the name "Paarden bergen," or horse hills.* They appear to possess no *peculiarities* of soil, vegetation, elevation, or climate to distinguish them from other spots around, and the cause of the immunity they enjoy remains as obscure as when it was noticed by the Dutch traveller Sparmann a century ago.†

A remarkable instance of the influence of the animal on the vegetable world, occurs in the migrations of game which annually takes place, from the desert towards the Cape Colony and Natal. In some cases these may be due to the state of the herbage, which varies considerably at different elevations, but in the more marked cases as the migrations of the spring bok (*Antelope euchore*) this is not the case. These animals leave the desert at the time the grass is *best*, and track down towards the colony. The difficulty of estimating the numbers of a herd of animals in movement is always great; indeed, during the frontier struggles with the Kaffirs, it was always remarked that the number of cattle driven off or recovered, was in every case overrated by the most experienced stock keepers, even where no object was to be gained by misrepresentation. With these antelopes the difficulty is greatly increased by a certain quivering motion of their horns which they maintain, and also by the gleams of white from the beautiful fan like manes which extend along their backs, and which they invariably erect when moving; considering, however, the great numbers afterwards found in the colony when the main body has divided, it appears probable that the estimate which places the numbers at between

* There are certain localities in India which appear to be similarly endued in respect to cholera. These have long been known to the natives who suppose them to be under the protection of a "swamy," or deity. The credit of *first* having called attention to these spots, we believe belongs to Colonel Haley, H.M. 108th Regiment, who has recently referred to them in the *United Service Magazine*.

† This disease, which is endemic in a part of the Trans-Vaal territory, becomes annually epidemic throughout a considerable part of the Cape Colony and Natal. Horses which have once passed through the disease are termed "salted," and are supposed to be safe from future attacks, a security which in the case of oxen is sought to be attained by inoculation with a portion of the diseased lung of a dead ox inserted in the fleshy part of the tail, near the root.

thirty thousand and forty thousand at starting,* does not exceed the truth. On certain seasons, generally recurring about once in ten years, there is a vast increase in numbers which causes the movement to take some of the features of an American "stampede." We have ourselves witnessed instances on these occasions, when the animals hurried along and seemingly bewildered by the numbers round them have allowed themselves to be caught by the hand.

It is to these larger occasional migrations that the Dutch Boers more especially apply the term "trek bokkens."

A scarcity of food in certain seasons inducing greater numbers thus to migrate, is the cause usually assigned to these movements, but there is another which we think may have at least an equal share in producing them. These animals are polygamous, consorting in the proportion of four or five females to one male. Now it has been asserted with apparent truth, in the case of animals in a state of domestication that the proportion of the sexes born in different years varies considerably, and it is we think likely that these "trek bokkens" take place when the numbers have been increased by a large preponderance of females born a few seasons previously.

Dr. Livingstone assigns another cause, viz., the wary habits of the animals which induced them to leave the high and rank grass and choose more open feeding grounds, an instinct by the way, often displayed by domestic oxen.

Wherever the herds of antelope are found, whether the numbers be large or small, they appear materially to influence the herbage of the district they frequent. Their close, cropping bite resembling that of sheep, opens out a place for the young shoots, while their droppings not only fertilize the ground, but return to it the seeds in the form most suitable for fecundation.

Dr. Livingstone has related some instances where the game having been destroyed, the grass totally disappeared, being succeeded by a growth of mesembryanthemum-like plants, a change, which it is needless to say, would materially affect the water supply of a scantily watered country.†

* They have *never* been noticed returning to the desert.

† The difference in the quality of the flesh of different closely allied varieties of antelope feeding on the same herbage is noteworthy; while the flesh of some is tolerable venison (as the spring bok), that of others (as the rhei bok) is rank carrion. This reminds us that the Dutch colonists have a curious idea respecting the varieties of the common hare, which are very numerous. These animals, they maintain, feed on garbage, an idea certainly confirmed by the places they appear to frequent. To give an example of this habit in a herbivorous animal, the writer remembers many years ago in Lisbon, seeing the goats feeding in the vicinity of the city muzzled, which he was informed was done with a view to prevent their feeding, as they would, if possible, on the offal and impurities that fill the purlieus of that dirtiest of dirty cities.

The migratory habits of these animals also prevent the herbage, and consequently the water supply, of any particular district being affected by over-cropping. In the Cape Colony, near Graaf-Reinet (and, we have been told, in some of the Merino districts in Spain), the reverse of this picture may be seen. In these cases, by *over-feeding* certain of the sheep-walks, the herbage has first become impoverished, and in the end, like the water supply, has nearly disappeared.

The numbers of these animals are also kept in check by the large proportion of the carnivora. Lions, indeed, are getting scarce; but the various species of leopard and tiger-cat, known to the colonists under the general name of tigers, and of hyænas (called wolves), is still very great. The beneficent purpose these animals fulfil in the great scheme of nature, has been so admirably pointed out in the "Bridgewater Treatise" of the late Dean Buckland, that although our limits forbid our transcribing it, we cannot help begging the reader to turn to it.

It is, indeed, trite and superfluous to say that this intimate relation between every department of nature may be traced by the attentive observer upon every spot on the earth's surface, but in South Africa it possesses an additional interest from the consideration that while on the one hand (if the surmises of recent geologists as to the antiquity of the present state of the South African continent be correct),* there is no region we can point to where those relations AS THEY NOW EXIST, have been longer in force; there is on the other none where the retreat of animal life before the almost imperceptible encroachments of civilized man has been and is progressing in a more marked or obvious manner.

* See Sir R. Murchison's remarks on the South African continent.

THE PLANET SATURN.

(CONTINUED.)

BY THE REV. T. W. WEBB, A.M., F.R.A.S.

BEFORE we proceed to review the anomalies exhibited during the lateral presentation of the ring-system, we must take some notice of an idea to which Secchi was conducted by the singular disagreement of the measures which he obtained of it in its more open position. This eminent observer was induced by Σ II.'s suspicions as to the permanency of the ring, and the remarkable differences between the results of the first astronomers—Lassell, Encke, and Galle having given upwards of $1''.5$ more than Bessel to the outer diameter of the whole—to use the micrometer largely himself. He found his values on any given evening very accordant among themselves, their discrepancies ranging within $0''.3$; on different ones perplexingly the reverse, much more so than in the case of double stars; for instance, as the extremes of sixteen nights, 1855, Dec. 15, $41''.443$; Dec. 27, $40''.412$. A comparison of these variations, which he found in some respects corroborated by the observations of Lassell, Main, and De la Rue, led him to reflect whether the ring, as a whole, might be subject to periodical dilatation, or might be elliptical in form, with a rotation sometimes presenting to us its longer, sometimes its shorter axis. Of these two suppositions he thought the latter the more probable, suggesting a period of about $14\text{h}^{\text{m}}.238$; but on the whole considered that there might be not merely ellipticity and rotation, but some actual variation in diameter; hence concluding that there is no reason to fear, with Σ II., a progressive alteration and final destruction of this "beautiful accessory" to the planet.

These last expressions of Secchi refer to a singular and impressive speculation of Σ II., who, from a careful comparison of the ancient drawings and measurements, such as they were, of the ansæ and the included space with more modern values, had been induced to believe that the ring-system, especially the inner edge of B, was in a state of such perceptible and rapid approximation to the planet that its ultimate disintegration was now not only a mere question of time, but, as it would seem, of a comparatively short interval. More recently, however, the improbability of this curious hypothesis has been shown by the measurements of Main (then Senior Assistant at Greenwich, now Radcliffe Observer at Oxford); and the ideas of both Σ II. and Secchi, though too interesting to be passed unnoticed in a recital like the present, have been so strongly

controverted by Professor Kaiser of Leyden that it may not be necessary to refer to them at greater length. We may, however, make the passing remark, the justice of which will be evident on more than one occasion, that the almost unapproachable mystery of the whole subject permits a latitude of speculation much more extensive than would be accorded in questions of a less obscure and perplexing character.

The want of symmetry which has led to these remarks is, as might be anticipated, not less evident during the lateral presentation of the rings. From an early period we meet with observations of anomalous appearances at these epochs, comprising not merely differences in the relative visibility of the two ansæ, but also other variations of aspect, all bearing similar testimony. As far back as Dec., 1671, the two Cassinis had seen Saturn attended by the blunted remainder of only a single ansa, and this not always on the same side.—1714, Oct. 1, 3, 5, 7, 9, Maraldi found the E. ansa rather the broader and more visible, while each, evidently from want of optical power, seemed reduced to one-half its usual length; 12, only W. was visible; 14, disappearance complete.—1715, March 22, a trace of W. only.—1743, Nov. 29, Heinsius found E. shorter than W.—1773, Sept. 24 to Oct. 4, Varelaz at Cadiz with three telescopes, one a 5-ft. reflector by Short, saw distinctly W. constantly brighter than E. ansa; he also remarked some more luminous points at the extremities; the first notice, it is believed, of an appearance frequently recorded in more modern times. Similar irregularities are stated to have been seen this year by Messier, who inferred much inequality of surface. Oct. 5, 6, W. only seen at Madrid.—1774, H₁ is stated to have seen only one ansa for some time. Jan. 11, Messier observed E. longer than W. Previous to its disappearance W. was seen the longer and brighter for four weeks at Mannheim; at its reappearance, Wollaston thought he detected W. June 30; July 2, he was certain of the whole, but W. was the larger.—1789, August 30, Ussher at Dublin found E. the more visible; Oct. 1, E. only. At Cork, E. only latterly to Oct. 5. Schröter perceived only a few luminous points till after Oct.; but 1790, Feb., in frequent observations incomparably more of them, in part at least not satellites. During twenty days he and another saw W. much brighter than E., which was far more irregular, and had on it the last two days a fixed point of light. Hence he concluded, as Messier and others had done fifteen and thirty years before, that the S. was by far the more uneven surface. [We have already mentioned that the fixed points or knots of light, which will now repeatedly be mentioned, though supposed by Schr. to be mountains, one between 400 and 500 miles high,

are no doubt, as Olbers suggested, the perspective projection of the brightest portions of the ring enlarged by irradiation; or if we are looking on the dark side, light reaching us through its openings. But their frequent absence of symmetry is the point to which we are directing our attention.] 1803, Jan. (3?) 4, Harding found W. ansa reappear alone, with a large knot of light. 11, Schr., Harding, and another found W. more visible, and the knot unmoved. 14, ditto, Schr. detected two smaller knots on E.; they observed by turns for $8\frac{1}{2}$ h., and found them unchanged; during the latter days the W. knot began to lengthen westward; it continued visible and unmoveable for $4\frac{1}{2}$ months. June 10, all E. had disappeared except two points, W. was extremely thin and interrupted, with its great point or *mountain*. 16, Schr. saw W. with much difficulty; E. had for some time disappeared. It vanished at last, even in 27-ft. reflector, and reappeared on each side alternately as a fine interrupted line. Nov., ring knotty, E. white, W. fainter; the same three spots. Schr. considered that when we looked on the S. side, W. was the larger, and the reverse, and inferred that the rings did not lie in the same plane.

I have found no record of its aspect at its next disappearance, but in 1832 and 1833 we have several notices, especially by Schwabe,* the great observer of the sun at Dessau. Dec. 1, he saw one minute point on E. side, fixed for 3h. so as to show that it could not be a satellite. 12, E. ansa had a bright spot (near outer edge of ring B), and did not close up to the ball; W. uniform, rather the shorter, broader, less defined, and fainter; but vanishing later behind clouds than E. The dissimilarity continued through the spring of 1833, but the spot grew less obvious on the widening ring, and the E. ansa became continuous, though feebly so, to the globe. April 2, ansæ evidently unlike; E. fainter than W.; both feeble. 7, 15, E. the longer; no brighter spots. 17, E. obviously the longer, and somewhat the sharper defined; very faint or invisible near ball, while W. closes up to it. 25, W. the more distinct; E. seems discontinuous. 27, ditto; sometimes, perhaps, a bright spot on E. May 1, ring gone. June 8, 13, sometimes very minute point E. 14, first certainty, W. somewhat the more distinct, and closing up to ball; E. does not close, but has a bright spot. 18, spot so bright as to make E. ansa, though the fainter, the more conspicuous. 24, W. very obviously the shorter and fainter, but uniform; E. brighter towards extremity. 25, ditto; the spot seemed double. July 16, W. uniform; E. distinctly longer, and very faint next

* This name was erroneously printed *Schuzbe* in our last No.

globe; spot more extended. These observations were confirmed by others. Petersen at Altona found E. always considerably the brighter. April 22, 25, 26, a distinct bright point E.; another, not symmetrical, suspected W. At re-appearing, June 16, Bianchi saw bright points in ansæ. 19, a point. 22, 24, several, E. Santini, 18, E. like a string of pearls, dissimilar to W. Mädler also saw a brighter point E. than W., and W. took the lead in the apparent shortening of the ansæ.

During the decrease of the ring in 1846, from Nov. 21, Schwabe found W. always rather fainter and less sharply defined than E.—1847, July 11 to Aug. 15, W. somewhat the more distinct, bright, and long, and its “lunule” more obvious, though not larger: from middle of Sept. both ansæ equal in all respects. At the ensuing edge-presentation in 1848, a greater degree of systematic attention was paid to these appearances, and the experience of Schwabe, the keen eye of Schmidt with the 8-feet Bonn heliometer, the unsurpassed vision of Dawes, and the extraordinary power of the achromatic at Harvard College, U.S., were all put in requisition. June 26, the dark side being turned towards us, the ring was visible in its whole length, but not continuous W.* Bond II. Traces rather plainer E. as a multitude of the finest points: Schm.—June 30, 2 faint dots, E. the plainer, about the extremity of ring B: Dawes.—July 3, W. more distinct than E.: Bond I.—10, an interruption and two bright points on each side: Bond II.—11, three detached bright portions W., two E.: Bond I. Continuous, but brightest in four places, like satellites strung on the ring, only fixed: B. II.—14, 16, 17, breaks visible, B. II.—15, as before, Dawes.—18, composed of fragments, but more continuous, and broadest near ball W.: B. I.—21, 4 fixed points: B. II.—Aug. 29, W. the more easily seen; 2 spots on it; one only on E.: B. II.—30, W. best, with a spot: B. II.:—31, unequally illuminated: B. I. II.—Sept. 3, sun passed to S. side: ring perhaps beaded: B. I. II.; probably not equable, yet not dotted as June 26: Schm.—4, perhaps not quite equable, but prominences and interruptions not perceptible; thinnest next ball: B. II. W. somewhat the plainer; E. interrupted: Schw. W. seen without any difficulty interrupted in 2 places; E. less certainly so: Schm. [personal or instrumental equation must come in here]. E. decidedly longer than W.: Dawes.—5, ring a sharp line, thinning off from W. to E. end; W. most obvious, and joining globe; E. interrupted and not joining: 2 bright longish thickenings on W., one sharp point on E., all fixed: Schw. and Habicht. W. in

* P. in original, as in many other places.

3 portions ; E. in 2 : Schm.—6, much the same : Schw. One break on each side at place of Ball's division ; E. somewhat the longer : Schm.—7, the same : Schw. and Hab. E. the longer ; Schm. who saw one break E. 2 W., so Argelander, who did not think them quite dark.—8, W. and 2 spots plainer, E. and point weaker : Schw. and Hab. 11h. 15m., break in each ansa, near Ball's. div.: 12h. 15m., W. the broader as before, E. the longer with 2 breaks ; 14h. (very fine, power 600) W. in 3, E. in 2 parts, but all W. broader, brighter, and stronger, ; E. perhaps longer and very pointed : Schm.—9, W. very broad, points well divided ; E. narrower, but of sharper light, showing besides old point, 2 fainter ones nearer globe, from which to the nearest was an extremely faint line. It seemed as though both ansæ were not in one plane, but E. was a little sloped towards S. : Schw. One break, probably more, on each side ; proportions E. and W., as yesterday : Schm.—10, the same in all respects : Schw. and Hab.—11, W. only one longish thickening ; E. three points : Schw.—10, 11, break on each side ; E. the longer : Schm.—11, no prominences : B. II.—12, W. certain ; E. nothing but 2 extremely fine points : Schw.—13, Earth passed to dark side ; W. perhaps visible close to ball : B. II.—18, ring extremely delicate ; W. 2 fixed points : B. I.—Oct. 5, interrupted, especially W. : B. II.—6, 7, rather broken, especially E. : B. II.—12, disconnected, and 2 points : B. II.—20, 23, inequalities as in July : B. I. II.—28, the dark part across the ball uneven : B. I.—Nov. 3, symmetrically interrupted, but broader E. : B. I.—13, 29, dark part uneven : B. I.—1849, Jan 6, brightest E. : B. II.—19, after earth had passed to illuminated S. side, ring rough, broken and not joining ball and longer E. : B. I. ; these differences not perceived : B. II.—21, W. unquestionably the broader, but less defined and fainter, broadest at end, and with a knot of light ; E. carried 2, possibly 3 points : Schw. A strong point at end of E ; doubtful whether ansa touches either it or ball ; fainter and less distant point on W. which touches ball : Schm.—27, W. uniform ; points on E. doubtful. E. seems longer than W., and not joined to globe : Schw.—29, ditto ; greater length of E. obvious : Schw.—31, no points, but ansæ very unequal ; W. evidently the shorter, less defined, and fainter ; yellowish ; E. orange ; joined to ball by a feeble line : Schw. Günther in Breslau, 1848, Sept. 5, found ansæ disjoined from ball, and E. distinctly brighter than W.—Sept. 7, Busch at Königsberg saw a fixed point at the very end of E., one nearer ball on W. So Wichmann.—8, point on W. invisible ; on E. somewhat nearer ball.—9, 10, point at end of E.—11, W. brighter than E.

The observations at the last epoch of similar presentation,

1861-2, were, as far as I have seen them, of the same character. As the ring diminished, Secchi found, if the air was not good, E. ansa sometimes the shorter. Nov. 8, both were short, but especially W.; E. the fainter. 15, ansæ dotted; E. much the narrower. 19, E. "apparent" ansa (qy.: does not this mean the real W. in an inverted field?) certainly the shorter. [We must not forget that these differences in length which so repeatedly come before us, may be as fairly ascribed to eccentricity, as to deficiency in reflective power of the extremity of the line.] During the following observations by Schwabe, with 6ft. Fraueuh. up to 360, the earth was on the sunny side of the ring.—Feb. 7—10, both uniformly smooth, E. growing brighter. 17, W. very blunt-ended; E. with 5 or 6 fixed knots, 2 strongest very near ball. 18, 19, W. the shorter; E. dotted and very pointed. 27, E. still dotted. March 1, 8, W. a little the more distinct. 10, both alike bright, long, and smooth. The dark spaces begin to appear as 2 very fine black lines. [This seems inconsistent with any appreciable thickness of C.] 12, ditto. Ring begins to be brighter than ball. 15, 16, 24, ansæ unchanged. April 1—8, W. less defined and shorter than E., which had a granular light. 10, E. obviously the longer. 14, E. very pointed and somewhat knotty. 15, E. certainly the brighter. 22, E. alone knotty. 24, E. so sharp that its termination is sometimes doubtful. 25, ditto; W. the more distinct. 29, E. end often vanishes. 30, 2 knots on E., and its end fainter. May 1, E. had 2 knots; it often vanished. 2, a third knot E. 3, E. the feebler; no knots. 4, 5, W. the plainer. Throughout these observations, from Feb. 7 to May 2, the ansæ preserved invariably a wedge-shaped aspect, tapering from W. to E., as Schröter had represented it in a "rough but very faithful" design; whence Schwabe infers that, whatever explanation may be given of the dots of light, rotation is impossible.—1861. Wray 7 in.: Dec. 17, line irregularly broken (looking on dark side); 26, 16h. 30m. E. scarcely, W. readily visible, and broken in 2 places; 18h. 30m., both equally bright; 19h., E. the brighter. Jan. 4, W. much broken, brighter than E. 5, 13h. 30m., W. much fainter and shorter than E.; 16h. 40m. equal in length and light; 17h. 15m. to 18h. W. decidedly the brighter. 18, ansæ equal.—1862. Huggins, May 2, 12, 13, two bright dots E. at inner and outer edges of ring. 16, ansæ steady; no dots.—Carpenter at Greenwich, May 5, E. $\frac{1}{10}$ the longer. 17, W. just visible; only one spot E. 19, W. the more visible.—Birt, May 13, with 2 achroms. by Slater, 3 beads W.; 4 (Slater 5), E., which was the longer.—Σ II. May 16, W. the longer as 5 to 4. 17, 18, 19, W. the more visible. June 3, perhaps the shorter.

The unvaried bearing of all this testimony is in favour of

the conclusion, already adopted by some of the very early observers, that, instead of the whole ring-system lying in an uniform plane, there must be a slight degree of mutual inclination in the surface of its subdivisions, and such an inclination as will occasion want of symmetry in its perspective projection.* This would not be the result of mere inclination, so long as the intersection of the planes, whatever might be their number, passed through the centre of the planet, because one half of each plane would be as much elevated as the other depressed on either side, like the ecliptic and equator in the sky, and symmetry would not be interfered with. We must, therefore, in order to explain the observed appearances, adopt the idea of planes whose intersection does not pass through the axis of Saturn—perhaps not even through any part of the globe, or ring-system itself; and whose varying inclination—for under the action of so many disturbing forces, their inclinations and nodes must vary—though symmetrical on either side of their own intersections, or *lines of nodes*, would not be so on either side of the centre of the planet. Such an arrangement would not involve any theoretical impossibility. It is not essential to the stable equilibrium of the whole system, that the centres of gravity of the several rings should coincide with that of the planet; so long as this is the case with the common centre of all, they would individually balance each other on opposite sides of it. And even a want of coincidence between the common centre of gravity of the rings, and that of the planet, would not produce disintegration of the system, provided each of those points revolved round an intermediate one, the general centre of gravity of the whole. The mutual attractions, however, of the rings, and the external influence of the satellites, while not of necessity causing any permanent derangement or ultimate collapse, would yet introduce a complexity of balancing, the result of which would probably transcend all human analysis, but which may *possibly*—more cannot be said—produce the peculiar variations which the foregoing details record, and which certainly are supported by too great a mass of evidence to be treated as mere optical deceptions. Theoretical inquiries, however, unless of the most superficial and familiar character, lie wide of our present object, which is simply to bring into one point of view the most accessible data, that the student may, as the result of a

* Bessel found by strict mathematical investigation that the times of the disappearance and reappearance of the ring were incompatible with parallelism in its opposite surfaces. But this, though harmonizing with the wedge-shaped form recorded by Schwabe, is scarcely an adequate solution of many of the recorded phenomena, and at any rate merely treats the system as a whole. Cassini II. had anticipated this conclusion.

careful comparison, ascertain for himself, what is pretty certainly known, and what is still ambiguous, in this wonderful subject.

To explain the variety of appearances, it would seem necessary to assume that Ball's is not the only actual division in the system, but that the minuter dark lines which have been often noticed, indicate its separation into many narrow concentric annuli. This is in every respect probable, and it is not impossible that the difference so frequently recorded in the visibility of these divisions on opposite sides of the globe, may be due to some of the perturbing influences to which we have alluded, and which may really, in the inscrutable arrangements of an all-wise Creator, be the source of preservation instead of ruin. Such at least was the opinion of Pierce, who considered that, without the compensation introduced by the influence and position of the satellites, not even the irregularities of the ring, to which Laplace had referred its equilibrium, would suffice to guarantee it from collapse and destruction.

The variation of inclination among the bright portions is obviously confined, as we must have remarked, within narrow limits, and disturbs the symmetry but in a small degree. But it may be questioned whether this may not be more the case with regard to the dark ring C, as well as whether it may not be of considerably greater thickness than its neighbours. Σ II. thinks both of these probable, from the visibility of what Maraldi called the equatorial belt during the disappearance of the ring in 1715. This, however, does not seem conclusive, unless it can be shown that he was not then looking upon the unenlightened side of the bright rings. But at the first discovery of C in 1850, Dawes remarked that it was always more plainly seen behind than in front of the ball, and that its projection upon the ball was then considerably too narrow to accord with that at the major axis; and more conspicuously so at that time, than at the end of 1852. These appearances, he says, might be satisfied by the supposition of a wedge-like form in C, the thick edge outwards, and a similar but reversed form of B: he preferred, however, the hypothesis of De la Rue of a different inclination for C, which would thus be tilted up, as it were, from behind towards the eye. De la Rue, in fact, in his first beautiful engraving, Nov. 1852, represents C as encroaching on the outline of B behind the ball; and in his second continues to show it wider there than in front.* he

* Lassell, on the contrary, at Malta, with 24 inches, found, 1852, Dec. 15, C so broad, and B so narrow, in front of the ball, that he thought the darkest part of the latter must have been merged in the appearance of the former.

considered, too, that its apparent ellipticity was not the same with that of the bright rings. Mitchell also, with the 12-in. achrom. at Cincinnati, noticed the disproportionate breadth at the major axis; and I thought it evident with $5\frac{1}{2}$ in. in June, 1865.

The very curious comparative indistinctness of the E. edge of ring B, observed by Schumacher and Dawes (INTELLECTUAL OBSERVER, ix., 371), struck Mr. Barrow, the companion of the latter, 1855, Dec. 19, as an indication of an inclination in the plane of C.—1857, Jan. and Feb. Morton, observing with Lord Wrottesley's achromatic of $7\frac{3}{4}$ inches, found the division of B and C never well marked, from the apparent overlapping of the latter, the opposite or inner edge of which was sharply seen. But still more curious are the observations of the eminent optician Wray and Σ II., in 1861-2, when the edge of the ring was presented to us. The former, using a 7-inch object-glass, distinctly saw, Dec. 23, 26, Jan. 4, 5, 11, 18, a faint, nebulous, bluish-white light, very different from the planet in colour, attending each side of the narrow ring-line for about $\frac{1}{2}$ of its length right and left of the ball. The latter, May 15, perceived luminous appendages like clouds of less intense light, lying on the S. side of the line, which was much sharper defined N.—19, they extended $0.6 p$, $0.3 f$, of the diameter of the ball; their colour very unlike that of the ring, being "not yellow, but more of a livid colour, brown and blue." 20, extent $0.65 p$, $0.5 f$.—21, $0.6 p$, $0.4 f$, on which side light much more feeble; breadth increasing towards limbs like sharp wedges.—22, $0.6 p$, $0.5 f$,—June 3, very bad image, yet appendages still distinctly visible. Winnecke concurred in these observations. Nothing of the kind, however, was noticed at Greenwich, May 17, 19, 20, June 3. During Σ II.'s observations the sun was nearly in the plane of the ring; more elevated during Wray's, when the earth, on the contrary, was much lower.

Our readers may have remarked that nothing has been said as to the period of the rotation of the ring, which, as is well known, was deduced by H₁, in 1789, from the luminous points of which such repeated mention has been made. He fixed it at 10h. 32m. 15.4s., and the dissentients from so high an authority have been very few. Schröter, indeed, from the unmoved position of certain protuberances; Schumacher, from the unvaried difference in sharpness of the inner edges of B; and Schwabe, from the unchanged direction of the wedge-like form of the lateral view, have not hesitated to express a doubt even as to the fact of rotation; but the generality of astronomers have acquiesced in H₁'s determination both of the fact and the period: and it would seem to involve no small degree

of hardihood, not to say presumption, for any but a great leader in science to call it in question now. But truth ought to be paramount to such considerations. It is not authority but fact with which we have to deal. It is not so much a matter of opinion as of evidence, and a circumstantial examination of the original observations seems to bring with it the inevitable impression that they are not adequate to bear out the conclusion which has been drawn from them. The lucid points which have been so often noticed, strung like beads, to use H's elegant illustration, upon the ring, may be referred to more than one cause. If fixed, the reasoning of Olbers and the measurements of Bond concur to prove that they are merely perspective foreshortenings or transmitted glimpses of the brightest portions of the ring, and their frequent want of symmetry offers, as we have seen, no insurmountable impediment to this explanation, in default of which they would be irreconcilable with any rotation whatever. It is only among such as are moveable that the indications of rotation can be sought; of these the greater number are confessedly merely satellites projected upon the line of the ring, and it remains to be inquired whether there are any others which cannot be accounted for in this way. Now, in 1789, after the discovery of the two innermost satellites, H found in the record of his observations that in 47 instances, extending through 20 nights, he had seen bright points not concurring with the position of any satellite at the time. The idea of their being mere results of perspective, or openings in the dark side, had then never been suggested, and he does not seem to have contemplated the possibility of their fixity: he therefore assumed the existence of 5 separate spots—which he preferred to consider as outbreaks of fire rather than as mountains—in different positions on the ring; and he proceeded to show that his observations might all be accounted for by a combined rotation of these hypothetical spots in rather more than $10\frac{1}{2}$ hours. This, it may be safely asserted, is a mode of proof which is entitled to little confidence. But, it will be asked, did he not actually witness their motion? That, it is obvious, would be the only satisfactory test. A point on a ring revolving with such rapidity would be carried through its whole apparent length in $5\frac{1}{4}$ hours, or through a space equal to the radius of the planet in about 1h. 10m., and, though considerable allowance must be made for the perspective foreshortening of the direction of motion, it is evident that among so many observations it ought to have been repeatedly perceived. But in two instances only is anything of the kind distinctly specified. Oct. 30, 20h. 53m. distance $\frac{1}{4}$ diam. of planet *f* (but this he is obliged to refer to a different hypothetical spot):—23h. 55m. $\frac{3}{4}$ ditto *p*, very near the end of the arm:—0h. 42m. a little nearer than before:—

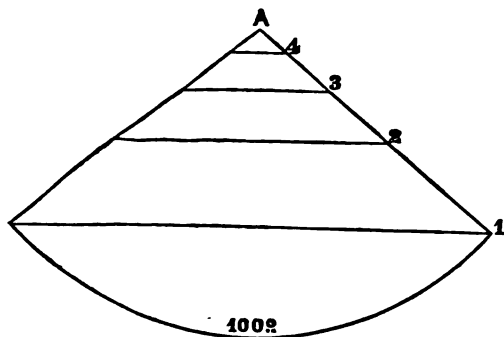
0h. 47m. $\frac{3}{4}$ again.—October 31, 21h. 13m. $\frac{3}{4}$ p:—22h. 11m. drawn nearer; “flying clouds prevent estimations of the distance.”—23h. 13m. “no longer visible.” From such very limited and incomplete data it does not seem too much to say, with all due respect to the illustrious observer, that no exactness of period could be deduced. And nothing has since been added to them. In an accompanying diagram the imaginary spots are set nearer to or further from the edge of the ring, to make the calculations correspond with the appearances; but he expressly states that his period applied to the exterior ring A. Laplace had previously given about the same value, but for the *interior* ring.

(To be continued.)

A near appulse of the moon to Saturn during the evening of Aug. 16 will be an interesting spectacle, the distance, at Greenwich, being only 36'.

ROSS'S FOUR-TENTHS CONDENSER.

THE subject of achromatic condensers for the microscope is not yet exhausted, and although several forms of considerable merit are now before the public, there is still room for experiment and invention, both in the glasses employed and in the nature of the stops. Mr. Ross has added to the number of condensers one that especially deserves notice and commendation; and, we think, after giving it a considerable trial, that it will be regarded with great favour by practical microscopists.



Before describing the new condenser, we must say a few words on the different results which proceed from employing combinations of different sizes and different degrees in angle of aperture. Let the microscopist draw two lines converging and making an angle of 100° , and then draw, at various dis-

tances from the angle, horizontal lines uniting the two lines that converge to form the angle. The figure will be like the preceding diagram, in which A represents the focal point of a series of lenses, 1, 2, 3, 4, of different sizes and focal lengths. Each lens, 1, 2, 3, or 4, can throw, through any transparent substance, appropriately situated, rays of light which converge at an angle of 100° ; but there will be a great difference in the total quantity of light which each lens can receive or refract, and also in the proportion which the marginal rays bear to the central ones. In 1, the marginal rays will be greatly in excess of the central rays; while in 4, as the marginal rays are fewer, and the central rays the same, the latter will be relatively much more important. This diagram distinctly expresses to the eye the fact that, when achromatic condensers are made with small lenses, the marginal rays do not exceed the central rays to anything like the same extent as when larger lenses are employed.

Suppose the diagram to be on such a scale, that the lens, whose diameter is represented by 2, will focus through the thickness of an ordinary glass slide, it is then plain that lenses of the same aperture, and so small as either 3, or 4, cannot possibly perform with their whole aperture, or anything like it, through the thickness in question. A lens of given aperture and of focal length greater than the thickness of a glass slide, may converge all its rays through any transparent object on the slide; and if the slide be much thinner than the length of its focus, all the difference is, that the thin glass will obstruct and refract the passage of the rays less than the thicker glass. If, however, we try to make a large-angled and small lens with a short focus work through a slide, the thickness of which exceeds the length of its focus, only the central rays, and those near them, can get through in the direction required. Thus, if a microscopist desires to have a large-angled condenser, for use with ordinary glass slides, as well as with thin glass, he must not take an optical combination of small lenses and very short focus, for if he does, a considerable portion of the slanting light he desires should reach his object will never get there at all.

It appears to us that two things should be required of achromatic condensers intended for general use and for *research*. First, that the optical combination employed should be adapted to a considerable range of power—say from an inch or two-thirds upwards to the highest; and, secondly, that it should be capable of working with a large aperture through ordinary glass slides. When low powers are employed, a pleasantly lit field can be obtained, by using a condenser a little out of focus, so that the rays cross before reaching the object; but a condenser for general use should be able to send

a sufficient quantity of its oblique rays, when in focus, through an object seen with very moderate magnification, and should be capable of giving a dark ground illumination with a half inch or two-thirds object glass.*

In Mr. Ross's four-tenths condenser, the principal desiderata are excellently provided. The optical combination is exactly the same as in his large angled four-tenths objectives, and the front lens has a diameter of one-fifth of an inch. In the best condensers the diaphragms are brought close to the lower lens, and this is the case with the instrument before us, which is provided with two revolving wheels of diaphragms. The upper one is pierced with eight round holes, or "circular apertures," as those who prefer learned phraseology may call them. One of these is, in point of size, a copy of its next door neighbour, and may be filled up with a polarizing slice of tourmaline, or may be made with a little rim, so as to receive any experimental stops the microscopist may wish to try the effect of. Omitting this stop, we have seven other stops, marked respectively 109° , 95° , 82° , 70° , 59° , 49° , and 40° . These stops allow the lenses to work with the angles of aperture named. In the wheel of diaphragms, below them, is another set of stops, which can be combined with the preceding. A, the first, is a large central stop adapted to 109° or 95° angles of aperture. B and C, smaller ditto; 3, 2, and 1 are *radial* stops—that is to say, they are pierced with slots, three, two, and one respectively, cut so as to converge towards the centre of the circle, but not carried as far as the centre. The single slot stop keeps out the central rays, and allows a radial beam, including its proportion of marginal rays, to illuminate the object. This can be used with the larger of the open stops. The two-slot stop gives passages to two such pencils of light, one at right angles to the other, a plan very effective with certain diatoms and other objects. The three-slot stop allows the transmission of three pencils, equidistant from each other. This gives the three readings of the *P. angulatum* beautifully. The arrangement for working the diaphragms in the condenser is very convenient, and the whole apparatus rotates with Mr. Ross' substage. The lenses are capable of adjustment to suit different thicknesses of glass.

Let us say a few words on the results. The proportion which, from the size of the front lens the marginal and central rays bear to each other is such, when the stop, allowing 40° of aperture is employed, that the two sets of lines, on *Pleurosigma hippocampus*, and *P. angulatum*, are distinctly shown with a one-fifth objective and first eye-piece. A slight change in

* With a two-thirds, we find it advisable to send the light through the four-tenths condenser with the *concave* mirror, when a dark ground illumination is required.

the position of the flat mirror makes this stop work excellently with the *podura* scale. Thus this arrangement enables an experimenter viewing a *new object* to see surface markings, and to obtain penetration with one and the same stop, an important gain in original investigation. For lined objects, other combinations will do better, but it is remarkable how well distance lines can be shown with only 40° aperture of the condenser, and no central stop at all. The slot stops have been found very useful in investigating unknown objects, as well as in displaying those that are known; and with the whole aperture and the two-slot stop many diatoms with double sets of lines are brought out very powerfully. The microscopist will find that from 40° to 59° angle of aperture will, in many cases, give the best results, when a one-fourth or a one-fifth objective is employed, though a larger aperture would be desirable to display the same objects if another condenser made of smaller glasses should be used.

LARTET ON THE ASPHALT OF THE DEAD SEA.

THE following paper of M. Louis Lartet will be found in *Comptes Rendus*, No. 26, 1866:—

“The ancient traditions concerning the appearance of bitumen on the surface of the Dead Sea bear testimony to the evident connection of this phenomenon with the persistent activity of the internal forces of the globe in this region, and which have given rise to profound dislocations of cretaceous and nummulitic rocks, to the flow of volcanic matter, and to thermal springs. In our own times, some travellers who, like the American missionary, Smith, had the advantage of knowing the Arabic language, have been able to obtain, from tribes actually stationed in this region, tolerably consistent accounts of the more recent appearances of bitumen in the waters of the Dead Sea. It seems that the appearance of this substance is always preceded by subterranean commotions. Thus, after the earthquake of 1834, a considerable mass of bitumen made its appearance at the southern end of the sea, and the Arabs detached about 220 quintals, out of which they made a good profit.

“In 1820, when another earthquake destroyed a great part of the city of Tiberias, and occasioned the death of more than 6000 inhabitants of the district, very violent shocks occurred in the direction of the great axis of dislocation of the basin; new hot springs uprose in the Tiberiad; and a few days after-

wards the Arabs saw a mass of bitumen floating on the Dead Sea, which they took possession of and sold in the bazaar in Jerusalem for 16,000 francs, being at the rate of 100 francs for a quintal.

"It is only along the western shore of the Red Sea that important deposits of bitumen occur. We know that Strabo mentions the existence, in the neighbourhood of Masada, of rocks distilling pitch. We think we have discovered the deposits to which the Greek geographer alluded, first in the ravine to the south of the hill of Sebbeh, whose summit is crowned with the ruins of the ancient Masada. We meet there with dolomitic rocks, the numerous cavities of which are partly filled with asphalt which must have been introduced in a fluid state, and gradually solidified, giving the rock the character of an asphaltic breccia. More to the south, and nearer the diggings of *sal gemmi* and gypsum of Djebel-Udum, if we ascend Wady-Mahawat to the height of about 300 metres, we find the same cretaceous formations strongly impregnated with bitumen, which runs from their fissures, and sometimes forms stalactites of asphalt. At certain points the bitumen has cemented together the ancient alluvium resting upon the calcareous rocks, and has formed bituminous pudding-stones, fragments of which are carried by torrents towards the Dead Sea.

"To the north of Masada we find traces of bituminous emanations at Ras Mersed; and lastly at Nebi-Musa, at the north-western extremity of the sea, the most considerable deposits of bituminous limestone are found, and where cretaceous fossils (*inoceramus*, *echinus*, etc.) are associated with the remains of fossil fish. This limestone contains as much as 25 per cent. of bitumen; and the cretaceous beds which have been impregnated with it contain also in the same vicinity salt, veins of gypsum, and traces of magnesia. It burns easily, and the Arabs call it Hajar Musa, or Stone of Moses, and make use of it to light their encampments. The Christians of Bethlehem make religious symbols out of it, which they sell, under the name of Dead Sea Stones, to the numerous pilgrims who flock every year to Jerusalem for the solemnities of the Holy Week.

"In the valley of the Jordan there exists, at the same level, other deposits of bituminous limestone. Such, without doubt, are those of Tiberias, from whence, according to Hebard, arise the Hot Springs of Hammon, the situation of which we could not verify.

"At Hasbeya, near the sources of the river, bitumen shows itself, as at Nebi-Musa, in fossil fish limestones, but it is less abundant, although it was the only deposit regularly worked at

the time of the Egyptian conquest, when shallow pits were sunk and a tolerably rich deposit arrived at, the *débris* of which we found on the margin of the pits.

"Besides this series of bitumen deposits of which are ranged in *échelon* on the long axis of the basin of dislocation, as well on the western bank of the Dead Sea. As on reascending the course of the Jordan, we found considerable traces of it, at the same geological level, in the inoceramous limestones of Khalwet, in the Anti-Libanus, between Hasbeya and Rascheya, and even in the approaches to Damascus; but the alignments of these last deposits departed considerably from the direction of the axis of the basin of the Dead Sea to arrange itself along the chain of the Anti-Libanus, and to direct itself towards analogous deposits of Mesopotamia and Persia—as if they would serve to unite these last with the long series of bituminous emanations passing by the Dead Sea, the point of Sinai, and the mountain of L'Huile, in Egypt.

"Much attention has been given to the origin of the fragments of asphalt which the Dead Sea throws up on its banks, and from its analogy with that of Hasbeya, it has been thought that it was brought down by the waters of the Jordan, forgetting that although bitumen is lighter than the water of the Dead Sea, it is much heavier than that of the Jordan, and that this river must have deposited it on its own banks in the course of so long a journey. It has also been supposed that vast sheets of bitumen, accumulated at the bottom of the Dead Sea, after hardening, have become detached and floated to the surface. This hypothesis is not justified by the numerous soundings made by the American expedition, nor by those of the Duke de Luines' expedition in which we had the honour to take part.

"Lastly, Dr. Anderson had a notion that under the bituminous deposit of Nebi-Musa there existed considerable layers of asphalt, intercalated with calcareous rocks, and the prolonged outlines of which stretched under the Dead Sea, and yielded to the erosive action of its waters the specimens which travellers noticed on its shores. This opinion does not appear to us more admissible than its predecessors. We do not see why the fragments of bitumen dispersed on the banks, and of which no trace is found in the ancient alluvium or the ancient deposits of the Dead Sea, should not come in part from the *débris* of these floating islands of asphalt, as well as, perhaps, from the disintegration of the bituminous rocks which the waters of the Wady-Mahawat and those of Wady-Sebbeh bring down at certain seasons.

"As for the occurrence of bituminous emanations in the

bottom of the Dead Sea or on its shores, or along the Valley of the Jordan, we believe that they are connected with a system of thermal, saline, and bituminous springs which extend along the major axis of the dislocation of the basin. This conviction rests first on the alignment of bituminous deposits along the same axis on which we find the rare representatives of springs which seem to have been connected with extinct volcanic phenomena: secondly, on the presence, verified by M. Hebard, of bitumen in the limestones, from whence emerge the thermal and saline springs of the Tiberiad, in which Dr. Anderson found bromine associated with organic matter; thirdly, on the analyses of the water of the Dead Sea, which, according to M. Terreil, contains an organic matter having the characteristic odour of bitumen, and which is particularly abundant in the neighbourhood of Ras Mersed, whose odours of sulphuretted hydrogen are noticed by all travellers, and which is the place signalized for its bitumen by Strabo.

“As at Ras Mersed the bitumen has penetrated the fissures of the calcareous rocks on the banks, and is found in the saline deposits in a little grotto very near this point, everything leads to the supposition that there still exists one of those submarine springs which in former times emitted considerable masses of bitumen, and which now confine their operation to exceptionally enriching the water in bitumen, chlorides, and bromides, and so disengaging sulphuretted hydrogen gas.

“In thus unfolding the reasons which lead to the belief that the bitumen has been brought by the hot and saline springs, and that it has impregnated the limestones after their deposit, we do not intend to decide the question whether this bitumen has been brought up direct from the depths, or whether the hot springs met with carbonaceous matter in their course, and reacted upon it. It is known that there exists in the Lebanon, in the system of sandstones below the cretaceous rocks which are impregnated with bitumen, considerable masses of lignite, of which the analogues may have existed in the Anti-Libanus and in the Dead Sea. In this hypothesis, which supports the observation of traces of vegetation found by Dr. Anderson in Dead Sea asphalt, the heated waters may have been able to extract from the lignites their hydro-carbon products, such as M. Daubrée has been able to show in his beautiful experiments illustrative of metamorphism.

“However this may be, we see in the preceding facts a fresh confirmation of the laws of association, connecting deposits of bitumen with salt, gypsum, hot springs, and volcanic phenomena.

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28' 6" N., LONGITUDE 0° 18' 47" W.

BY G. M. WHIFFLE.

1866.	Reduced to mean of day.				Temperature of Air.			At 9-30 A.M., 2-30 P.M., and 5 P.M., respectively.			Rain— read at 16 A.M.
Day of Month.	Barometer, corrected to Temp. 32°.*	Temperature of Air.	Calculated.		Maximum, read at 9-30 A.M. on the following day.	Minimum, read at 9-30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.		
			Dew Point.	Relative Humidity. Tension of Vapour.							
	inches.	°	°	inch.	°	°	°	0—10		inches.	
April 1	...	...	...	...	49.5	36.6	12.9	...	...	0.085	
" 2	29.435	38.2	36.4	.94	248	47.4	35.8	11.6	10, 8, 7	N by E, N by E, N by E.	.006
" 3	29.637	39.7	35.8	.88	261	49.3	38.5	10.8	9, 8, 9	NNW, N by E, NE.	.000
" 4	29.672	37.5	35.8	.94	242	46.8	35.2	11.6	10, 9, 10	SSE, E by S, NE by E.	.031
" 5	29.881	42.4	38.6	.88	287	51.5	34.8	16.7	10, 7, 3	E by S, E by S, E by N.	.067
" 6	30.014	45.1	40.7	.86	315	53.2	42.0	11.2	9, 2, 3	E by N, E, NE by E.	.025
" 7	29.910	40.8	40.7	.99	271	47.8	40.6	7.2	10, 10, 9	NE, NNE, NE by N.	.008
" 8	...	...	...	...	...	52.4	41.5	10.9	...	...	.010
" 9	29.903	38.9	39.2	1.00	254	44.8	42.4	2.4	10, 10, 10	NE by E, NE, N.	.005
" 10	29.844	43.5	40.4	.90	298	51.4	42.0	9.4	10, 10, 10	WSW, SW by W, SW.	.191
" 11	29.528	46.1	44.4	.94	326	54.8	41.6	13.2	10, 10, 10	ESE, ESE, S by E.	.000
" 12	29.778	47.5	42.5	.84	343	58.8	45.3	13.5	7, 9, 10	WSW, SW by S, SW.	.215
" 13	29.884	48.5	46.7	.94	354	58.5	49.8	8.7	10, 10, 10	SW, SW, SSW.	.020
" 14	30.009	46.8	39.5	.78	334	58.4	40.1	18.3	5, 8, —	WSW, W, W by N.	.021
" 15	...	...	...	...	...	58.3	39.7	18.6	...	...	.178
" 16	29.924	46.8	45.1	.94	334	54.9	39.5	15.4	10, 10, 2	SSW, SW, SSW.	.104
" 17	29.948	50.7	37.6	.64	382	58.0	45.7	12.3	9, 6, 3	W, WSW, W.	.033
" 18	29.976	52.2	39.4	.64	402	61.8	38.1	23.7	0, 4, 3	SW, W by N, WNW.	.000
" 19	29.808	52.8	44.7	.76	410	62.5	40.1	22.4	10, 5, 7	S, S by W, SW by W.	.000
" 20	29.886	47.4	38.9	.74	341	57.8	43.1	14.7	6, 9, 4	W, W by S, W.	.000
" 21	30.136	51.1	40.3	.69	387	60.6	43.9	16.7	6, 6, 4	NW by W, NE, W by S.	.031
" 22	...	...	...	...	...	55.8	38.2	17.6	...	...	.000
" 23	30.342	44.9	31.5	.62	313	52.8	39.5	13.3	0, 0, 0	E by N, E, E by N.	.000
" 24	30.165	48.4	34.2	.61	353	55.8	38.9	16.9	0, 0, 0	E, E, E.	.000
" 25	30.068	55.3	35.6	.51	447	63.4	44.3	19.1	0, 0, 0	E, E, E.	.000
" 26	29.944	61.4	46.6	.61	547	71.7	41.7	30.0	0, 5, 4	ENE, SE, SE.	.000
" 27	29.742	64.4	50.6	.63	605	74.6	50.4	24.2	0, 6, 10	E, SSW, S.	.000
" 28	29.469	52.0	51.7	.98	399	66.8	53.0	13.8	10, 10, 10	SW by W, WNW, NE.	.020
" 29	...	...	...	...	...	46.5	39.1	7.4	...	...	.717
" 30	29.738	39.1	24.7	.60	256	46.3	35.3	11.0	7, 9, 6	E by S, E by N, ENE.	.040
Daily Means.	29.866	47.3	40.1	.80	348	...	...	14.5	...	...	1.807

* To obtain the Barometric pressure at the sea-level these numbers must be increased by .037 inch.

HOURLY MOVEMENT OF THE WIND (IN MILES), AS RECORDED BY ROBINSON'S ANEMOMETER.—APRIL, 1866.

Day.	Hour.	A.M.												P.M.												Total Daily Movement.	Hourly Means.						
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12								
1	12	8	4	8	2	4	10	18	6	297	6	4	20	15	6	8	18	19	4	5	8	7	10	1	13	13	10	9	9.3				
2	1	6	2	10	2	5	10	19	7	297	4	4	18	15	6	8	19	17	5	2	7	10	1	13	12	6	9	6	18	9.0			
3	2	3	3	9	1	3	13	20	8	3	4	22	14	6	8	18	18	5	2	6	10	1	13	12	6	9	5	2	14	8.6			
4	3	4	5	10	1	7	13	13	11	4	5	19	14	6	8	18	19	5	1	9	10	1	11	14	8	4	5	2	11	8.9			
5	4	3	8	6	2	9	17	18	10	2	8	17	16	3	6	19	18	4	2	8	6	3	13	11	9	5	5	6	3	10	9.1		
6	5	3	8	8	2	9	17	18	10	2	8	17	16	3	6	19	19	5	2	8	6	3	13	11	9	5	5	6	3	12	17	9.2	
7	6	3	7	9	1	11	16	18	8	0	10	12	14	3	11	21	20	6	2	12	7	3	20	15	11	5	5	5	5	10	16	9.7	
8	7	4	10	13	4	12	19	17	8	1	8	17	16	11	12	21	23	6	2	13	8	8	28	22	14	9	5	9	16	19	13.4		
9	8	4	11	10	3	14	19	17	8	2	11	17	21	15	14	21	24	8	6	16	11	11	32	22	14	9	5	9	16	19	13.4		
10	9	7	13	13	6	16	25	17	11	22	4	18	20	18	13	14	22	22	7	15	17	12	16	27	27	21	13	7	7	20	23	14.1	
11	10	6	12	9	5	17	28	16	9	20	6	16	17	21	16	18	24	20	9	15	20	8	18	27	31	21	14	10	11	17	22	16.1	
12	11	8	15	11	8	17	28	14	10	19	6	20	18	22	15	18	24	21	8	20	16	8	18	34	30	29	11	12	10	19	25	17.1	
1	12	5	15	11	11	19	29	12	16	16	8	19	21	15	22	20	22	14	9	17	16	7	18	30	29	23	17	10	13	20	25	17.2	
2	1	1	13	10	8	17	28	12	15	15	8	21	18	16	13	26	25	21	10	16	11	5	21	29	29	20	14	11	10	18	24	16.7	
3	2	10	12	13	10	18	32	7	15	13	13	20	14	15	13	23	28	18	10	13	15	8	17	32	27	23	13	11	17	21	25	17.0	
4	3	11	13	10	8	17	28	12	16	16	9	16	15	13	13	20	27	15	10	13	10	9	1	13	28	15	14	12	6	16	20	14.7	
5	4	5	11	7	14	20	38	10	11	11	13	16	15	13	13	20	28	12	4	10	10	7	15	26	20	13	12	5	17	19	22	13.3	
6	5	4	9	6	9	20	28	10	10	10	6	16	13	14	12	14	28	12	4	10	10	9	1	13	28	15	14	12	2	13	17	20	11.8
7	6	1	10	4	9	20	28	10	10	10	5	9	12	11	9	16	22	7	8	11	6	1	13	28	15	14	12	2	13	17	20	11.6	
8	7	5	11	4	7	16	22	9	11	11	7	16	13	10	11	15	22	7	8	11	6	1	13	28	15	14	12	2	13	17	24	10.9	
9	8	1	11	4	4	8	15	19	5	9	8	6	22	13	11	9	12	19	8	7	9	5	1	15	17	11	13	11	3	11	17	24	10.9
10	9	3	14	4	3	12	19	5	9	8	6	22	12	10	10	15	24	7	5	10	10	2	19	21	10	10	10	12	4	18	18	25	11.7
11	10	1	10	4	5	16	16	8	6	4	15	15	8	18	18	18	18	5	5	10	8	2	14	15	9	7	10	2	17	16	22	10.1	
12	11																																
		111	232	198	132	319	503	315	599	130	331	398	365	248	355	519	400	162	218	278	164	280	548	461	364	242	157	230	395	615	12.9		

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28' 6" N., LONGITUDE 0° 18' 47" W.

1866.	Reduced to mean of day.					Temperature of Air.			At 9.30 A.M., 2.30 P.M., and 5 P.M., respectively.			Rain— read at 10 A.M.
Day of Month.	Barometer, corrected to Temp. 32°.*	Temperature of Air.	Calculated.			Maximum, read at 9.30 A.M. on the following day.	Minimum, read at 9.30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.		
	inches.		Dew Point.	Relative Humidity.	Tension of Vapour.							
May 1	29.470	36.0	34.2	.94	.229	41.8	38.8	3.0	10, 10, 10	NE by N, NE, NNE.	0.000	
" 2	29.573	39.9	32.3	.76	.263	48.2	36.5	11.7	10, 3, 1	NW, WSW, WNW.	.140	
" 3	29.614	41.7	37.8	.87	.280	52.8	36.9	15.9	6, 7, 4	—, WSW, WNW.	.136	
" 4	29.843	46.1	29.1	.55	.326	54.8	31.4	23.4	1, 3, 3	NNW, W by N, W by N.	.024	
" 5	30.093	48.0	40.5	.77	.348	57.7	33.6	24.1	7, 9, 7	SW, SW, SW.	.021	
" 6	...	...	...	...	...	58.6	42.5	16.1	...	...	.036	
" 7	30.219	54.9	42.2	.64	.441	62.7	45.7	17.0	2, 3, 6	S, W by S, SW by W.	.000	
" 8	30.005	53.5	40.9	.65	.420	62.6	41.1	21.5	2, 7, 9	SW by W, W, WSW.	.000	
" 9	29.770	52.6	42.7	.71	.408	62.7	47.8	14.9	10, 6, 3	W, WNW, W.	.042	
" 10	29.973	51.0	38.3	.64	.386	58.7	45.2	13.5	8, 8, 8	W, W, W.	.000	
" 11	29.624	50.4	45.3	.84	.378	62.7	49.7	13.0	10, 9, 6	SW, W, W.	.360	
" 12	29.661	46.1	41.8	.86	.326	57.1	42.4	14.7	9, 8, 7	WNW, W by N, WSW.	.025	
" 13	...	...	...	...	...	51.3	39.1	12.2	...	...	.020	
" 14	30.151	45.9	32.1	.62	.324	53.7	38.3	15.4	7, 7, 9	—, E by N, ENE.	.000	
" 15	30.344	44.0	30.8	.63	.303	50.4	35.9	14.5	7, 8, 9	NNW, NE, NE by N.	.000	
" 16	30.363	47.3	35.8	.67	.340	56.2	38.1	18.1	10, 6, 10	ENE, ESE, ESE.	.000	
" 17	30.256	54.5	40.2	.61	.435	62.5	36.1	26.4	4, 6, 2	SW by S, SE by S, —.	.000	
" 18	30.162	56.5	42.5	.62	.465	65.5	34.5	31.0	4, 4, 0	SE by E, E, E by N.	.000	
" 19	30.159	59.4	40.5	.52	.512	67.0	41.0	26.0	1, 2, 0	E by N, E, ESE.	.000	
" 20	...	...	...	...	...	63.2	41.0	22.2	...	...	.000	
" 21	30.358	51.4	39.4	.66	.391	58.8	46.7	12.1	0, 0, 0	... E, E, E, ...	.000	
" 22	30.263	50.3	31.9	.52	.377	57.7	42.2	15.5	0, 0, 0	E by N, E by N, ENE.	.000	
" 23	30.064	55.8	39.7	.57	.454	64.1	41.1	23.0	0, 2, 0	NE by N, NE, NE by N.	.000	
" 24	29.892	45.6	34.1	.67	.321	54.7	42.1	12.6	10, 7, 5	NE by E, E by N, NE by E.	.000	
" 25	29.747	49.0	30.8	.53	.361	56.7	42.3	14.4	4, 3, 2	E, ENE, E by N.	.000	
" 26	29.612	53.5	44.9	.74	.420	64.2	42.7	21.5	7, 9, 9	NE, NE by E, ENE.	.000	
" 27	...	...	...	...	...	63.7	45.3	18.4	...	...	.515	
" 28	29.806	60.0	43.7	.57	.523	68.4	43.7	24.7	0, 4, 4	SE by S, SW by S, SW.	.000	
" 29	29.811	55.0	40.1	.60	.442	64.0	41.7	22.3	0, 6, 8	NE by N, N by W, N.	.000	
" 30	29.882	52.4	38.7	.62	.405	61.7	39.1	22.6	3, 10, 9	E by S, NE, E.	.000	
" 31	29.690	54.7	45.8	.74	.438	63.6	49.4	14.2	10, 10, 10	SE by S, E by S, ESE.	.000	
Daily Means. }	29.941	50.2	38.4	.67	.382	...	...	17.9	...	...	1.319	

* To obtain the Barometric pressure at the sea-level these numbers must be increased by .037 inch.

HOURLY MOVEMENT OF THE WIND (IN MILES), AS RECORDED BY ROBINSON'S ANEMOMETER.—MAY, 1866.

Day.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Hourly Means.			
Hour.	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	
A. M.	26	13	3	5	5	5	7	5	11	9	7	17	7	2	3	4	1	2	6	4	13	9	11	6	14	18	6	7	4	7	19	19	8.2		
	12	1	2	3	5	5	2	5	14	11	9	16	7	2	5	2	2	2	6	2	12	11	11	4	13	17	9	4	4	1	2	19	8.0		
	27	12	10	4	2	5	3	2	5	12	10	13	15	4	1	6	1	3	2	4	2	11	10	8	9	12	14	12	1	2	19	7.4			
	28	9	4	0	2	3	3	1	4	13	10	13	14	5	1	6	2	1	1	2	2	9	11	8	14	12	11	5	4	2	2	20	7.0		
	29	10	4	0	3	3	3	1	3	14	8	19	15	6	3	5	3	3	4	3	5	11	10	7	12	10	13	10	3	3	2	17	7.2		
	30	4	3	1	2	2	3	3	1	5	12	10	20	15	7	1	2	2	2	8	5	12	9	4	11	15	14	2	1	2	2	15	8.9		
	1	19	8	4	1	4	3	3	4	12	16	24	15	12	0	9	2	3	2	4	8	16	15	7	15	21	16	2	1	2	1	15	11.1		
	2	22	11	6	2	14	4	4	4	5	11	15	22	14	15	1	4	4	5	6	12	24	23	8	19	28	15	5	3	3	2	15	11.4		
	3	25	9	6	3	16	4	4	5	13	9	17	17	17	3	12	7	6	7	12	20	27	12	10	20	28	14	6	8	6	3	13	11.4		
	4	26	12	7	3	16	4	5	13	9	17	17	17	17	3	12	7	6	7	12	20	27	12	10	20	28	14	6	8	8	3	12	12.4		
	5	28	11	7	3	16	4	5	13	9	17	17	17	17	3	12	7	6	7	12	20	27	12	10	20	28	14	6	8	8	3	12	12.4		
	6	29	12	7	3	16	4	5	13	9	17	17	17	17	3	12	7	6	7	12	20	27	12	10	20	28	14	6	8	8	3	12	12.4		
P. M.	7	20	11	8	17	6	6	15	13	16	20	16	14	10	11	8	5	8	14	19	30	32	15	25	25	13	6	9	10	6	12	13.0	13.0		
	8	20	11	8	17	6	6	15	13	16	20	16	14	10	11	8	5	8	14	19	30	32	15	25	25	13	6	9	10	6	12	13.0	13.0		
	9	20	11	8	17	6	6	15	13	16	20	16	14	10	11	8	5	8	14	19	30	32	15	25	25	13	6	9	10	6	12	13.0	13.0		
	10	20	11	8	17	6	6	15	13	16	20	16	14	10	11	8	5	8	14	19	30	32	15	25	25	13	6	9	10	6	12	13.0	13.0		
	11	20	11	8	17	6	6	15	13	16	20	16	14	10	11	8	5	8	14	19	30	32	15	25	25	13	6	9	10	6	12	13.0	13.0		
	12	20	11	8	17	6	6	15	13	16	20	16	14	10	11	8	5	8	14	19	30	32	15	25	25	13	6	9	10	6	12	13.0	13.0		
	1	20	10	13	10	20	4	6	16	15	13	21	13	15	10	10	5	6	11	16	22	30	31	15	25	25	13	6	9	10	13	9	16	14.6	
	2	20	10	13	10	20	4	6	16	15	13	21	13	15	10	10	5	6	11	16	22	30	31	15	25	25	13	6	9	10	13	9	16	14.6	
	3	17	8	13	8	13	8	13	13	12	19	14	25	19	11	11	12	10	5	11	16	24	32	29	15	25	27	15	8	10	14	8	15	14.8	
	4	17	8	13	8	13	8	13	13	12	19	14	25	19	11	11	12	10	5	11	16	24	32	29	15	25	27	15	8	10	14	8	15	14.8	
	5	16	5	9	13	12	5	11	1	15	18	10	21	11	8	12	7	6	7	18	12	22	25	25	13	13	22	22	13	5	10	11	16	10	14.8
	6	16	4	3	3	5	11	1	8	15	18	10	21	11	8	12	7	6	7	18	12	22	25	25	13	13	22	22	13	5	10	11	16	10	14.8
7	16	4	3	3	5	11	1	8	15	18	10	21	11	8	12	7	6	7	18	12	22	25	25	13	13	22	22	13	5	10	11	16	10	14.8	
8	14	3	2	2	6	11	1	8	14	16	13	19	9	7	8	10	5	11	11	19	17	18	13	13	22	22	13	5	10	11	16	10	14.8		
9	13	3	3	4	5	6	0	6	11	10	18	9	8	7	8	8	5	11	7	15	18	21	3	16	17	7	9	4	8	17	8	9	9.4		
10	14	2	2	4	5	6	1	6	11	11	5	16	8	7	7	5	9	4	10	6	15	18	5	15	13	4	6	3	7	20	11	9	8.5		
11	14	2	2	4	5	6	1	6	11	11	5	16	8	7	7	5	9	4	10	6	15	18	5	15	13	4	6	3	7	20	11	9	8.5		
12	13	2	4	5	5	5	2	4	10	8	6	16	7	1	4	5	5	6	5	14	16	12	6	15	18	4	15	4	6	15	9	9	7.9		
Total Daily Movement.	473	187	158	123	255	85	114	242	307	286	448	330	220	129	202	152	106	173	209	364	499	497	233	420	501	327	159	140	171	201	324	10.8			

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE
KEW OBSERVATORY.

LATITUDE 51° 28' 6" N., LONGITUDE 0° 18' 47" W.

1866.	Reduced to mean of day.				Temperature of Air.			At 9.30 A.M., 2.30 P.M., and 5 P.M. respectively.			Rain— read at 10 A.M.	
Day of Month.	Barometer corrected to Temp. 32°.	Temperature of Air.	Calculated.			Maximum, read at 9.30 A.M. on the following day.	Minimum, read at 9.30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.		
			Dew Point.	Relative Humidity.	Tension of Vapour.							
	inches.	°	°	inch.	°	°	°	°	0—10		inches.	
June 1	29.657	54.8	51.4	.88	.439	66.0	50.6	15.4	6, 10, 8	SE, E by S, ENE.	—	
" 2	29.854	61.7	46.8	.60	.553	71.5	51.4	20.1	3, 5, 1	SSW, E by N, ESE.	0.030	
" 3	...	...	...	...	...	76.4	55.2	21.2	...	...	.000	
" 4	29.838	57.8	55.5	.92	.485	68.7	55.4	13.3	6, 10, 10	SW, WSW, SW.	.424	
" 5	29.874	52.2	49.4	.91	.402	62.5	51.7	10.8	10, 9, 9	S by E, S, S.	1.100	
" 6	30.045	53.4	48.6	.85	.419	63.1	51.4	11.7	10, 9, 6	SSW, SW, S by W.	.039	
" 7	30.125	59.1	54.7	.86	.507	71.8	53.2	18.6	10, 8, 8	SSE, SW, SW.	.004	
" 8	30.217	66.2	55.6	.70	.642	75.2	49.9	25.3	5, 7, 3	SW by S, W by N, S by W.	.000	
" 9	30.187	68.8	56.0	.65	.699	80.3	49.4	30.9	4, 4, 9	SSE, SSW, SW by S.	.000	
" 10	...	...	...	...	...	78.6	58.9	19.7	...	...	.000	
" 11	30.022	56.5	48.0	.75	.465	66.8	48.3	18.5	7, 8, 9	NW by W, SSW, SSW.	.000	
" 12	29.631	52.2	50.7	.95	.402	62.5	53.6	8.9	10, 10, 10	SW by S, SW, S.	.000	
" 13	29.771	51.3	49.1	.93	.390	60.1	49.8	10.3	10, 10, 10	W by S, WNW, —.	.019	
" 14	29.969	56.7	50.3	.81	.468	65.7	46.7	19.0	10, 9, 7	W, W, W.	.196	
" 15	29.910	56.3	54.0	.92	.462	66.8	47.2	19.6	10, 10, 10	SW, SW, SW by W.	.000	
" 16	29.687	54.0	40.1	.62	.427	64.5	51.3	13.2	7, 7, 3	SW, WNW, W by N.	.000	
" 17	...	...	...	...	...	60.7	41.7	19.0	...	...	.101	
" 18	29.547	49.7	50.4	1.00	.369	62.8	45.1	17.7	10, 10, 9	W, S, SW.	.074	
" 19	29.681	55.5	47.4	.76	.450	64.8	51.0	13.8	9, 8, 7	W, SW, W by N.	.038	
" 20	30.038	55.9	52.0	.85	.455	71.3	43.6	27.7	10, 10, 10	S. SSE, S.	.014	
" 21	29.863	66.2	55.8	.71	.642	76.1	54.0	12.1	7, 7, 8	SW, SW by S, S.	.004	
" 22	29.933	61.7	49.1	.66	.553	71.6	56.8	14.8	3, 3, 2	W by N, W, WNW.	.861	
" 23	30.118	64.0	53.8	.71	.597	74.8	49.7	25.1	10, 3, 3	SW, E by N, ENE.	.000	
" 24	...	...	...	...	...	70.3	52.9	17.4	...	...	.000	
" 25	30.081	61.9	57.4	.86	.557	72.2	50.5	21.7	10, 9, 5	NE by N, NE, NE by N.	.000	
" 26	30.018	68.4	54.3	.62	.690	76.8	56.6	20.2	0, 1, 0	E by N, E by N, E by N.	.000	
" 27	29.882	65.0	61.0	.88	.617	79.5	58.0	21.5	3, 5, 5	NE by N, W, —.	.000	
" 28	29.948	68.6	56.1	.66	.694	80.8	58.9	22.9	1, 4, 8	—, —, —.	.257	
" 29	29.960	62.8	57.4	.83	.574	74.3	58.8	15.5	10, 7, 7	NNW, NE, N.	.000	
" 30	29.777	64.4	58.2	.81	.605	78.8	56.8	22.0	3, 9, 6	SW by S, N by W, NNW.	.000	
Daily Means.	29.909	59.4	52.4	.76	.521	...	...	18.3	...	...	...	3.161

* To obtain the Barometric pressure at the sea-level these numbers must be increased by .037 inch.

HOURLY MOVEMENT OF THE WIND (IN MILES), AS RECORDED BY ROBINSON'S ANEMOMETER.—JUNE, 1866.

Day.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hourly Means.						
Hour.	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
A.M.	10	6	11	2	15	15	7	2	1	2	14	10	9	2	6	5	13	8	7	3	2	2	2	10	2	7	13	5	4	4	4	4	6	0	6	0	
P.M.	10	6	10	2	10	15	5	1	1	3	10	10	9	4	4	6	15	6	6	5	5	3	3	7	3	3	7	11	2	7	7	0	0	5	8		
	6	6	10	4	11	16	5	2	2	2	1	7	4	4	5	3	15	6	6	5	3	2	3	7	3	3	8	9	2	7	0	0	5	8			
	6	6	12	4	6	16	6	2	2	1	6	8	13	3	5	2	17	7	6	4	2	2	3	5	5	6	6	4	9	1	2	2	1	6	0		
	5	7	13	4	6	14	6	1	2	4	3	4	15	3	5	5	15	10	10	1	6	4	2	6	9	6	6	4	7	7	2	2	3	6	3		
	3	7	13	2	7	15	6	4	1	2	4	14	13	3	5	5	15	12	12	1	2	8	9	4	1	7	6	8	4	10	3	3	2	7	8		
	3	7	11	4	13	16	9	1	2	4	3	14	15	4	13	5	15	10	11	1	2	8	9	4	1	7	6	8	4	10	3	3	2	7	8		
	8	4	11	3	14	16	11	8	2	5	10	4	16	17	5	13	10	23	11	10	14	8	4	4	11	10	9	8	5	10	5	5	10	0	6		
	9	4	11	6	16	17	11	7	1	7	3	14	17	5	13	10	23	11	10	14	8	4	4	11	10	9	8	5	10	5	5	10	0	6			
	8	5	11	3	14	16	11	9	5	10	2	17	14	6	15	12	21	18	21	10	14	4	4	11	11	11	10	9	8	5	10	5	5	10	0		
	7	10	14	6	17	19	13	13	6	17	10	18	11	8	20	17	23	21	21	8	18	10	6	18	11	15	10	6	12	8	9	13	2	8	12		
	5	9	14	6	21	19	15	9	8	13	12	20	9	7	15	19	21	27	23	13	18	10	6	17	12	19	13	7	9	8	7	14	13	9	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18	25	25	17	17	10	3	18	11	18	18	4	7	7	7	8	13	6	13		
	12	9	7	10	23	20	15	11	6	16	13	16	10	10	15	19	18																				

ARCHÆOLOGIA.

ANOTHER example of the primitive CANOE has lately been found in WHETTALL MOSS, about three miles from Ellesmere, in Shropshire, in the course of some extensive excavations for agricultural drainage on the estate of Earl Brownlow. As the men were employed in cutting a main drain, they came upon this canoe, at about six feet below the surface. A large birch tree was growing over it. The canoe was found in tolerably perfect condition. It is eleven feet long by two feet five inches wide, and one foot four inches deep. A considerable number of similar canoes, usually about the same dimensions, have now been found in different parts of Britain, but never in such immediate connection with relics of known date as to enable us to fix the period or periods to which they belong. Our own opinion is that, for the most part, they are by no means necessarily of so remote a date as has sometimes been ascribed to them.

A rather interesting sample of a Roman TESSELATED PAVEMENT has been found in the churchyard of CAERLEON, the site of the *Isca Silurum* of the Romans. It was carefully taken up, and removed into the museum of the Caerleon Antiquarian Society, where it will be preserved. It offers a good specimen of the labyrinthine, or maze, pattern, of which other examples might be pointed out. This is not the only instance in Britain of a fine tessellated pavement being found under a churchyard, a position no doubt arising from the circumstance that at the time the church was first built, the builders selected a spot which had been occupied by a previous building of some extent, such as a Roman villa, the ruins of which furnished them with plenty of building materials ready at hand; and the ground covering the pavements of some of the larger rooms offered a clear space which would serve conveniently for the churchyard. This was the case with the principal apartment of the extensive villa at Woodchester, in Gloucestershire, the pavement of which lies under the modern church and churchyard, in consequence of which the mosaic work has been cut through and broken up in all parts by the sinking of graves.

SOME ANGLO-SAXON ANTIQUITIES, found in excavations in Leicester and the neighbourhood, have recently been laid before the Leicestershire Architectural and Archæological Society. The more remarkable of these relics were discovered in the parish of Glen Parva, some four miles from Leicester, in a grave containing a skeleton which is assumed, from the objects found with it, to be that of a Saxon lady. There were two bronze pendants, perhaps part of a sort of chatelaine which is often found in such graves, and appears to have been suspended to the lady's waist; three bronze fibulæ; part of an article made of bone, supposed to be an amulet; two flat pieces of bone, with corresponding rivet-holes, and one bone rivet remaining, apparently belonging to the handle of a knife; a drinking vessel of thin glass, which was broken to pieces in taking it out of the earth; two large finger rings; several beads, of glass and

other material; and a crystal ornament, cut in facets like a diamond, and drilled through, which measures in its horizontal diameter nearly two inches, and in its transverse diameter not quite an inch and a half. There was also found in this grave the claw of an animal, pierced through, evidently for suspension on the person.

T. W.

The Rev. W. Kilbride, vicar of Aran, and G. H. Kinahan, F.R.G.S.I., of the Geological Survey of Ireland, have recently discovered the sites of two ancient settlements on the Islands of Aran, County Galway. The settlement on Inish More, the largest of the islands, consists of eight Cloghauns, or dry stone cells with "beehive roofs;" fifteen Cnocāns, or dry stone beehive cells covered with clay; four Fosleac, or cells built of and roofed with flags; four Ointigh, or dry stone cells that had not beehive roofs; two Doons, and one Cashel. The settlement on Inish-Maan, the centre island, consists of thirteen Cnocāns and Cloghauns and one small Doon.

PROGRESS OF INVENTION.

NEW REGULATOR OF VELOCITY.—Motion is rarely obtained continuously from any source in such a state of uniformity, as the purpose for which it is destined requires. Hence ingenuity has devised a number of contrivances which, if they, in no case render the motion perfectly uniform, in most they regulate it with sufficient precision for the attainment of the intended object. The regulators used with chronometrical instruments give rise to periodic alternations of rest and motion; which though objectionable from the necessity of alternately destroying motion and overcoming inertia, is found to comply sufficiently with the conditions which are to be fulfilled. Such regulators, it is obvious, would be inapplicable where interruption of motion is inadmissible; and hence regulators, founded on different principles, are then indispensable. It might be supposed that friction would answer the purpose of absorbing the excess of motion which would produce augmented velocity; but such is not the case, as the circumstances which give rise to friction are so various, and so little under control; and hence it is never used as a means of regulation, when great exactness is required. The resistance of the air affords a more suitable mode of regulation. As the resistance offered by the air to any surface moving in it, is proportionable to the square of the velocity, it is clear that the resistance increases much more rapidly than the velocity; and that the velocity of any body having a large surface will be but little affected by slight variations in the power. It will, however, be affected; and hence absolutely uniform motion is unattainable when the regulator consists of revolving vanes. The happy idea occurred to M. Leon Foucault, of combining with the principle of revolving vanes that of the centrifugal governor used with the steam engine, etc.: and the result is a regulator of great simplicity, which affords a motion

that may be considered absolutely uniform. In this apparatus, the rods and balls of the centrifugal governor are replaced by oblong triangular thin plates of metal, constituting vanes, which are hinged by their vertices to the revolving upright spindle, and move in the same vertical plane. They are prevented from flying out to their full extent by slight increments in the velocity of rotation, by spiral springs which, being fixed to their centres of gravity, are the causes of no disturbing influence. When the velocity is that which is required, the resistance offered by these vanes, as they hang down along the revolving spindle suffices to absorb the excess of motion, so as to prevent the velocity from becoming accelerated; but the slightest increase of velocity causes them to fly asunder by means of centrifugal force, and to an extent which depends on the increase of velocity. As the distance of the vanes, and especially of their broader portions, from the axis of motion is increased, the resistance they experience from air, which has also been augmented by the increased velocity, is increased; and hence equilibrium is soon established between the disturbing and controlling agents. The velocity which this apparatus will permit is entirely under control; since it depends on the size of the vanes, the quantity of matter they contain, and the relative power of the springs. When one velocity is to be changed into a very different one from that previously required, it is necessary to change the springs; but when the desired alteration is inconsiderable, movable metallic masses, are merely slipped up and down along the vanes by means of screws, so as to alter their distance from the axis of motion, when the vanes fly apart. This affords an easy mode of regulation to any velocity desired. So accurate is the adjustment of velocity obtained by this contrivance that power may be taken for any required purpose from a clock regulated by it, without disturbing the accuracy of the rate of going.

A NEW AND EXTREMELY POWERFUL ELECTRICAL APPARATUS.—The production of electrical currents by means of magnetism, or electro-magnetism, is used by Mr. Wild of Manchester for the obtaining of enormous quantities of electricity, by means of a contrivance which, considering its vast power, is neither complicated nor expensive. He was led to the invention of this apparatus, by discovering a mode of utilizing the important fact ascertained a considerable time since by M. Seguin, that a very large quantity of electricity may be developed in an electro-magnet by a permanent magnet of very small power. As an electro-magnet possesses all the properties of a permanent magnet, the effect thus obtained can, of course, be multiplied to any extent, by successive elements added to the apparatus; but it was found that the principle repeated three times, that is by the use of three elements; afforded quantities of electricity quite as large as could be desired. Each element of this apparatus consists of one or more, either permanent or electro-horse-shoe magnets, and a kind of cylinder within which revolves an armature. The cylinder, or rather the cylindroid, which has four flattened sides, constituting a kind of quadrangular prism, having rounded corners parallel to its length,

consists of two plates of cast iron, placed opposite to each other, and united by two plates of brass. In the ends, which are of some non-magnetic substance, are small circular apertures, that allow an armature to revolve in the axis of the cylindroid. This armature is a cylinder of iron, down the two sides and across the ends of which are deep grooves, within which is wound a helix, formed of copper wire 0.03 of an inch in diameter, and about 160 feet in length. When the cylindroid is placed between the poles of a magnet, so that the latter are in good contact with the cast-iron plates, and the armature is made to revolve, it is evident that two opposite electric currents are formed in its helix during each revolution of the armature. All the currents may, by means of a commutator, be made to pass in one direction, and when the rotation is very rapid, the amount of electricity produced by even a single, permanent magnet, is very great; but every additional magnet placed on the cylindroid causes the addition of an equal effect. If the electric current thus obtained is made to excite one or more electro-magnets, the poles of which are in contact with a cylindroid similar to the first, and the two armatures are made to revolve rapidly, the effect becomes very considerable. And if the second current is transmitted through the helices of other electro-magnets, the poles of which are in contact with a third cylindroid, the third secondary current thus obtained is of great power. With four permanent magnets, each only one pound in weight on the first cylindroid, the armatures in the first two cylindroids being two inches and half in diameter, and that in the third cylindroid ten inches, a current was obtained which, with carbon electrodes, and a parabolic reflector, produced so intense a light on the top of a lofty building at night, that shadows were projected by the flames of street-lamps a quarter of a mile distant. The calorific power of the apparatus sufficed to melt an iron rod a quarter of an inch in diameter, and copper wire 0.125 of an inch in diameter; and to keep twenty-one feet of iron wire 0.065 of an inch in diameter at a red heat. This instrument seems applicable to lighthouses and numerous other practical purposes; since it is neither very large nor very costly, and the only expense its working entails is the rotation of the armatures, which should each make about 3000 revolutions per minute. Its effects at first sight would appear at variance with the ordinary laws of the conservation of force; but all difficulty will vanish if we remember that the machine is merely an apparatus for changing rotary motions into electricity. In many cases, the motion required may conveniently be obtained from a steam engine.

PEROXIDE OF HYDROGEN.—This curious compound, which is every day being applied to new uses, and is likely to become a very valuable agent in the hands both of the philosopher and the manufacturer, may, as Schönbein has discovered, be prepared with great facility, by agitating in a large receiver, into which the air has free access, amalgamated zinc in powder and distilled water. The oxygen of the air combines both with the zinc and water, oxide of zinc and peroxide of hydrogen being formed. The peroxide of

hydrogen does not contain a trace of either zinc or mercury ; and being quite free from acid, it remains for a long time without decomposing.

IMPROVED ELECTROTYPE PROCESS.—Christoffe and Bouillet, of Paris, have introduced three great improvements into the electrotype process. They add to the silver bath sulphuret of carbon, or an alkaline sulphuret, which produces a small quantity of sulphuret of silver ; and this, for some reason not yet explained, causes the silver deposit to be, not dim and lustreless, but as brilliant as if it had been carefully burnished. They add to the sulphate of copper bath a moderate quantity of gelatine, which, for some reason, also as yet unexplained, causes the copper deposit to be as compact and dense as the very best rolled sheet copper. And lastly, they secure very great economy, by attaching plates of lead to the platinum wire, which forms the interior skeleton of the mould used for the production of articles in relief. The results produced by this modification of M. Lenoir's process affords products yet more perfect than those obtained by casting and chasing.

REPRODUCTION OF DESIGNS ON GLASS.—The decoration of porcelain with designs embracing every grade of excellence, and at a very trifling cost, compared with the beauty of the products, has long been practised in this and other countries. But, hitherto, glass appeared to be incapable of receiving any kind of ornamentation except by methods tedious, difficult, and expensive. It is likely, however, that such is now no longer the case, as a process has been invented in France, by means of which engravings are transferred to glass with nearly the same facility as they have hitherto been transferred to ceramic products. In the case of porcelain, fine lined copper plate engravings on tissue paper are applied to the surface of the article, the engraved side inwards ; and the paper having been washed away, the lines of the engraving which still adhere to the porcelain are permanently attached by firing and glazing. In the case of glass, this process requires to be modified ; a fine lined engraving would not answer, and hence, one having lines of sufficient depth is used. Also, stearates and oleates are added to the silicates and borosilicates, which are intended to support, or to fuse the coloured or colouring oxides, for the purpose of giving to the enamels the thickness which glass requires them to have ; and a solution of resin in ether or benzine is added. The engravings on paper are produced by means of engraved rollers ; and, after having been treated very much in the same way as with porcelain, the glass is placed in the furnace, and thus the most beautiful results are obtained with certainty, ease, and economy.

OXYGEN IN A DIFFERENT STATE IN DIFFERENT PEROXIDES.—Our knowledge regarding the different conditions in which oxygen may exist is receiving constantly new accessions. Not the least important of these is the fact recently discovered, that the oxygen in the peroxide of manganese is in a very different state from that in the peroxide of barium : a circumstance which is strongly confirmative of the theory of Schönbein, that oxygen may exist in two opposite states, which he has termed *ozone* and *antozone*, oxygen in its ordi-

nary state being a combination of both. It has been proved by recent researches that the oxygen in peroxide of barium is in the form of ozone, and that in the peroxide of manganese in the form of antozone. The consequences which follow from these discoveries are of a most interesting description: since if the two kinds of oxygen enter into combination, it is probable that the elements with which they combine exist in two allotropic states; and the inference may indeed be extended indefinitely, so as to lead to a belief that also all the elements, and perhaps all their compounds, are capable of existing in two opposite allotropic states. The facts which demonstrate that the oxygen elements in the peroxides of barium and manganese are in very different states, are very remarkable, and are such as admit of no doubt. Thus the oxygen in the peroxide of barium has a less affinity for hydrogen than chlorine, since, when it is acted on by the latter, hydrochloric acid will be formed, oxygen being given off; while on the contrary, hydrochloric acid is decomposed by peroxide of manganese, chlorine being evolved. It is worthy of remark that the oxygen given off by the peroxide of barium is in the form of ozone. Again, if peroxide of barium is treated with hydrochloric acid, peroxide of hydrogen will be formed; but if peroxide of manganese is treated with the same acid, ordinarily, water will be formed, and chlorine evolved. Sulphovinic acid, if heated in presence of peroxide of barium, affords ether, bicarburet of hydrogen, and sulphurous acid; but if in presence of peroxide of manganese, aldehyde. Peroxide of hydrogen may be formed by means of either peroxide of barium or peroxide of manganese; but the two peroxides of hydrogen thus obtained are very different, since each will be decomposed by the peroxide employed in forming the other; and, what is still more remarkable, they will decompose each other.

MISCELLANEOUS.—*Damping Apparatus for Copying.*—In copying letters, the most troublesome portion of the process consists in damping the paper: this is greatly facilitated by means of a simple apparatus recently invented in Germany. It consists of a hollow perforated roller covered with linen, and rotating on a tube connected with the handle, which serves as a reservoir for water. When the roller is in use, the water flows from the handle into the tube, thence into the perforated roller, and thus the linen is kept wet while being rolled over the paper. When the instrument is not required, it is left in such a position as causes the water to flow back into the handle.—*Purification of Water.*—There is good reason to believe, from certain experiments recently made, that any kind of water may be freed, not only from the impurities it contains in suspension, but also those it holds in solution, and may thus be made fit for drinking, by adding to it a very small amount of a solution of permanganate of potash, and then filtering it through a layer of magnetic oxide of iron and carbon, a few inches thick. The required mixture may be obtained by heating in a close vessel red oligist ore and a small quantity of sawdust.—*Petroleum as Fuel.*—In the ordinary modes of using petroleum as fuel, there is very frequently produced a very large quantity of black smoke,

which not only is very offensive, but a source of great waste. This is entirely prevented by mixing superheated steam with the petroleum vapour, as has been done for some time past in America, and more lately at Woolwich Dockyard; which causes the smoke instantly to disappear, and the whole fire-place and tubes to be filled with a bright white flame. We need not remark that the decomposed water causes no addition to the total amount of heat, since water absorbs the same quantity of heat during decomposition as its elements afterwards give out during combination. The economy arises from the waste of a large part of the fuel, as smoke, being prevented.—*New mode of fixing Photographic Prints.*—Chloride of sodium (common salt) was one of the very first fixing agents employed; it was used by Daguerreotypists before Sir John Herschel's discovery that hyposulphite of soda is better suited for the purpose was generally known. A slight modification in the use of it renders it, however, all that can be desired as a fixing agent. The prints, when taken out of the frame, are to be placed for some time in a solution containing five per cent. chloride of it, and the solution is then to be raised to the boiling point, and left at it for about ten minutes. The prints may then be removed and washed, and the pictures will be found completely fixed.——*New Mode of Utilizing Combustible Fluids as Fuel.*—For this purpose a lamp is used in which the turpentine, or other combustible fluid, is reduced to a fine dust by an apparatus, which the inventor, a Russian professor, terms a "pulveriser." The flame produced by means of this is of great size and power, and of a whitish-yellow colour. The heat it emits is so intense as to melt steel. The contrivance is certainly not so economical as the ordinary furnace; but it is expected that, for many purposes, this will be far more than counterbalanced by its convenience and power.

NOTES AND MEMORANDA.

THE DHURMSALLA METEORIC STONE.—A paper in *Proceedings of Royal Society*, by Professor Haughton, states that on the 14th July, 1860, at 2.15 P.M., a remarkable meteoric stone fell at Dhurmsalla, and that the cold of the fragments that fell was so intense as to benumb the hands of the coolies who picked them up. A fragment they sent to the museum of Trinity College, Dublin, was analyzed by Professor Haughton, who found 100 parts to contain nickel iron 8.42, proto-sulphuret of iron 5.61, chrome iron 4.16, chrysolite (peridot or olivine) 47.67, and minerals insoluble in muriatic acid 34.14. The proportion of chrome is unusually large.

NEW MARINE WORM (*Phenacia pulchella*).—Mr. Edward Parfitt describes, in *Annals of Natural History*, No. 103, a new species of marine worm thrown up by the sea at Exmouth on 6th January during a heavy gale. It inhabits a thin, flexuous, horny tube, three inches long. The worm itself is two inches long, the body composed of forty annulations, the anterior of which were armed with two fascicles of yellow bristles of about three or four each, placed opposite to each other. The rest of the rings have about two each, but the numbers vary. Colour pale orange, red mouth with a purple cast. Buccal cirri twenty, white, beautifully

maculated with oblong spots of orange, red down the centre. Dorsal cirri reflexed purple, with faint reddish tinge.

IODINE DISSOLVES GOLD.—M. Nickles states, in *Comptes Rendus*, that if iodine, water, and gold leaf, are heated in a tube to 50° C. (122° F.) the gold is dissolved. Ether may be substituted for water, and the action will take place on exposure to strong sunshine. The filtered solution deposits a film of gold on evaporation, if the heat at the end of the operation is sufficient to decompose the iodide of gold which is deposited. Sesqui-iodides and bromides of iron likewise dissolve gold.

SIZE AND LIFE OF A MAMMOTH TREE (*Sequoia gigantea*).—M. A. De Candolle, giving an account to the French Academy of the recent Botanical Congress in London, stated that an exact measurement of one of the mammoth trees of California, the "old maid," which was blown down in a storm a few years since, had been made by Mr. Edmond De la Rue. It was found to be twenty-six feet five inches and nine lines, six feet above the ground. Mr. De la Rue traced the annual layers on a sheet of paper which M. de Candolle exhibited, and it was found that the layers amounted to 1234.

VOLCANIC EMANATIONS AND DISEASE.—M. de Corogna states to the French Academy that in districts towards which the winds blow the gaseous matter given off by the eruption at Santorin, inflammations of the eye, bronchitis, and digestive derangements have been frequent, while other districts have not suffered in the same way. Asphodels, and generally, plants of the lily tribe have been injured. He ascribes the human maladies of indigestion, etc., chiefly to sulphuretted hydrogen, and the vegetable disorders to hydrochloric acid vapours. The ophthalmia is traceable to volcanic dust.

THE ZODIACAL LIGHT.—M. Liandier has a note in *Comptes Rendus* stating that for several years he has watched the zodiacal light during the evenings of February and March. This year, for the first time, he saw it on the 19th of January, and watched it till the 5th of May. He considers it to have the shape of a perfect cone, varying in luminosity and colour from dull grey to silvery white, the changing aspect probably being occasioned by the condition of our atmosphere. In February the summit of the cone reached the Pleiades, and the Twins in May. Between January and May he found it to follow the zodiacal movements of the sun. He believes the luminous cone to be a fragment of an immense atmosphere enveloping the sun on all sides. If so, he says it may be expected to exercise an enormous pressure on the sun, with great development of heat; and if local variations occur, he thinks they may explain the occurrence of spots through the reduction of temperature that would follow diminished pressure.

EFFECTS OF INCREASE OF SUN'S MASS.—On the 1st September, 1859, Mr. Carrington and Mr. Hodgson witnessed a sudden blazing up in the sun, which is supposed to have indicated the fall of an extraneous body into our luminary, and a consequent accession to his mass. In *Monthly Notices*, vol. xvi., No. 8, recently issued, will be found a mathematical paper computing the effects of the fall into the sun of such a body as our earth, which some persons suppose would produce such a blaze as to scorch up all the planets. Mr. Waterston finds that if the blaze so occasioned were persistent, the general rise of temperature would not exceed 10° or 15°, but he observes that as soon as the falling body had plunged below the atmosphere into the fluid incandescent body of the sun, the blaze would terminate, though the temperature of that part of the sun would be sensibly increased. If the whole potential radiating power of the sun were increased 1000°, he says, "even this is only one twelve-thousandth part of the potential temperature that sends heat to us sufficient to maintain a general average temperature over the surface of the earth of about 500° above the absolute zero of space. Now this proportion of 500° is only one twenty-fourth of a degree, and this is the extreme maximum effect that can be reasonably expected from such a planet fall." But increase of the sun's mass would shorten the year, and the addition of matter equal to our globe would effect this to the extent of 130", causing a difference in the longitude of the sun at the end of the first year equal to 5'·3.

PRISMS AND SILVERED FLATS FOR TELESCOPES.—A paper by Mr. Browning will be found in *Monthly Notices*, comparing the action of a prism and a silvered flat when used with the glass reflecting telescopes. The prism he finds to reflect more light, as might have been expected, and he found that when a prism and a flat, placed side by side, threw down two pencils of the light from a paraffin lamp, that the circle of light from the prism looked *white*, while the other was strongly tintured with a reddish chocolate colour. We have made experiments with prisms and flats fully according with Mr. Browning's results. The prisms, if accurate in form, are far superior to the silvered flats in light and colour, and quite equal to them in point of definition. Mr. Browning exhibited to the Astronomical Society a fine prism made for Mr. De la Rue.

FUNGUS IN A TREE.—The *Archives des Sciences* has an account of a paper by Signor Gasparini, in which he states that a fine *Acacia dealbata* from New Holland, when in full flower in a garden at Naples, was broken through its stem by a slight blast of wind. It was found that the heart wood was black and rotten, and microscopic examination revealed the mycelium threads of a fungus. The medullary rays, pith, and spiral vessels were not attacked, but the dotted vessels (*vaisseaux ponctués*) were so. Signor Gasparini considered that the spores of the fungus had introduced themselves through the rootlets. He states that when the spangioles have been broken in plants of the lily tribe, spores have found entrance, and occasioned damage.

STRANGE EFFECT OF LIGHTNING.—*Cosmos* states, on the authority of M. Saillant, that on May 15 an oak was struck by lightning in the forest of Vibraye (Sarthe) at about two-thirds of its height, at the origin of the large branches. The upper third, comprehending the crown and its branches, was not touched, but the remainder of the tree was split to shivers, and dispersed in all directions. No vestige was found of the bark, the root was partly torn up, and a heavy fragment hurled more than fifty paces. "The most curious thing is that the top of the tree was stuck in the ground, just where the original trunk was, so that the trunk and roots must have been swept away the time the tree-top took in falling."

ACHROMATIC EYE-PIECES FOR TELESCOPES.—For ordinary use the Huyghenian eyepiece will probably remain the favourite for achromatic telescopes, though for extent of field Horne and Thornthwaite's aplanatics are preferable. For reflecting telescopes, now coming into more general use since the success attained by Mr. With and Mr. Browning in making and mounting the silvered glass mirrors, the Huyghenian eye-piece scarcely works as well as it does with the achromatic. In the latter case the Huyghenian eye-piece corrects errors which do not exist in reflectors. Mr. Browning has constructed a series of achromatic eye-pieces to work with the silvered glass reflectors, and, after giving them many trials, they appear to us decidedly advantageous where smallness of field is not objectionable. If a good Huyghenian eye-piece is employed on Saturn or Jupiter, and then an achromatic of the same power, a noticeable improvement in definition is obtained. Thus the divisions in Saturn's ring can be seen with the achromatic eye-piece when the Huyghenian will scarcely indicate them. We recommend those who possess reflectors to try Mr. Browning's achromatic eye-pieces.





ARISAEMA VEITCHIANUM.

THE INTELLECTUAL OBSERVER.

SEPTEMBER, 1866.

LADIES' SLIPPERS.

BY SHIRLEY HIBBERD.

(With Coloured Plate of *Cypripedium Veitchianum*.)

THE ladies' slippers are at once the least interesting of all known orchids with those who cultivate solely with a view to their decorative uses, and the securing of special variations from types; but the most interesting to those who give attention to organic structure, and physiology, and botanical distinctions. While both parties rejoice in their exquisite beauty, the first is oftentimes wearied with their stubborn adherence to settled forms and colours, and the apparent impossibility of altering their forms by hybridization, the philosophic observer finds in them solutions of problems in phytology, and exceptions to the prevailing details of orchid structure that render them perpetually entertaining and attractive. In common with the majority of orchids now in cultivation, they have not long enjoyed the favour of cultivators, for the simple reason that until lately very few were known. One of them, the common ladies' slipper, *C. calceolus*, is a native of Britain, though very rarely to be found growing wild at the present day; and of all the rest it may be said that we have so recently become acquainted with them that very much pertaining to their history has the charm of novelty added to peculiarity of structure. In the *Hortus Kewensis*, of 1810, only six species of *Cypripedium* are entered as being then cultivated in the Royal Gardens, and they are all (with the exception of *C. calceolus*) hardy North American species, named respectively *parviflorum*, *pubescens*, *spectabile*, *humile*, and *arietinum*. In Sweet's *Hortus Britannicus*, 1830, eleven species are entered, and these again are all hardy English and American kinds, except two—namely, *C. venustum* and *C. insigne*, natives of India, and originally obtained from Nepaul—the first in 1816, the second in 1819. In Don's *Hortus Cantabrigiensis*, 1845,

there are thirteen entered, including *C. purpuratum*, introduced from the Malays in 1837, and the beautiful *C. barbatum*, from Mount Ophir, in 1841. Since that date the number has steadily increased, and within ten years past some very notable additions have been made by the introduction of such noble species as *Veitchianum*, *laevigatum*, *caudatum*, *concolor*, and others. It must not be supposed, however, that all the species and varieties recorded in the books are valued, or even known to cultivators. With the exception of *C. calceolus*, which is known by a few—very few—collectors of scarce and curious plants, the hardy species have no place in our gardens, success in cultivating and keeping them having proved so rare as to discourage the most ardent lovers of herbaceous plants. Now and then some spirited trader secures an importation of these plants, but it invariably ends, not in his finding customers for them, nor yet in growing them for his own amusement; he simply loses them, and there ends the speculation. But the majority of the tropical species are easily grown and multiplied; and as they are very various in character, some of them extremely curious, and all of them beautiful, so we meet with some of them wherever exotic orchids are cultivated, even if only on a small scale. The favourites at present are *C. insignis*, which will thrive in any warm greenhouse; *C. barbatus*, and its varieties; *C. villosum*, *C. Veitchianum*, *C. Stonci*, and *C. caudatum*.

The distinctive character of the *Cypripedium* must become immediately evident to the most casual observer who has an opportunity of seeing any of the species grouped with examples of other families of orchids. They are terrestrial plants; they neither produce pseudo-bulbs above the soil, nor send out snake-like aerial roots for prehensile or nutritive purposes. Instead of the great branching spike bearing hundreds of flowers, as in some of the *Oncidiums*; or the compact panicle towering high above our heads, as in some *Vandas*; or the whip-like, arching stem, bearing many great butterfly-shaped flowers, as in *Phalænopsis*; or the forest of flowers, making clouds of gold, and amber, and rose, as when the sun sets in glory, which the *Dendrobies* surprise us with; we have here flowers that are generally rather sober in colouring, and that are in many cases produced singly; or when more than one occurs on a stem, the spike is few-flowered. But as every genus has what may be called its accidental characters, by means of which it is identified without the aid of a botanical analysis, we may allow all this to pass in order to take note of the structural peculiarities of these plants. Comparing them with other orchids, it will be observed that the lip is neither like a frill, nor a banner, nor a tongue, nor a hood; but it is folded so as

to form a pouch, and in some of the species the pouch so nearly resembles a shoe as to justify the popular likening of it to a "lady's slipper." This pouch-like labellum is an essential part of the organic construction, and is directly related to the fertilization of the ovary, as Mr. Darwin* has very clearly shown by his original and painstaking researches. In other words, were the pouch modified or removed, the whole plan of the flower, as respects the disposition of the reproductive organs, would need to be modified also, the mechanical relationships of the several parts being matters of necessity, and every minute detail fitting properly into a complicated scheme.

But let us glance at the construction in order to obtain some distinct idea of the nature of the demarcation which lends so peculiar an interest to the study of the ladies' slippers. The plan of an orchid is *ternary*, and it consists in all of fifteen elementary parts. That we cannot very easily trace these out in any orchid is owing to the fact that some of the parts are commonly confluent, or peculiarly modified, or extravagantly developed, or nearly suppressed. There are three *sepals*, and these are usually determinable, because usually nearly equal; three *petals*, one of which usually gives the flower its most interesting feature, being modified into what is termed the *labellum*, or lip. There are three *stamens*, only one of which is commonly developed, and this is confluent with the pistil forming the *column*. In *Cypripedium* alone do we find three stamens, and by the aid of this genus, therefore, we obtain a key to one of the life mysteries of this mysterious order. Yet here again ordinary eyesight is baffled, for only two stamens can be found in *Cypripedium*, and these are placed right and left of the column; the third is in the customary place between them, but being sterile is not recognised until we have made a careful study of the flower. There are three *pistils*, but these again are so modified as to require to be discovered in the mind ere they can be traced in the flower. They are, in the first place, united, and confluent with the stamen; the upper stigma is modified into the extraordinary organ called the *rostellum*, which ordinarily presents no likeness to a stigma at all; and the two lower stigmas are confluent, and appear as one, and this one occupies a central position below the anther, and is the *stigma* to which reference is made in descriptions, and to which special interest attaches in respect of the process of fertilization. Lastly, the ovary consists of three perfect *carpels*, stationed alternately with the stamens opposite the petals, and bearing the placenta in their axes, and of three other pieces, destitute of placenta, and eventually

* *The Various Contrivances by which British and Foreign Orchids are Fertilized by Insects.* By Charles Darwin, M.A., F.R.S., etc. Murray, 1862.

separating from them when the fruit is ripe. The frequency of composite organs, and the peculiar individualities of development of certain parts, especially of the petals and the lip, result in that endless variety of form which render the orchids so strangely attractive and fascinating to botanists, florists, and sight-seers, all of whom are not the less charmed by their beautiful colouring and their exquisite odours.

In *Cypripedium* there are several exceptions to the prevailing type of structure, as will be seen on reference to the plate of *C. Veitchianum*. The topmost piece, which may be likened to a banner, and the striated colouring of which is beautiful beyond all description, that piece is a sepal; where are the other two? They are conjoined, and form one, corresponding in position to the one already likened to a banner. Right and left of the centre are placed two petals, like a pair of wings, and in the centre is the third petal in the form of a pouch or slipper. The elder Darwin saw in this arrangement of parts, and especially in the swollen pouch and eye-like anthers of *C. calceolus*, a resemblance to a spider, and in the figure of the plant in the "Botanic Garden" a very spider-like aspect is given to it—in fact, a *little* exaggeration, perhaps, to justify the fancy embodied in the passage in which the flower is celebrated:—

"So where the humming-bird in Chili's bowers,
On murmuring pinions robs the pendant flowers;
Seeks where fine pores their dulcet balm distil,
And sucks the treasure with proboscis bill;
Fair CYPRIPEDIA, with successful guile,
Knits her smooth brow, extinguishes her smile;
A spider's bloated paunch and jointed arms
Hide her fine form, and mask her blushing charms;
In ambush sly the mimic warrior lies.
And on quick wing the panting plunderer flies."

CANTO IV. 501—510.

That stress should be laid upon the exceptional character of the orchids under consideration will not surprise any who have read the masterly treatise of the living Darwin. He says, "Lindley's last and seventh tribe, including only one genus, *Cypripedium*, differs from all other orchids far more than any other two do from each other. An enormous amount of extinction must have swept away a multitude of intermediate forms, and left this single genus, now widely disseminated, as a record of a former and more simple state of the great orchidean order." *Cypripedium* is destitute of a rostellum, all three stigmas being fully developed, but confluent. The anther, which is present and fertile in other orchids, is here rudimentary, sterile, and appears as a shield-like projecting body deeply notched on its lower margin. The two fer-

tile anthers producing pollen grains, which are not united into waxy masses, nor tied together by elastic threads, nor furnished with a caudicle as in other orchids, but are immersed in, and coated by, viscid fluid, which is so glutinous that it can be drawn out into threads. "As the two anthers stand behind and above the lower convex surface of the stigma, it is impossible that the glutinous pollen can get to this, the fertile surface, without mechanical aid. An insect could reach the extremity of the labellum, or the toe of the slipper, through the longitudinal dorsal slit; but according to all analogy, the basal portion in front of the stigma would be the most attractive part. Now, as the flower is closed at one end, owing to the toe of the labellum being upturned, and as the dorsal surface of the stigma, together with the large shield-like rudimentary anther, almost close the basal part of the medial slit, two convenient passages alone are left for an insect to reach with its proboscis the lower part of the labellum—namely, directly over and close outside the two lateral anthers. If an insect were thus to act, and it could hardly act in any other way, it would infallibly get its proboscis smeared with the glutinous pollen, as I found occur with a bristle thus inserted. . . . Thus an insect would place either the flower's own pollen on to the stigma, or, flying away, would carry the pollen to another flower. . . . We thus see how important, or rather how necessary, for the fertilization of the plant is the curious slipper-like shape of the labellum in leading insects to insert their probosces by the lateral passages close to the anthers." Glutinous pollen grains, so peculiar to the *Cypripediums* that they alone possess them, are equally essential to this scheme of fertilization, and thus Mr. Darwin winds up by remarking, that "there is no superfluity in the means employed."

The cultivation of *Cypripediums* is, generally speaking, a most easy matter. Indeed *C. insigne* is the best of all plants for beginners in orchid culture, as it at once furnishes a key to many of the peculiarities of orchids, and adapts itself to various degrees of good and bad treatment. A shady position in a warm greenhouse, the soil to be a mixture of peat, loam, and silver-sand, and plenty of water in the season of its growth, are the conditions most conducive to its well-being. The stove kinds require only the ordinary treatment of what are called Indian orchids—that is, a temperature varying from a day maximum of 65° in winter to a day maximum of 90° in summer, and a night minimum of 60° in winter to a night minimum of 70° in summer, to be kept moist at all seasons, and when in active growth to have abundance of water. The hardy species are so difficult to grow that even in botanic gardens, and in places where all the resources of art and fortune are at com-

mand for the purpose, it is but seldom any of them are seen at all, or if seen are far from presenting such an appearance of health, and vigour, and beauty, as they are described as presenting when found growing wild. I wish to speak with all possible modesty on this subject; but having something to communicate, I shall endeavour to combine the results of experience with the results of thought in offering a code for the management of these rare plants. The first new light that dawned upon me in connection with this subject came from a collection of hardy orchids, that had been obtained with great care, and were planted out in a border consisting of a mixture of peat, leaf-mould, loam, and nodules of chalk. They had the usual care, and made the usual return, some doing well, but the majority making but a sorry figure. Still the collection was kept up by supplying with new plants the places of those that perished; and in due time I was laid by through a long and severe attack of tic, and as the collection of hardy orchids was looked upon with contempt by all in the place except myself, the bed became a mass of weeds; and though it was scarcely possible to find the places of any of them by their leaves, which were mixed with much rough herbage, their flowers surpassed in strength, and abundance, and beauty, everything of the kind I had ever seen before. I began to reflect upon this, and soon came to the conclusion that as they invariably grow amongst grasses, sedges, patches of *Narthecium*, etc., etc., in their native wilds, so, when brought into the garden, they should be similarly accompanied. No doubt our customary mode of keeping the beds clean exposes these plants to an undue amount of evaporation, which is exhaustive to them, and deprives them of a share in that condensation of dew which goes on all night long where innumerable living vegetable sprays are associated together, each spray distilling its nutrient drop from the generous atmosphere. I thenceforth sought for suitable plants to "surface" the beds where the orchids were planted, and I never found any to surpass *Festuca ovina*, which rejoices in the same soil as an orchid bed should consist of, and is both elegant, appropriate, and marvellously active in the condensation of dew and its conveyance to the earth by means of its wiry leaves; equally useful for small growing kinds, such as *Gymnadenia*, *Ophrys*, *Habenaria*, etc., etc., is the neat mossy herbage of *Spergula saginoides*, or of *Saxifraga hypnoides*; and to make an end of this part of the disquisition, it may be said that hardy orchids should always be grown in the midst of herbage of some sort, and the best way to accomplish it is to select plants that are suitable in habit, and at the same time worthy to be associated with such beautiful subjects. Shade, moisture, and protection in winter, are points of some impor-

tance, but given the herbage, nearly all the difficulties of orchid-growing come to an end.

Among the hardy species the first, without doubt, is *C. spectabile*, with its huge, finely-formed, rosy-purple lip. Next to this we may place *C. calceolus*, which is still to be met with in certain spots in the county of Durham known to a few, and who happily have sufficient caution to abstain from publication of the names of the localities. *C. acaule*, with the lip split into two equal lobes, is both interesting and pretty.

Among the species requiring to be cultivated in the stove, *C. Schlimii* is at once rare and exquisitely beautiful. It produces spikes of five to eight flowers each, the sepals and petals are white and green, the lip mottled and striped with rose on a white ground; *C. barbatum*, and its varieties; *C. Veitchianum*, so superbly striped; *C. caudatum*, *C. lævigatum* and *C. Stonei*, are the finest of the "tailed" series; in these the petals are prolonged, so as to present, with the help of a little fancy, a resemblance to mustachios set on each side of a gaping mouth and extravagant chin—a burlesque altogether of humanity. *C. insigne* is beautiful, and as it does not need stove heat, is useful to persons who grow orchids in cool houses. *C. villosum*, *purpuratum*, *Farrieanum*, and *hirsutissimum* are essential in a collection. The last is indeed a remarkable species, producing flowers of great size. *C. concolor* is notable for the beauty of its variegated foliage; the flowers are yellow, with chocolate spots. If we halt here, it is not because the subject is exhausted, but because we cannot afford more space, even for any more of such elementary and superficial particulars as have been hazarded already.

HYPOTHETICAL CONTINENTS.

BY H. M. JENKINS, F.G.S.

THE present surface of the globe has admitted of division into several marine and terrestrial regions, each characterized by its inhabitants possessing, as a whole, more or less distinctive features; just as, on the principle of nationalities, we might divide Europe, Asia, and Africa into several natural kingdoms. This division has involved no theoretical considerations of any importance, and it is only when an attempt is made to explain the *origin* of the inhabitants of any particular area that the naturalist ventures to step beyond the region of unyielding facts, and addresses himself to the more pliant province of hypothesis. The palæontologist, also, frequently seeks to trace the origin of ancient faunas and floras, and finds assistance in comparing the population* of bygone periods with that now peopling the earth's surface in the same, or neighbouring, or distant areas. And as, in searching for the origin of things, we must necessarily go back to some previous period, his palæontological knowledge specially fits him for the task, on account of his being acquainted with those facts, the ignorance of which not unfrequently forces the student of recent nature into the wilderness of pure hypothesis, or even imagination.

Two theories are prevalent respecting the origin of organic beings in particular areas. The first of these is that the fauna and flora of each great area possess, as a whole, certain distinguishing characteristics which belong to that district alone, and have never been disseminated through other regions; and that the species composing the population of that area have been *created* from time to time, probably as representative species died out. The opposing theory is that of the derivative origin of every group of organisms, whether species, genus, etc.; in other words, that each species is the modified descendant of some other species of the same genus, until the successive modifications cause so wide a divergence from the type, that a modified form transgresses the conventional circle which we draw round the generic type, and thus causes us to refer it to another genus.

It is quite obvious that if the first theory be true, any attempt to trace the origin of the present and past faunas and floras must necessarily be completely futile; for have we not their origin sufficiently elucidated in the dogma that "they

* The use of the terms "population," "peopling," etc., is in this paper restricted to the animal and vegetable "population," and is not meant to include man.

were created on the spot"? How utterly aimless, then, is palæontology, reduced in this way to a leviathan catalogue of fossils!

It will, therefore, be necessary for me to assume as a postulate the truth of the doctrine of the derivative origin of species; but it is not my intention here to adduce any facts or arguments in its favour, or respecting the causes which have conspired to produce the necessary modification; it is enough for my purpose to mention that compulsory wandering, or "migration," as it is termed, is one of them, and the one that most concerns the subject of this article.

Granting the postulate I have mentioned, the palæontologist can frequently infer—with greater or less probability of its truth, according to the state of our knowledge on the subject—whence came the progenitors of any particular assemblage of animals and plants. In the case of marine organisms he can also indicate, by reference to the position of geological formations of the period, the route by which the ancient ancestors travelled from their own habitation to that of their more recent descendants; in fact, it is chiefly where terrestrial life is concerned that he meets with any serious difficulty, and then generally as to the route.

During the tertiary period, and probably through all geological time, organic life was subject to similar laws of distribution as at present, and as climatal, hydrographic, and other physical conditions changed, a corresponding alteration was produced in the faunas and floras of the regions affected. We may therefore consider that migration and emigration of animals and plants were as constantly taking place as elevations and depressions of the land.

During their wanderings the specific features of organisms became more or less changed; weak and tender species dying off or becoming modified, new forms thus coming in, and varieties of old ones being formed, and the representatives of the various faunas becoming entombed at their death in the localities where they had severally existed. Now the palæontologist has to contemplate the results of these changes and migrations; he has to "try back," and decipher step by step the order of proceeding, and to write a history of the life of each period—not a mere catalogue of names and list of peculiarities, like the foreign consular passports, but an intelligent record of the wanderings and fortunes, ancestors and descendants, of the different faunas, and even species, with which he has to deal.

As a few out of many known examples of the evidence of changes which palæontology has revealed to us, I may cite the correspondence in facies between the recent American flora

and the plants of American eocene deposits and of European (notably Swiss) miocene; between the shells of the Faluns and those which are now found in eastern seas; between the eocene mammals of Europe and the existing tapirs of South America; and, finally, between the eocene plants of Europe and the existing flora of Australia. Many other examples might be given, but we have selected these as specially bearing on the subject of this article. There are also instances of "isolated faunas," such as those of Australia and Madagascar, which present some very curious differences from the animal population of the nearest continents.

Now "hypothetical continents," the term I have chosen as the title of this article, have been invoked to account for both classes of phenomena, and in the following pages I shall endeavour to investigate the probability of their furnishing the true explanation of the facts in each case.

Of these "hypothetical continents," the most celebrated is the Atlantis, partly on account of its having been the first proposed to explain a natural history difficulty, and partly on account of its name and position giving it an appearance of truth, by resolving an ancient legend into a scientific fact. This great continent, or "sunken island," was used by Professor Unger to account for the similarity of the miocene flora of Europe to the recent flora of America; it has formed the subject of several essays by distinguished botanists and geologists, and has been popularly illustrated on more than one occasion;* its prominent features are therefore tolerably well-known.

A less known theory of Professor Unger's is that of a complete land-connection between Europe and Australia during the eocene period, an idea suggested by the affinity of the majority of European eocene plants to those now living in Australia, the remainder belonging to genera now exclusively Asiatic.†

A third theory is Dr. Sclater's hypothetical continent, "Lemuria," stretching from Hindostan through Madagascar to the West Indies.‡ Dr. Sclater believes that this continent must have existed on account of the affinity of some of the curious mammals of Madagascar to some now living in India, and to others existing in the West Indies; and on account of the entire distinctness of the Madagascarian from the South-African mammalian fauna.

Now these theories depend upon the principle that the

* See especially *Journal of Botany*, No. 25, January, 1865, p. 12; Lyell's *Elements*, sixth edition, p. 265; and *Natural History Review*, 1862, p. 149.

† *Neu Holland in Europa*, and *Journal of Botany*, No. 26, February, 1865.

‡ *Quarterly Journal of Science*, vol. i. No. 2, p. 213, 1864.

affinity of certain animals, or of certain plants, implies their common origin, and in the case of terrestrial organisms, an almost if not a quite continuous land-connection between the habitats of the allied organisms. This principle is perfectly sound, according to my notions, and of infinite value in palaeontological reasoning; but the upheaval of these various hypothetical continents is by no means the only way of explaining known phenomena in accordance with it. It therefore seems reasonable to expect some physical evidence in confirmation of their former existence, and unless this evidence is forthcoming I should much prefer another explanation if supported in that way.

I shall now endeavour to make clear an explanation of the phenomena which have hitherto required the aid of an Atlantis and a Lemuria, treating them as belonging to one category. This hypothesis will also explain certain facts requiring elucidation by any theory framed to account for the peculiarities of the Swiss miocene flora, and will, I hope to be able to show, accord with others which have, apparently, no necessary connection with the subject.

I have stated that the Atlantis theory was founded on the similarity of the miocene flora of Europe to the recent flora of America. According to Dr. Oswald Heer, 186 species of miocene Swiss plants have their nearest allies living in the United States, 40 in tropical America, 6 in Chile, 58 in Central Europe, 79 in the Mediterranean region, 108 in Asia, 25 in the Atlantic Islands, 26 in the rest of Africa, and 24 in Australia. This analysis, by a strenuous and able advocate of the Atlantis theory, shows that there are other facts to be explained besides the preponderance of American types. Dr. Asa Gray, therefore suggested that the plants had travelled by way of Japan, Northern Asia, and Asia Minor to Europe, instead of across the Atlantic over a great island-continent, and this theory has been received with great favour by geologists like Sir Charles Lyell, and botanists like Professor Oliver. The latter gentleman, indeed, has ably seconded Professor Asa Gray in attempting to show that the plants travelled by the longer rather than the shorter route, and in comparatively high latitudes.* It will be unnecessary for me to do more than mention some of the chief features of his analysis of the three recent floras, namely, of Europe, Japan, and the Southern United States, in so far as they are allied to the Swiss miocene flora.

Of the miocene plants of Switzerland there are 76 genera common to the recent flora of Europe, 88 to that of the Southern United States, 77 to that of Japan, and 123 which occur in the united floras of Europe and Asia. The 77 genera

* *Nat. Hist. Review*, 1862, p. 149.

common to Japan include 26 not recent in Europe, and several of these are eminently characteristic tertiary types. Taking the orders of the Swiss miocene plants, 73 are common to the Southern United States, and 71 to Japan; but while 6 of the largest Japanese orders are represented in the Swiss miocene, there are only 4 of the largest American. The inference therefore appears natural and legitimate that the larger the group which is taken as the basis of the comparison, the smaller is the preponderance of American types; and considering the nature of many so-called species of fossil plants this fact has a remarkable significance. Professor Oliver also uses as a basis of comparison the proportion of ligneous species in each flora, and he finds that while about 40 per cent. of the Japanese flowering plants are ligneous, only about 22 per cent. of the American come into that category. The proportion of ligneous species in the Swiss miocene flora is even larger than in the Japanese, amounting to 60 per cent., and the former therefore corresponds more closely in this respect with the latter than with the flora of the Southern United States.

The foregoing facts seem to render reasonable the expectation that the true explanation of the affinity of the Swiss miocene plants to those of the Southern United States should, at the same time, account for its correspondence with that of Japan, and for the occurrence of allies of other species in different parts of the world. The Atlantis hypothesis does not answer this expectation; but a modification of the theory of an Asiatic route does. On natural history grounds, therefore, we should prefer the latter.

Another consideration to which I must direct attention, is the direction in which the migration took place. Hitherto it has been taken for granted, that the migration was *from* America to Europe during the miocene period, that is to say, the American flora being stationary, it spread during the miocene period as far as Europe. The Ex-President of the Geological Society, Mr. W. J. Hamilton, is, I believe, the only geologist who has ventured to dispute this assumption, and he has characterized the idea of a recent flora migrating to an ancient as a physical impossibility.*

I have just stated the assumption rather differently, and, put in that way, it does not seem impossible; still, I venture to support Mr. Hamilton's view, that the Swiss miocene plants emigrated towards America, and that during the emigration, many became dispersed to other regions; but, at the same time, I believe, on palæontological grounds, that they came from that continent at an earlier period.

In any area undergoing great physical changes, such as

* *Quarterly Journal of the Geological Society*, vol. xxi. p. 94.

Europe underwent during the tertiary period, there must also be great changes taking place in its fauna and flora. Consequently we find that the eocene flora of Europe is largely Australian in its character,* that the miocene flora is largely American and Japanese, and that the miocene shells are largely East Indian.† Respecting this last character, I have shown that the only legitimate inference to be drawn from it, is that the mollusca emigrated from Europe in a south-easterly direction; and this conclusion is borne out by the fact, that some still exist in the Mediterranean and Red Seas, having been left behind by the less hardy species, for the emigration was no doubt chiefly the result of the climate having become colder, in consequence of physical changes. This cooling of the climate of Europe began towards the close of the eocene period, for while the eocene fauna and flora were purely tropical, the miocene were scarcely more than subtropical, and the pliocene hardly more than temperate in some regions and much colder in others.

It is worth remarking, that the emigration of animals and plants from Europe seems to have taken place more constantly towards the east than in an opposite direction; witness, for instance, the affinity of the Australian mammals to those of our oolitic rocks, the affinity of the eocene European plants to the Australian recent, and the likeness of the European miocene flora to the recent American and Japanese. The tertiary character of the American cretaceous plants is notorious, as is the miocene (European) and recent (American) character of the eocene flora of that continent; I believe, therefore, that our miocene plants came from America during the eocene period, and that their progenitors were the plants of the eocene and cretaceous periods in America, from which have also descended the recent flora of that continent.

If these views be admitted, the large number of Swiss miocene species represented in America is naturally explained, for the American plants had a double chance of preserving their likeness to their descendants. Again, if the present flora of America (or that from which it has descended), has existed on that continent ever since the cretaceous period, we ought to find the remains of it imbedded in leaf-bearing strata of all succeeding periods in America, if such deposits exist. At present, this crucial test is not available for periods later than the eocene; but the evidence at our command bears out, as we have seen, the views I am advocating.

* Ettingshausen—*Ueber die Entdeckung des Neuholländischen Charakters der Eocenflora Europás*, 1862. Unger—*New Holland in Europa, and Journal of Botany*, No. 26.

† See *Quarterly Journal of the Geological Society*, vol. xx. p. 63.

At present, the miocene Atlantis theory has received no confirmation from students of physical geology; we have no evidence of such vast changes in the physical features of the Atlantic having taken place since so recent a date as the miocene.* On the other hand, the modifications of it which I have just enunciated are well sustained by known geological, as well as palæontological data.

In studying the distribution of the cretaceous and nummulitic strata of the Old World, one cannot avoid remarking their persistent east and west extension, in temperate and northern sub-tropical regions. We thus find them occurring in southern Europe from Portugal to the Black Sea; and, in Asia, from Asia Minor as far east as geological researches have been made. These and other facts, especially the east and west direction of the lines of volcanic disturbance of the same periods, induced Mr. Searles Wood, jun., to promulgate, in 1862,† his view of a land-connection between America and the then existing Europeo-Asiatic continents at the close of the cretaceous period and the dawn of the tertiary. We have seen that this hypothesis accords remarkably well with one section of the palæontological facts which it is our endeavour to explain; it now remains for me to show that other phenomena can likewise be explained by the same theory.

I have already stated, in general terms, the grounds on which Dr. Sclater was led to promulgate his theory of the ancient continent Lemuria. As instances of the peculiarities in the fauna of Madagascar, sought to be accounted for by this "hypothetical continent," I may mention, quoting Dr. Sclater,‡ that the Insectivora of that island are most nearly allied to the American genus *Solenodon*; that the frugivorous bats of Madagascar belong to the Indian section of the group, and not to the African; and that certain American forms of serpents and of insects are also found in Madagascar, while the characteristic members of the African fauna are entirely absent from the island. Dr. Sclater also states that the lemurs of Africa are abnormal when compared with those of Madagascar; but that those of India appear to form in some respects an intermediate group. The theory he has proposed, does therefore account for the facts he wished to explain; but the question to be solved is its admissibility on other grounds.

In the proceedings of the Zoological Society for 1863, Mr. H. W. Bates gave an analysis of the affinities of eleven families of the coleoptera and lepidoptera of Madagascar, and referred also to Dr. Hartlaub's analysis of the birds. The general

* See Lyell's *Elements*, 6th Edition, p. 267.

† *Phil. Mag.*, 4th Ser., vol. xxiii. p. 277.

‡ *Quarterly Journal of Science*, No. 2, pp. 213, *et seq.*

result is the same as that arrived at from a consideration of other classes of animals, namely, that there exists a large number of genera and species peculiar to the island, certain others common to it and to Africa, some allied to Asiatic types, and a few having tropical American affinities. The proportions differ, of course, in the different classes, owing to a difference in the powers of locomotion and other causes.

Dr. Hartlaub had previously hinted at the connection of Madagascar with South-Eastern Asia, rather than with Africa; but Mr. Bates rightly observed that if the Asiatic element justifies such a conclusion, the American ought also to be taken into account. This suggestion, as we have seen, has since received its complete development at the hands of Dr. Sclater.

Mr. Bates's own idea is "that the island (whether previously stocked with anti-African forms or not) was at one time much more closely connected with Africa than it now is, and that the time of connection was anterior to the date when the continent became peopled by *Simiæ*, and the bulk of its present mammalia; but posterior to the introduction of lemurs." With this opinion I entirely agree.

Palæontology is not yet in a position to furnish us with any complete evidence on the question; but some few facts are known which seem to bear on it. The mammalia which existed in eocene and miocene times include forms, such as *Didelphis*, that are now restricted almost entirely to America, with others now South African and Asiatic in their affinities; but these types, geographically distant at the present day, have a very striking stratigraphical distribution in the tertiary deposits of Europe. As examples I may quote the following: In the eocene strata we have the genus *Chæropotamus* most nearly allied to the peccari of America; a species *Didelphis*, the opossums being now confined to that continent; and such genera as *Coryphodon*, *Pliolophus*, *Hyracotherium*, *Palæotherium*, *Lophiodon*, *Anoplotherium*, etc., all tapiroid pachyderms more or less allied to the tapirs of South America.

Miocene deposits have also furnished the remains of some interesting mammalia. I may especially quote two genera of old-world monkeys from Eppelsheim, named respectively *Pliopithecus* and *Dryopithecus*, so that here we get the first indication of true eastern types. The *Macrotherium*, a gigantic sloth allied to the old-world genus *Manis* was also obtained from the same deposit. The genus *Dinotherium*, a miocene ally of the tapirs, has hitherto been recognized only in strata of that period; but great interest is attached to it from its having been obtained from a locality so far east as the Gulf of Cambay. The genus *Mastodon*, which appeared first in miocene times, has

a still greater geographical range, several species of it having been obtained from both hemispheres.

Unfortunately no species of lemur has yet been discovered in the fossil state, although it is in accordance with all analogy to infer that they existed during the tertiary period.* New-world monkeys of pliocene age have been found in South America, but not elsewhere; and old-world monkeys have been found in Europe, as we have seen, and in Asia in miocene and more recent deposits. So far as we know, therefore, new-world monkeys never have existed in the old world, nor old-world monkeys in the new; and we have no certain record of any quadrumana during the miocene period. Had the Atlantis existed during the miocene period, it would be strange to find the distinctive features in the distribution of the monkeys of the two hemispheres still preserved; but if the Atlantis was of eocene date—before monkeys lived on the existing continents—then the differences in the distribution and structure of the *Catarrhini* and *Platyrrhini* cease to be marvellous.

These facts show that it is possible to account for the American affinities of certain of the vertebrates of Madagascar by supposing their ancestors to have come to Europe from America by the eocene Atlantis, and to have travelled thence to India, Africa, and Madagascar at a later period. The affinities of the European tertiary insects are in favour of this view, which is also curiously confirmed by the fact that the lemurs, which are not known in the fossil state, are confined in the living state to the old world; and if they are ever discovered fossil, it probably will be in the eastern hemisphere; while most, if not all, of the Madagascarian animals having allies in the new world are known to have been represented, more or less closely, in eocene and miocene times.

There is no physical evidence in support of the hypothetical continent Lemuria, while, as we have seen, the eocene Atlantic continent was suggested by Mr. Searles Wood, junior, almost entirely on physical grounds. That India may have been connected at some not very remote period with the Mascarene Islands, Madagascar, and Africa, is, however, extremely probable. Such a connection no doubt existed when the *Glossopteris* flourished in South Africa, Central India, and Australia, and it may have continued to a comparatively recent period, or have been reproduced in tertiary times, or the connection may have been similar to what exists at present.

Our knowledge of the geology and palæontology of Mada-

* Prof. Rüttimeyer has announced the discovery of the remains of an eocene monkey allied to the lemurs; but although this fact would add considerably to the strength of my argument, caution forbids me to quote it until its truth has been placed beyond doubt.

gascar is so extremely scanty and indefinite that we cannot quote a single fact derived therefrom in support of either view; but doubtless future discoveries will prove the probability or the impossibility of the hypothesis I have here advocated. I will just venture to anticipate one element of uncertainty in future inquiries into this subject, namely, the probability of a great Pacific continent having formerly united the old and new worlds on that side, for we know that that great region is even now an area of depression. It seems probable, however, that this consideration would more nearly affect the relation which formerly existed between Australia and South America, than the regions which now concern us.

In the foregoing pages I have endeavoured to establish the following conclusions:—

1. That hypothetical continents belong to two categories; namely, first, those supported by physical evidence, and, second, those unsupported in that respect.

2. That while the miocene Atlantis and Lemuria come into the second category, the eocene Atlantis and the possible Pacific continent come into the first.

3. That the theory of a miocene Atlantis and that of Lemuria each explains only one portion of the palæontological facts that call for elucidation; while the theory of an eocene Atlantis explains the whole of the facts of both cases.

4. That for these reasons it is probable that the miocene fauna and flora of Europe came from America during the eocene period by way of the eocene Atlantis; and that since the miocene period they spread over Asia and Africa and the eastern seas, and that a part of the flora returned to America by way of Northern and Central Asia and Japan.

5. That the fact of American cretaceous and eocene plants uniformly occurring in older deposits than a European palæontologist would, *à priori*, consider possible,* is of itself a most remarkable confirmation of two theories; namely (1), that organisms have migrated from west to east (*e. g.*, from America to Europe in eocene times); and (2) that deposits in the old and new worlds should be treated as homotaxeous,† and not as contemporaneous.

* See Dana's *Manual of Geology*, p. 510.

† *Quarterly Journal, Geological Society*, Vol. xviii., p. 52; and *Quarterly Journal of Science*, Vol. ii., No. 8, p. 622.

THE PERSISTENCE OF LUMINOUS IMPRESSIONS.

BY THE ABBÉ LABORDE.

THE following paper is translated from *Comptes Rendus*, 16th July, 1866:—

“When a luminous point strikes the eye and suddenly disappears, the sensation which it produces does not become immediately extinct, and according to the researches of some physicists, it remains for about one-third of a second, from whence arises all the phenomena known and explained under the title of *persistent luminous impressions*.

“It occurred to me to inquire whether in white light all the component colours had the same degree of persistence, and to study this question I submitted the sensation of light to an experiment which revealed to me a very curious fact, which seems to demonstrate that in white light the most refrangible colours are more persistent than the others, and that they act in advance of the others, so that the organ of vision decomposes white light by dispersing its colours in different times, just as the prism decomposes it by dispersing in different places.

“I make this experiment: the light of the sun is received upon a mirror which throws it horizontally on to a slit made in the shutter of a dark chamber. This slit should be three millimetres* wide and six long. Close to this slit, inside the chamber, a disk of metal is placed, on the margin of which, similar slits are made, with wide interspaces between them. A clockwork movement turns the disk, and a clamp, which the observer can operate upon at a distance, allows the revolution to take place with greater or less velocity. In the line of the light rays, at a distance of about a metre, a screen of ground glass is placed, behind which the modifications of the light can be observed when the disk is in motion. At first the light is made to appear or disappear slowly, and is found uniformly white; but when the successive appearances are made to take place more rapidly, the margins begin to be tinted, and by progressively increasing the velocity, the surface of the image becomes successively affected by blue, green, rose, white, green, blue. After this last blue, increasing velocities restore the whiteness of the light.

“The whole of the phenomena depend, as will be seen, on the varying periods occupied by the revolutions of the disk.”

* In Darling's *Metric Tables* we find 3 mm = 0.118 of an inch.

M. Laborde does not give us any information on the rates of velocity which produce the different effects; but we apprehend those of our readers who wish to repeat his experiments will have little trouble in preparing the necessary apparatus, as the velocities required in the movement cannot be great.

GOSSIP ABOUT FISH.*

MR. COUCH's great work on British Fishes has arrived punctually at its termination in the fourth and concluding volume, which contains no less than seventy-three beautifully executed coloured plates. The entire work is enriched by two hundred and fifty-two coloured plates and numerous woodcuts. The illustrations thus afforded by Mr. Couch are the more valuable from being, with very few exceptions, drawn by his own hand from *freshly* caught specimens, and thus they are characterized by a degree of fidelity rarely attained in natural history works. Another highly important and valuable peculiarity of Couch's *British Fishes* is the large amount of information which it affords concerning the habits of the creatures described. Some of the older naturalists, with considerable talent for observation, were not sufficiently careful in description, and hence it is often difficult, and sometimes impossible, to identify the objects of their research. Since their days a new school has grown up, very careful in descriptive accuracy, and, we might add, very careless as to modes of life, and relations of habit to structure, which really constitute the essence of natural history, properly so called. Those who write as Museum naturalists may add very valuably to the means of identifying species; but unless their labours are supplemented by the observation of the field naturalist, they eventuate in nothing better than a long catalogue of names. Inaccuracy of description destroys the worth of field labours, because it leaves in doubt to what particular creature they were directed; but accurate description is of little value until some observer of habit, or some deep-thinking tracer of structural relations, has built up the raw material thus afforded into something that may be fairly dignified with the name of science.

The different dispositions and capacities of men naturally cause them to view external objects, and especially living ones, from two distinct points of view. According to one, and the

* *A History of the Fishes of the British Islands*, by Jonathan Couch, F.L.S. 4 vols. Groombridge and Sons, 1862—1866. Vol. i., fifty-seven coloured plates; Vol. ii., sixty-three, ditto; Vol. iii., fifty-nine ditto; Vol. iv., seventy-three ditto, from drawings by the Author.

most popular, because the apparently simplest, method of observation and philosophizing, every animal, for example, is supposed to be gifted with a special structure, *in order* that it may live under particular conditions and perform particular acts. According to another method of reasoning, the structure is the result of general laws operating under special conditions, and each animal belongs to a group, the whole of which must be studied before the individuals composing it can be understood; while the entire group has definite relations to other groups, and so on throughout the whole round of nature, which forms one great unity, in which Creative will and intelligence are displayed in conformity with an all-comprehending plan. Which ever mode of reasoning the tendencies of particular minds may lead them to adopt, the relation of habit to structure, or of structure to habit, is equally important; the difference being that the more philosophical and wider of the two systems give a proportionately ampler signification to every fact that is ascertained.

The fish, the reptile, and the bird, at first sight so different in appearance, and so apparently separated by a great gulf in structure as well as in habit, are found to grow nearer to each other the better they are understood.

Professor Huxley divides the vertebrate animals into three ascending groups; (I.) the *Ichthyoids*, comprising fishes and amphibia, defined by the presence of branchiæ or gills at some period of existence, nucleated blood corpuscles, and certain other peculiarities; (II.) the *Sauroids*, which have no branchiæ or gills at any period of their existence, nucleated blood corpuscles, certain peculiarities in the skull, and other structures, and which comprise reptiles and birds; and (III.) the mammalia.*

It is by tracing points of resemblance of too technically anatomical a character to be referred to in detail in this place, that Professor Huxley expresses the decision of comparative anatomists, when he speaks of the class of birds as "an ex-

* The passage stands as follows:—"The vertebrata are capable of being grouped into three provinces: (I.) The ichthyoids (comprising fishes and amphibia) defined by the presence of branchiæ at some period of existence, the absence of an amnion, the absence or rudimentary development of an allantois, nucleated blood corpuscles, and a parasphenoid in the skull. (II.) The sauroids defined by the absence of branchiæ at all periods of existence, the presence of a well-developed amnion and allantois, a single occipital condyle, a complex mandibular ramus articulated to the skull by a quadrate bone, nucleated blood corpuscles, and no parasphenoid, comprising reptiles and birds; and (III.) the mammals devoid of branchiæ, and with an amnion and an allantois; but with two occipital condyles and no parasphenoid; a simple mandibular ramus articulated with the squamosal and not with the quadratum with mammary glands, and with red non-nucleated blood corpuscles."—*Elements of Comp. Anat.*, p. 74.

tremely modified and aberrant reptile type ;” and if the general reader will take for granted the connection between reptiles and birds, he will have no difficulty, from a slight knowledge of frogs in their tadpole and gill-breathing state, in carrying the argument further, and connecting reptiles, through the amphibia, with fish.

These considerations will serve to show that the fish are not so distinct and essentially different from other creatures as might have been supposed. The peculiarity of their abode marks them out with a certain conspicuous breadth of divergence ; but several fishes can live for a time on dry land, and do so occasionally, by choice, while the whales represent mammalian life in the water, and the amphibia show how, at different stages of existence, the same animal may comport itself as a land reptile or as a fish.

From a survey of Mr. Couch’s work, it becomes evident that the British coasts supply the naturalist with a great variety of species of fish, some occurring constantly in vast multitudes, and others, if not permanent inhabitants, visiting us sufficiently often to reward the attention of those who live near the sea.

The first volume of Mr. Couch’s work discourses of the sharks and rays which belong to us or visit us, and concludes with delineations of sturgeons, sticklebacks, perches, basses, etc. The second volume contains, among other fishes, the gurnards, to which additional interest has been excited by recent researches into their capacity for producing vocal sounds. Mr. Couch gives sketches of several of their air-bladders, which are concerned in their vocal utterances. In the case of the piper (*Trigla lyra*), he says, “Several of the fishes of this genus are known to utter obscure grunting sounds when newly taken out of the water, and they continue them at intervals as long as they are alive.” And, when speaking of the common gurnard (*Ouculus griseus*), he mentions its social habits, and tells us that “sometimes, in the fine weather of summer, they will assemble together in large numbers, and mount to the surface, over deep water, with no other apparent object than the enjoyment of the season ; and, when thus aloft, they move along at a slow pace, and rising and sinking in the water for short distances, and uttering a short grunt as if in self-gratification.” In fact, they have a sort of musical water-party ; and, possibly, if they heard some of the bipeds singing, they might not speak of the performance more respectfully than Mr. Couch does of theirs when he calls it “a short grunt.” These assemblies of gurnards, and other gatherings of certain fishes that might be adduced, certainly indicate the presence of a social instinct much more distinctly

than the progress of many fish in shoals, which may result from a community of impulse, quite distinct from companionable qualities.

In Mr. Couch's third volume, comprehending mullets, wrasses, rocklings, flounders, soles, etc., we find many illustrations of greater mental powers than fish are usually imagined to possess. Thus, the grey mullet is singularly watchful against restraint, and tries to leap over obstacles in preference to passing through them. Mr. Couch says, "In the port of Looe, in Cornwall, there is a salt-water mill-pool of thirteen acres, that is enclosed on the side of the river by an embankment, and into which the tide flows through flood-gates that afford a ready passage for fish to the space within. When the tide begins to ebb, the gates close of themselves; but even before this has happened, the mullets which have entered have been known to pass along the enclosed circuit within the bank, as if seeking the means of deliverance, and, finding no outlet, they have thrown themselves on the bank at the side, to their own destruction." Mr. Couch adds, all writers agree in ascribing to this fish great quickness of hearing, and it has even been supposed that it is capable of the perception of particular sounds. The Cornish historian, Carew, had formed a pond on a branch of the Tamar, in which mullets were fed at regular periods, and they were drawn together to the appointed spot at the sound made by the chopping of their food.

The carps (described in Mr. Couch's fourth volume), like the mullets, can be brought together by sounds intimating that their dinner is ready, and they seem to be fish of a highly intelligent character, with more than the usual fishy allowance of brain. "According to Professor Owen, the average proportion of the size of the brain to that of the body in fishes is one in three thousand; but in the carp, according to Blumenbach, it amounts to one in five hundred, which is the same as is found in the 'half-reasoning' elephant." Why the elephant should be called "*half-reasoning*" we never could understand, unless human vanity cannot bear the notion of ascribing reason to any other animal than man himself. Reasoning may be logically correct as far as it goes, and as far as the materials at its disposal allow it to go, and then it is as much *whole* reasoning in a fish as in a Newton, though the results may be less grand. The disciples of old Izaak are well acquainted with the cleverness of the carp, and when we regard him as a highly-organized specimen of the finny tribe, it is the more remarkable to find that he may—to use a Paddyism—be frozen to death, and yet come to life again.

Sir J. Franklin, cited by Mr. Couch, is the authority for this statement. He says that in his voyage to the Polar Sea,

"the fish caught in their nets became so frozen that in a short time they formed a solid mass of ice ; and by a blow or two of the hatchet they were easily split open, so that their entrails might be removed in one lump. But if in this frozen state they were thawed before the fire they recovered their animation. This was particularly the case with the carp, and he has seen a carp so completely restored after being frozen for thirty-six hours as to leap about with much vigour." Mr. Couch alludes to experiments of John Hunter, which had an opposite result, as the carp which he subjected to a freezing mixture was killed ; and he observes, "if we are to suppose that the fish frozen by Sir J. Franklin were of the same time species as those of Hunter, the only explanation of the difference of result will be that the suddenness of the operation in the north prevented that exhaustion of vitality which was fatal in the other." We are also told that carp can be kept alive for weeks in a cool cellar, if the body is kept moist and appropriate food supplied.

The minnows seem to possess their full share of piscine mother wit and natural politeness. When they have discovered some dead animal substance, "they arrange themselves in the form of a ring, which has been compared to that formed by the petals of a flower, with their heads lower than the level of their bodies, and in this situation no one jostles another. But however peaceable among themselves, the circle must not be broken into by a stranger, for on the approach of such, the most powerful of the company will quit his station to drive him away, while his place is kept vacant by his companions until his return to the feast."

Fishes with filaments hanging from their heads have usually keen sensations of touch, and some species seem equally remarkable for fine scent, if, indeed, the fish sense residing in the nostrils be not a sort of taste. Thus Mr. Couch informs us that the loach has been seen to follow his food by scent, so as to have discovered it "when intentionally concealed from the mere influence of sight and feeling." With reference to fish hearing, Mr. Couch states that a shoal of pilchards have been known to sink and disappoint the fishermen at the firing of a heavy gun twenty miles off.

Many curious instances will be found in Mr. Couch's fourth volume of the skill evinced by the eel in surmounting obstacles in his migrations. It appears that he gets up rocks, climbs gate-posts in canals, and, as is generally known, occasionally takes a walk in the fields. "It is said to have been known to devour newly-sown green peas in a garden, and I have been credibly assured that one was found in a field of turnips at the distance of a quarter of a mile from a river." An eel keeps one

of his five senses, that of touch, in his *tail*, and Dr. Marshall Hall discovered a sort of supplementary heart in that curious situation, and he noticed that "the vessels which issue from the caudal heart appears to have a particular distribution to the spinal marrow." The vertebræ of the tail allow of great flexibility. Thus, they not only use their tails to collect information by their superior sense of feeling, but also as bands to grasp any object round which they can be twined. The conger eel uses his tail in the same way. "When taken on board a boat, and left undisturbed, the sensitive powers of its tail are employed in searching out the nature and limits of its prison, and then this organ is stretched out to lay hold of the gunwhale, by fixing its hold fast on which a reversed muscular action is put in force, and the whole body is turned overboard." A small blow at the root of the tail disables the creature.

Among the curiosities of the fish world which attract the constant attention of visitors to the aquarium-room in the Zoological Gardens are the pipe-fish, remarkable for their slender, worm-like bodies, elongated snouts, and the exquisite motions of their dorsal fins. These creatures are no less remarkable for their domestic habits, as the males perform the functions of nurses—*dry* we cannot say, considering the watery situation in which the duty is discharged. The greater pipe-fish and the red-nosed pipe-fish are, like kangaroos, marsupial animals so far as the males are concerned. Mrs. Pipe-fish hands her eggs over to the male, who puts them in his pocket, and hatches them in due time. The slit, opening into the pouch, is closed by adhesion of its lips, and opens again when the time has arrived for the infants to get out and see a little more of the world. The males of the ocean pipe-fish (and some others) having no pockets, carry the eggs about cemented to the abdomen. Concerning the snake pipe-fishes, Mr. Couch says, "When on our coast their actions are amusing, as with their slender and prehensile tails they lay hold of some loose and floating object, with the aid of which, and the anterior portion of the body free, they steer their wandering course by the wavy action of the dorsal fin."

Little is known concerning the sleep of fishes. Mr. Couch supposes that some of them go to sleep, if we so phrase it, a piece at a time—that is, that certain portions of the brain rest while others remain at work. He thinks the pike may be asleep when he lies so quiet and stupid as to be caught by having a wire noose laid over his nose; and that great monster, the sun-fish, may be "enjoying a snooze" when it is found lying on the surface of the water, and allows itself to be seized. The shape of this fish is very queer. It is a sort of blunt oval, very obtuse at the tail end, at which it is furnished with two

great spear-shaped fins. If awakened from its slumbers, its usual mode of escape is along the surface of the water with great swiftness, so that, in a case which Mr. Couch mentions, a rowing boat could not overtake it. Mr. Couch gives a beautiful figure of it, and informs us that when seen shining in the water, it is found to merit its sunny name. Our readers will remember its portrait, drawn in a former number, to illustrate its capacities for playing the part of host to some of Dr. Cobbold's vermicular pets.*

Among the queerest of queer fishes are the lampreys. They are of worm-like form, with soft bones, and mouths rather vertical than horizontal, which can be expanded, and act as sucking disks. The sea-lamprey is often found tightly adhering by its sucker mouth to a ship, and it has been supposed by some that it mistakes the sides of the vessel for something good to eat; while others consider that, without studying Bishop Berkeley, it has a high opinion of the virtues of tar, and adheres to the ship for the sake of that substance. The sea-lamprey is described by Mr. Couch as dining off its fellow-creatures after a fashion more skilful than kind. "The whole of the interior arch of the mouth is studded with regular rows of teeth, each one of which, on a broad base, is furnished with one or two apparently reversed points; and the teeth which are the most distant and concealed are larger than the others, and more effectually crowded with these points. For simply biting, as in other fishes, they are useless; but when the breadth of the open mouth is brought into contact with the surface of a fish on which the lamprey has laid hold, by producing a vacuum, these roughly-pointed teeth are brought forward in a manner to be able to act on it by a circular motion, and a limited space on the skin of the captive prey is thus rasped into a pulp and swallowed, so that a hole is made which may, perhaps, penetrate to the bones." The victims of this singular "diner out" cannot succeed in throwing off their tormentor; but they seem to get well of their wounds, and are ready, like the Abyssinian cows, when one slice has been taken away, for their devourers to come again. A more amiable trait in the lamprey character is the aptitude for matrimonial felicity at the spawning season. Both sexes then combine to excavate a trench at the bottom of a river, in which their eggs are to be deposited, and when a stone of considerable size is in the way, the sucker-mouth seizes it, and it is thrust on one side. Stones of even ten or twelve pounds weight are said to be turned over by the zealous pair, who no doubt experience satisfaction in the performance of their task. The lamprey figures in heraldry, and is occasionally met with as a surname, though what resem-

* Vol. ii. p. 82.

blance our forefathers could have discovered between the man who first bore the appellation and the creature itself, history, as known to us, does not record.

As we come to the conclusion of Mr. Couch's work, we find ourselves passing out of the fish world altogether, through those singular transition links—the myxine, or borer, and the amphioxus, or lancelet. The myxine, Mr. Couch tells us, is scarcely rare in our northern waters, especially about Scarborough, and is no favourite with the fishermen, as it attacks the fish caught on their long lines as soon as they are dead. The myxine is worm-like in aspect, and breathes by means of little vesicles or chambers, the lining of which forms folds. The spine is a cartilaginous tube, and the nervous cords lie upon it unprotected by bone. This creature enters the bodies of larger fish through the gills when they are dead, and devours their muscular structure very much as the lamprey feeds.

Older naturalists took the myxine for a *worm*; and the lancelet, another of the lower fishes, was regarded as a *slug*. This very curious creature is of small size, the largest Mr. Couch has seen being two inches and three-tenths long, with a depth of about three-tenths of an inch, exclusive of the fins. Its gelatinous vertebral column exhibits separate joints; but it has no skull and very little brain. It has no true gills and no true heart.

In taking leave of the fishes, we strongly recommend those who wish to acquire a general knowledge of them in a very agreeable way to turn over the pages of Mr. Couch's splendidly illustrated volumes, and glance at his descriptions. For strangeness and variety of form and beauty of colouring, fish are not surpassed by any other animals, and we have no doubt Mr. Couch will tempt many to become real students of fish under his able guidance, whose original intention went no deeper than to amuse an hour by looking through his plates.

LARGE BRITISH OAKS.

MODERN discoveries have enlarged our notions on the size of trees as well as many other subjects, and it is now no longer a doubt that, in proportions of height and expansion, there are those both in the old and new world that can look down with dimensions of superiority upon our ancient standards, the cedars of Lebanon.

From time immemorial, the natives of the British Isles have justly boasted of their oaks; since the days of the Druids, who bore an identical name with them and abode beneath them, down to the present generation. The idea of them is associated with bulk, elevation, strength, durability, and stateliness: they are the monarchs of the forest. Until metal was substituted for wood, the universal testimony of ages concurred in assigning a decided preference to their employment in the most important services. To them, under Divine Providence, has been ascribed not only the feeling, but the actual existence of that national security that England has enjoyed from her "wooden walls." Iron, it is true, has recently waged war against oak in several ways—in the construction of our dwellings, as well as of those floating habitations or castles that, under various forms, have been applied, in conjunction with steam, to the circulation of commercial enterprise as well as to the protection of our shores.

Leaving speculation, however, and coming to matter of fact, while we consign the discussion of the *genus Quercus*, and the relative merits of its different species to the naturalist, and the comparative growth of other trees in other regions to the traveller, let us descend to some notable proof of what the English oak is capable of producing for our use, in justification of the ground of a preference cherished for a time, "whereof the memory of man runneth not to the contrary."

What has been remarked of the cow among the "beasts of the field," that it contains no part or property, living or dead, that is not in some way or other convertible to the use of man, may, with little exception, be fairly predicated of the oak among "the trees of the forest." Shelter and shade, and the acorn while living; bark, fuel, and material of the best and most enduring quality when the axe has laid it low. Whatever of it is undecayed is applicable to useful purposes. The term *materies*, by which the Romans designated timber in general, is eminently descriptive of the product of this noble and valuable gift of the Creator to man.

Of the particular value, variety, and extent of its application some notion may be formed by the selection, among

many others that might be made, of two striking examples. They consist of trees that grew in the county of Monmouth, a part of this island so abounding in them for ages that, even at a late period, they obtained the appellation of "the weed of the soil." Diminished in size and number by thinning out, and the facility of removal through railroad accommodation, they still flourish innumerable amidst the hills and valleys of that beautifully diversified region. Specimens, both here and elsewhere, may no doubt be found upon record that may have exceeded the largest to which we are referring; but they both appear so remarkable, on account of the ends to which they were applied, that they deserve to be rescued from oblivion. The first and smaller of the two was called

THE BRYNGWYN OAK.

Bryngwyn (signifying the White Hill) is a term of frequent occurrence in Wales and on the borders. In this case, the estate on which this tree was felled, in 1791, is near Raglan, and was then the property of William Morgan, Esq. Its price was forty guineas, and its dimensions and various distributions on dissection were thus minutely described by the purchaser:—

Bark, 3 tons, 17 cwt., 2 qrs.
Cordwood, 31 cords, 3 qrs.

Cooper's timber, from slabs, etc.

84 hogshead staves.
67 barrel staves.
106 kilderkin staves.
256 cooper's ends,
28 hogshead heads.
38 barrel heads.
49 kilderkin heads.

	FEET.
Butt-piece 31 feet long, when sided to upper piece of stem	330
From the two slabs, 216 feet of knees, sided square from the angle	216
1 branch, 29 feet long, siding 17 inches	58
1 ditto 24 ditto by 19	60
1 ditto 19 ditto by 17	38
13 sided knees	217
When converted	919

In the square state.		FEET.
One piece growing from the side, about 12 feet from the ground, squared in nine pieces .	106	
One piece damaged by felling	52	
23 ends of crooks from different branches not less than 6 inches in girth	118	
Or 29 tons, 35 feet		1195

This account, somewhat irregular in its arrangement, though there is no reason to think inaccurate as to number, weight, and measure, appears by itself somewhat extraordinary, but is marvellously surpassed by the next example, that in gigantic proportions may be said literally to *cast it into the shade*. The ensuing statement, put into the hands of the writer of this article, some years ago, by one who was resident near the place where this enormous tree grew, is detailed in a different but more satisfactory form. Like the preceding, it stood on an estate from which it took its name of

THE GOLYNOS OAK.

Golynos is about four miles from the town of Newport, and is in the parish of Bassaleg. The tree was purchased by his Majesty's Purveyor of Plymouth Dockyard and Dean Forest, in the year 1810, for one hundred guineas, and was felled and converted in the same year. Five men were each twenty days stripping and cutting it down, and a pair of sawyers were constantly employed one hundred and thirty-eight days in its conversion. The expense of stripping, felling, and sawing, exclusive of superintending the conversion or hauling any part of it, was eighty-two pounds. It was felled in separate parts, and stages were erected by the workmen to stand on to cut down the valuable limbs. Previous to being felled it was divested of its brushwood, which was placed as a bed to prevent the timber from bursting in falling. The main trunk of the tree was nine feet and a half in diameter, and consequently no saw could be found long enough to cut it down; two saws were therefore brazed together. In cutting the main trunk through, a stone was discovered six inches in diameter, six feet from the butt, and three feet in a diametrical direction from the rind, round which the timber was perfectly sound. The rings in its butt being reckoned, it was discovered that this tree had been improving upwards of FOUR HUNDRED YEARS! and, as many of its lateral branches were dead and some broken off, it is presumed that it must have stood little short of a *century* since it attained maturity. When

standing it overspread *four hundred and fifty-two square yards of ground*. Its produce was as follows :—

	FEET.
Main trunk, at ten feet long	450
One limb	472
One ditto	355
One ditto	235
One ditto	156
One ditto	113
One ditto	106
Six smaller ditto	413
Dead limbs of the size of timber	126
Total quantity of timber	2426

Its conversion was thus :—The main trunk was cut into quarter boards and cooper's stuff; the limbs furnished one upper piece-stem for a hundred-gun ship; one ditto, fifty guns; one rother (rudder?) piece, seventy-four guns; three lower futtocks, each one hundred guns; one fourth futtock, one hundred guns; one ditto, seventy-four guns; one ditto, forty-four guns; one floor-timber, seventy-four guns; one second futtock, one hundred guns; and about twenty knees, all of which were large enough for the navy. The heavy body-bark was three inches thick. When all its parts passed into the market, they produced nearly six hundred pounds! What compression, what expansion from a single seed, weighing probably less than a quarter of an ounce, and contained with ease in the hollow of the human hand!

The secret of the growth and magnitude of these and similar specimens is, that for the most part they were solitary beings, that spread out their limbs without any neighbouring opponent or control. Such as these, rearing their heads aloft on the wide common or wayside green, charm the eye of the lover of nature's beauties, who deplores the utilitarian feeling that imperils their lives. Their majesty and beauty conspire to seal their doom; the contractor and carpenter see nothing in them but pounds, shillings, and pence, and they are gradually disappearing by the railway at hand. All things must yield to traffic in a money-getting age; but the exertions of the poet and the painter will still survive the destruction wrought by man and time.

"Everything," says Epictetus, "hath two handles." Your readers, Mr. Editor, will be differently affected by the representation of the fate of these objects. There may be those who think they could not be appropriated to a better purpose; on the other hand, there are those who, if they had their own

way, would gladly have spared them till they perished by decay. All do not view the same object in the same light, and it is well for the general good that it should be so. Each has thus his share in it.

It happened to the writer many years ago that he was riding in company with several persons, among whom was the celebrated author of the *Essay on the Picturesque*, together with a simple country squire, whose ideas and admiration of forest scenery centred in trees as timber. "What a charming effect," said the lover of pictorial beauty, "do those masses of foliage produce!" "Yes," added the other, "but the trees are worth next to nothing in the market." The man of taste turned round with a glance of disapprobation, and was silent at the moment, but could not refrain from expressing apart his disgust and indignation at such an absence of feeling; and yet each in his own way was not far from right.

Sir Uvedale Price, Bart., the person alluded to, a man of taste and a scholar, was an enthusiastic lover of forest scenery, as his oaks at Foxley, near Hereford, bore ample testimony. He used to prune them regularly, in part, with his own hand, and had under him a set of pruners who worked beneath his own eye. On the loss of one of them he expressed his regret to the writer in the words employed by Priam on the death of Hector, "Ὅς δέ μοι ὁῖος ἔην (*Iliad*, Ω), such was his zeal for the care and cultivation of the oak.

A taste of this kind seems to have been inherent in the family. Colonel Price, a brother of the above gentleman, was a great and deserved favourite of George III. An anecdote is related of him that the King, intending to have a certain tree taken down, asked the Colonel's advice respecting it, at the same time expecting to meet with a ready acquiescence in the notion of its propriety. The Colonel, however, ventured respectfully to say that he was of a different opinion. "Aye," replied the King, somewhat hastily, "that's your way, you continually contradict me." "If your majesty," resumed Colonel Price, "will not condescend to listen to the honest sentiments of your faithful servants, you can never hear the truth." After a short pause, the King very kindly laid his hand upon the Colonel's shoulder, "You are right, Price, the tree shall stand."

J. W.

ON THE GENUS FICUS.

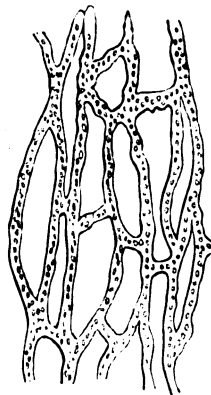
BY JOHN R. JACKSON,
Curator of the Museum, Royal Gardens, Kew.

(*With a Tinted Plate.*)

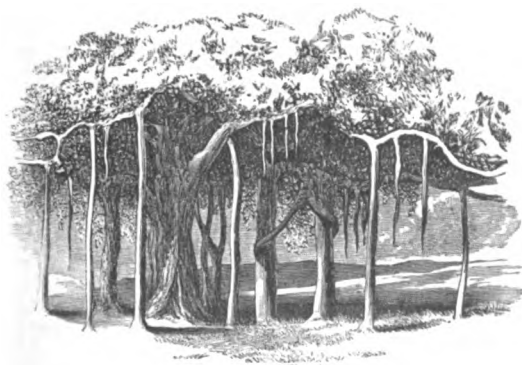
WE have before spoken of tropical forest trees, and in a previous paper in the *INTELLECTUAL OBSERVER*, we gave a brief account of some of the most noble of the Australian forms; we also, in that paper, made a passing allusion to the denizens of the oriental forests. We purpose now to conduct our readers into some of these forests, or rather to introduce them to some of their inhabitants. Amongst the finest trees of purely tropical scenery, of course still excepting the palms, the members of the genus *Ficus* hold a prominent place. This genus belongs to the natural order *Moraceæ*, and is that also to which our common fig belongs, besides *Morus* itself, which includes the mulberry, *Broussonetia*, the paper mulberry, *Dorstenia*, and others. Though the order is small, it is a most important one, both in an economic point of view, and also in botanical interest. The genus *Ficus* is especially rich in many varied forms of useful products, for besides the fig itself, we have caoutchouc, lac, etc. Whether any of the species are European is a question upon which our best botanical authorities have differed. Lindley says that none of the *Morads* are European, and that the mulberry and common fig have both been brought from the East; other writers consider the fig to belong originally to Asia Minor, Persia, South-Eastern Europe, and North Africa. We can only say, that if not truly indigenous, the plant has become thoroughly naturalized in all the countries mentioned above. The way in which many of the species adapt themselves to circumstances in their mode of growth is peculiar, and very striking to an observer. In many cases we find them twining, and almost enveloping, colossal palm trunks, though they are capable of forming very thick trunks of their own, which frequently bear an immense spreading crown. The magnificent wild fig-trees of the East, indeed, are always regarded as the true friends of the sun-scorched traveller, affording, as they do, such a cool retreat, and such a complete shelter from the sun. Lindley says the genus *Ficus* is one of those which travellers describe as most conducing to the peculiarities of a tropical scene; and, quoting from the "*Annals of Natural History*," he says, "Mr Hinds points out the complex appearance of the main stem of many species; their immense horizontal branches, their proportionate lowness,



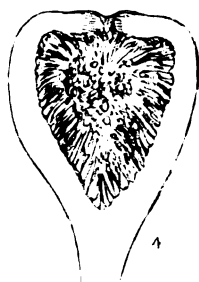
2



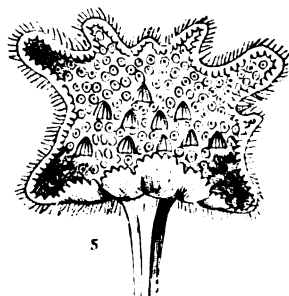
3



1



4



5

THE GENUS FIGUS.

1.—Banyan tree, (*Ficus Indica*, L.)

2.—Palm encircled by *F. Indica*.

3.—Laticiferous tissue of *F. elastica*, Rox.

4.—Section of Common Fig. (*F. carica*, L.)

5.—Open receptacle of *Dorstenia contrayerva*, L.

and the vast number of smaller stems in every stage of development—some just protruding from the horizontal limbs, others hanging midway between the leafy canopy and the earth, displaying on each thick rounded extremity an enormous spongiole, while many reach the soil, and, having attained strength and size, act as columns to sustain the whole structure.” The best example of this very peculiar provision for supporting so wide-spread a canopy is to be found in the Banyan-tree (*Ficus Indica*, L.) Fig. 1. This tree is certainly one of the most famous and interesting of all the East Indian forms of vegetation, and is the best type of the peculiar adaptability of the genus in forming irregular trunks, and that in a manner quite contrary to the usual mode of proceeding in the vegetable world. We all know that one of the laws of plant-life is to send its root downwards and its stem upwards, so that the former may take in from the earth the nutriment there stored, while the latter, developing itself by its natural appendages, performs the important functions of respiration. This, of course, in its infancy, is the case with the banyan; but after it has grown, and formed its crown of foliage by throwing out its branches, and while yet a young tree, these branches perform a double duty; for besides being the support of the leaves, they throw out again downward branches, which reach, and strike root in the ground, and then go on growing as true stems, thus forming a support for the spreading mass above. These trees are common all over the East Indies: and to such a size do they grow, that one tree forms a miniature forest in itself. The largest banyan-tree is said to be on the banks of the Nerbuddah river, where, for aught we know, it is still growing. Forbes, in his “Oriental Memoirs,” says the circumference of the tree at the time of writing the account, was nearly 2000 feet, and the overhanging branches which had not thrown down their props or supports, stretched over a much larger area. The tree had as many as 320 main trunks, and over 3000 smaller ones, and was capable of giving shelter to 7000 men. These dimensions appear almost fabulous; there is, however, another fine tree at Mhow, which has sixty-eight stout stems, and can give shade, even under a vertical sun, to an immense number of men; indeed, we are constantly told that a regiment of cavalry can conveniently take refuge beneath one. For large assemblies or meetings they form perfect natural tents. It is very certain that these immense trees must be of great age; and we should naturally expect to find a full description of so remarkable an object in the works of the old classic authors. Strabo’s description is both minute and accurate, as is also that of Pliny. The banyan has been the theme of poets in more recent times, as well as of travellers

and naturalists. Milton beautifully describes it in the following passage—

“Branching so broad and long, that in the ground
The bending twigs take root; and daughters grow
About the mother tree; a pillared shade,
High over-arched, with echoing walks between.
There oft the Indian herdsman, shunning heat,
Shelters in cool; and tends his pasturing herds
At loop-holes cut through thickest shade.”

And Southey, in his “Curse of Kehama,” says—

“’Twas a fair scene wherein they stood,
A green and sunny glade amid the wood,
And in the midst an aged banyan grew.
It was a goodly sight to see
That venerable tree.
For o’er the lawn, irregularly spread,
Fifty straight columns propped its lofty head;
And many a long depending shoot,
Seeking to strike its root,
Straight, like a plummet, grew towards the ground.
Some on the lower boughs, which crossed their way,
Fixing their bearded fibres round and round,
With many a ring and wild contortion wound;
Some to the passing wind, at times, with sway
Of gentle motion swung;
Others of younger growth, unmoved were hung
Like stone-drops from the cavern’s fretted height.
Beneath was smooth and fair to sight,
No weeds nor briars deformed the natural floor;
And through the leafy cope which bowered it o’er,
Came gleams of chequered light.
So like a temple did it seem, that there
A pious heart’s first impulse would be prayer.”

Though habit has taught us to look upon the root of a plant as that part alone which is buried in the earth, we see there are such things as roots being given off from totally different parts. This occurs mostly, if not entirely, in tropical climates, and is effected greatly by the influence of moisture and shade, considering, of course, that the plants have a natural predilection for forming these aerial, adventitious, or secondary roots. The banyan is a good example of a plant producing aerial roots.

The structure of a true root, when fully developed, is very similar in all respects to a true stem. The epidermis, however, is without stomata, and the bark is always very thick, owing to the moisture it absorbs from the earth. Thus we find that stems of many plants are capable of forming roots, as is instanced by the growth of plants from cuttings, or by pegging a bent branch down to the ground. In the case of the banyan, so long as the roots are pendant, they derive their nourishment from the parent trunk, but so soon as they reach the ground,

the spongioles or absorbent parts of their roots become more developed, and strike into the earth, and then begin the necessary functions for increasing their diameter, and supporting the weight of the new foliage above. It is not at all uncommon to see the trunk of the talipot palm (*Corypha umbraculifera*), or the palmyra (*Borassus flabelliformis*), completely encircled by one of these figs. (Fig. 2.) This is caused by the seeds, which are very small, dropping into the axils of the leaves of the palm, where they vegetate, and send their roots downwards, embracing the trunk in their descent. In very old specimens, where these aerial roots have extended to a goodly diameter, the palm is seen emerging from the thickness of the fig, as if it was actually one and the same plant. These combinations are considered sacred by the Hindoos, who call them holy marriages. A white, glutinous juice exudes from the stem, which is considered a remedy in toothache; bird-lime is also manufactured from it, and an infusion of the bark is said to be a powerful tonic.

A small but very good specimen of the banyan-tree may be seen in the palm-house of the Royal Gardens, Kew, and a trunk of the talipot palm, encircled as described, is in the museum of the same establishment.

The Popul (*Ficus religiosa*, L.) is also a native of the East Indies, and is remarkable for the long tapering points of its leaves, as well as the closely reticulated and strong vascular fibre. The Chinese make very pretty and effective ornaments of these leaves, by removing the cellular tissue or green pulpy matter, and covering the skeleton with a coat of varnish or gelatine, and then painting figures of birds, flowers, etc., on the surface. The ease with which the cellular tissue is removed by macerating, recommends the leaves of this species for the purpose of dissecting or skeletonising for leaf bouquets. Amongst the Hindoos, the popul-tree is greatly venerated, their belief being that among the branches the goddess Vishnu first saw the light. The plants are, in consequence, frequently to be met with near houses, pagodas, etc., and the natives are very unwilling to cut them down. Birds devour the fruit with avidity; and in their flight, instances have been known of the seeds having fallen into the cracks of buildings, where they have germinated, and caused much damage. They are used in medicine by the native practitioners, as is also the bark. The leaves of the different species vary much in form, those of the popul being heart-shaped, with the long slender point before spoken of, and seated upon long and slender petioles; they have a trembling motion in the air, very similar to that of the common aspen. They are a favourite food for silkworms.

Peculiar as the two species here enumerated are, the most

important of the Indian species, in an economic point of view, is *F. elastica*, Roxb. It is a tree growing some thirty or forty feet high, with large oval or oblong leaves, very thick and glossy, and is now well known as a common conservatory and parlour plant. The fruits are arranged in axillary pairs, sessile, or without stalks, not larger than an olive. From this species most, if not all, the caoutchouc or India rubber brought from the East Indies is obtained. We all know how abundantly a white milk flows from the least fracture occasioned to any part of this plant, the prick of a pin upon its stem or thick green leaf will cause it to ooze out, and by exposure to the air become thick and elastic. When collected in its native country for commercial purposes, deep incisions are cut through the bark nearly down to the wood, in a transverse direction, and about a foot apart. The juice flows from these wounds in large quantities, and, on coming in contact with the air, forms itself spontaneously into a solid elastic substance, from which a kind of whey or foetid fluid separates. After such a tapping as this, the tree is said to require but a fortnight's rest before it is ready for a similar operation. The presence of caoutchouc or milky juices in plants is a character of many natural orders. Some yield a pure milky fluid, which never hardens. The vessels that contain this fluid are called laticiferous tissue, or cinenchyma. They are very minute, the average diameter of one of them not exceeding $\frac{1}{1000}$ of an inch. One of the chief distinctions of these vessels is, that they lie in no regular or definite position to the other tissue, and consist of long branching tubes, as seen at Fig. 3. In their young state, they are very thin and hair-like, but as they get older, they become large, their sides thicken, and contract in some places, and swell in others. This has given rise to an opinion amongst some botanists that they are merely a series of cells, placed end to end, in which the partitions have become absorbed, as there are no divisions through their entire length. The contents of these tubes, called the latex, is not in all plants milky, but sometimes coloured, and at other times quite transparent and colourless. It is always of a granular nature, but its chemical composition varies in different plants; for while some give a perfectly harmless, and even a nutritious milk, others are acrid and narcotic. The cells which contain caoutchouc, and similar juices, must therefore not be confounded with the cells or vessels through which the ordinary nutritive functions of the plant are carried on, nor must the fluid itself be confounded with the sap.

The common Fig (*Ficus carica*, L.) is perhaps the best known of all the species, owing to its valuable fruit. As we have before said, its native country is doubted. The plant is,

however, now cultivated to a very large extent in Turkey, and on the shores of the Mediterranean. It is a tree growing in favourable situations to a height of twenty or thirty feet. The plant is so well known in our gardens and greenhouses, that it would be needless to describe it. We may, perhaps, however, be allowed to say a few words about the fruit, as it is a peculiar, though a common one. We hear people speak of the "seeds" of the fig, meaning those little granular sago-like things so numerous inside a fig. These are not seeds, which we should soon discover were we to examine them in a green fig. They are each of them a small individual fruit, which in this form is called an achene. The *Ficus carica* is not cultivated for the sake of its flowers, for though it does flower, and that profusely, we venture to doubt if there are many of us who have actually seen the flower. It is not showy, nor is it exposed, as most flowers are, to the air and light. In most of our common fruit-producing plants, we first behold the bud, then the expanded flower, which in time drops away, leaving the fruit to develop itself to the size limited by nature; but in the fig, what we call the fruit is not the produce of one flower, but of many. The fleshy part which we eat, is in botanical language called a receptacle. (Fig. 4.) There are, however, various forms of receptacles, and even in the same family to which the fig belongs; thus, for instance, in *Dorstenia* (Fig. 5), we have an open, somewhat irregular square receptacle, slightly turned up at the edges like a tray. In this genus the flowers are exposed, but are still numerous as in the fig. Another common example of an open receptacle is to be found in the sun-flower, and we have only to bring up the sides, and nearly unite them at the top, and we shall have the same form of receptacle as the fig, namely, a hollow one, with the inflorescence inside instead of out. This inflorescence is of both sexes, else fertilization could not take place; and it is worth noticing the provision of nature in placing the male flowers near the orifice, at the apex of the fruit, while the females are seated in the concave part below; by this arrangement, the pollen from the male flowers, in dropping, is more sure to fall on the stigmas of the females, as the figs themselves, in their earlier stages of formation, and when the flowers are fully expanded, are nearly always more or less upright upon the stalks which bear them, seldom drooping until after fertilization has taken place, and the receptacle has become swollen. It frequently occurs, however, that the stamens are imperfect and no pollen formed. A practice, called caprification, has been resorted to in the East to provide for this natural deficiency. A number of wild figs, which are often infested with a species of cynips, are strung on threads and hung above the

cultivated ones. When the insects escape from the former, they enter the latter by the orifice at the apex, and so, by carrying the pollen grains upon their wings or otherwise, fertilize the female flowers. This system, however, is not so generally adopted as formerly, as it is now considered to injure the quality of the figs. It appears to have been clearly understood and practised by the ancients, as it is fully described by Theophrastus and Pliny. The introduction of the fig into this country is by some writers attributed to the Romans, and by others not till the early part of the 16th century, on the return of Cardinal Pole from Italy. The very trees which he brought, and which were planted in the garden of Lambeth Palace, are said to have flourished for 300 years. There is, or at least was until very recently, several fine examples of very old fig-trees in the kingdom, some of them of very great diameter, proving that even in our climate the fig is capable of thriving, though a severe frost is liable to do it great injury. The south coast of England, however, appears to agree with it, and standard trees have been known to produce fruit in tolerable abundance.

There is yet another species of this interesting genus which we must just notice before taking leave of it, and this is the sycamine or sycamore fig (*F. Sycomorus*, L.). This is supposed by some to be identical with the tree into which Zaccheus climbed. If this is so, and the tree is to be identified with that mentioned in many passages of Scripture, it must have been of great importance among the Jews, though the fruit is small, and hardly worth eating compared with that of the common fig. The light wood of this plant is said to be almost imperishable, and served to make the cases of the Egyptian mummies. The genus includes about 200 species, but the few we have described are the most important in an economic point of view, the most peculiar, and the types of the genus generally.

RED STARS.

GREAT interest attaches to red stars, not only from their extreme beauty when seen through a good telescope in contrast with a dark clear sky, but also from the changes which many of them undergo. Our numerous readers who possess telescopes will therefore be gratified with the following abridged list of solitary red stars published by Dr. Schjellerup in the *Astronomische Nachrichten*, No. 1591. We have omitted all the stars he mentions below the eighth magnitude (except some of the variables), as ordinary telescopes cannot exhibit them satisfactorily; and in consideration of the wants of subscribers living in more southern lands, we have inserted many stars not visible in this country. Those who possess equatorial telescopes will find the red stars without difficulty, and those who are not so provided will be able to trace their position on a map, and thus learn where to point their instruments in search of them.

Dr. Schjellerup remarks on the general interest excited by red stars, and he observes that with few exceptions variable stars are reddish, either constantly, or at some period of their transition. When changes of colour occur at definite periods in variable stars we may expect that interesting information concerning them may be afforded by the spectroscope.

As the following list contains the great majority of the solitary stars mentioned by Dr. Schjellerup, it follows that the majority of these bodies at present known are of the eighth magnitude and upwards; and the reader will notice how large a proportion range between the seventh and eighth magnitudes. Sir J. Herschel mentions an 8.5 mag. star, R.A. $12^{\text{h}} 39^{\text{m}} 15^{\text{s}}$ D. $-58^{\circ} 55' 7''$ as the "most intense blood red" of any star he has seen, and it will be found from the list that stars approaching this tint are rare. Observers who use reflectors for their observations will find the colours more exactly seen when a glass prism is used instead of a smooth mirror, and achromatic eye-pieces like those of Mr. Browning will (with reflectors) be more reliable than Huyghenian.

R.A. 1860. h m s	Decl. 1860.	Mag.	
0 51 41	— 6 38.2	8	Schj. 340: <i>red</i> .
1 8 27	+25 1.6	8	Bessel: <i>red</i> .
1 9 42	+46 57.5	7.5	Argelander: <i>very red</i> .
1 10 15	+ 8 11.5	var.	S Pisc. Hind: <i>reddish</i> .
1 13 47	+ 6 17.0	neb.	h. 101: <i>red star</i> . 7.5. 45° s.p. According to d'Arrest, in 1864, Sept. 25, this star was 9 mag.
1 20 32	—33 16.6	6	Cape Obs.: <i>most beautiful orange red</i> .
1 23 25	+ 2 9.5	v	E Pisc. Hind: <i>fiery looking</i> .

A.R. 1860. h m s	Decl. 1860. ° ' "	Mag.	
1 45 24	+69 30,8	8	Argelander: <i>very red</i> .
1 59 35	+ 0 46,5	7	Cape Obs.: <i>very red</i> .
2 8 10	+24 24,3	v	R Arietis. Winnecke A. N. 1224: <i>orange in max.</i>
2 12 18	— 3 36,6	var.	o Ceti. Cape Obs. <i>Very full ruby; sang.</i>
3 9 1	—57 50,9	7.5	Cape Obs.: <i>high orange or brick red.</i>
3 9 26	— 6 14,8	7	Bessel: <i>red.</i>
3 37 1	—10 3,0	8	Schj. 1132: <i>red.</i>
3 45 13	+60 41,6	5.5	Conn. d. T. XV.: <i>red.</i>
3 48 31	—15 19,2	8	Schj. 1216: <i>yellow red.</i>
4 13 46	— 6 34,9	7.7	Schj. 1375: <i>yellow red.</i>
4 14 9	+20 28,9	6.5	Radcliffe Obs. XIX.: <i>pale red.</i>
4 20 38	+ 9 50,8	var.	R Tauri. Hind: <i>red.</i>
4 21 32	+ 9 38,0	var.	S Tauri. Hind: <i>reddish.</i> Winnecke A. N. 1224: <i>no colour.</i>
4 26 45	—11 5,1	6.7	Schj. 1462: <i>yellow red.</i>
4 27 53	+16 13,5	1	a Tauri.
4 36 45	+67 54,8	6.5	Argelander Zone 80: <i>very red.</i>
4 42 45	+28 16,9	8	Cape Obs.: <i>a very extraordinary ruby</i>
4 44 37	+14 0,9	5	Conn. d. T. XV.: <i>red.</i> [coloured star.
4 46 5	+ 2 15,6	5.5	Conn. d. T. XV.: <i>red.</i>
4 48 14	+ 7 33,0	7	Conn. d. T. XV.: <i>red.</i>
4 51 22	+ 7 54,7	var.	R Orionis. Hind: <i>reddish.</i>
4 53 14	—15 1,2	var.	R Leporis. Hind's <i>crimson star.</i>
4 54 38	+ 0 30,9	6	Schj. 1615: <i>yellow red.</i>
4 58 10	+ 0 58,9	6.5	Hist. Cél. pp. 49 and 316: <i>red.</i> [yellow.
5 2 55	— 0 44,5	7	Knorre Acad. Sternk: <i>red.</i> Schmidt:
5 10 26	+39 11,5	7	h. 350: <i>very ruddy, almost orange coloured.</i>
5 11 35	+34 7,1	8	Cape Obs.: <i>very remarkably red.</i>
5 16 36	— 9 27,7	8	Schmidt: <i>very red.</i>
5 22 38	— 1 12,3	5	Hist. Cél. p. 251: <i>red.</i> Schmidt: <i>yellow red.</i>
5 24 1	+18 29,2	5.5	Conn. d. T. XV.: <i>red.</i> [red.
5 29 18	+10 56,7	7.5	Hist. Cél. p. 311: <i>red.</i> Schmidt: <i>yellow</i>
5 34 0	— 3 55,2	8	Schj. 1878: <i>red.</i>
5 35 0	+ 2 17,6	7.7	Schj. 1888: <i>red.</i>
5 36 40	+24 21,4	8	Markree Cat. I. p. 76: <i>very red.</i>
5 39 19	—46 31,4	8	Cape Obs.: <i>vivid sanguine red, like a</i>
5 47 36	+ 7 32,6	v	a Orionis. [blood drop.
5 49 32	+45 55,1	6	Hist. Cél. p. 142: <i>red.</i> [2 Observ.
5 55 15	— 5 8,5	7.7	Schmidt: <i>yellow red.</i> Schj. 2015: <i>red.</i>
6 2 12	+26 2,3	8	A. N. No. 77, p. 73: <i>reddish.</i> Greenw. Obs. 1863: <i>very deep crimson colour.</i>
6 17 29	+14 47,7	8	Bessel: <i>red.</i> Cape Obs.: <i>vivid red.</i>
6 18 4	—26 58,7	8	Cape Obs.: <i>very intense ruby coloured.</i>
6 23 26	— 2 55,9	7.7	Schj. 2236: <i>red.</i>
6 26 55	+38 33,2	6.5	Hist. Cél. p. 208: <i>red.</i> Cape Obs.: <i>superb orange red, very rich colour.</i>
6 35 17	—52 48,5	6	Moesta Obs. p. 103: <i>reddish.</i>
6 41 0	—20 36,0	neb.	h. 411: <i>the chief * 8 mag. is red.</i>
6 49 59	+70 55,6	6	Struve Obs. Dorp. II. p. 60: <i>sub-red.</i>
6 52 32	—48 31,6	5.5	Moesta Obs. p. 111: <i>reddish.</i>
6 56 8	—27 44,2	3.5	Piazzi 320: <i>sub-ruby.</i>
6 58 55	+22 54,9	var.	R Gemin. Radcliffe XV.: <i>red.</i> Auwers A. N. 1238: <i>pale red.</i>
7 0 9	— 7 20,7	8	Bessel: <i>red.</i>

AR. 1860. h m s	Decl. 1860. °	Mag.	
7 1 31	—11 42,6	7.5	Hist. Cél. p. 271: <i>red</i> . Argelander: <i>reddish</i> .
7 6 30	+59 9,7	7	Struve Obs. Dorp. II. p. 76: <i>red</i> .
7 7 11	+22 12,6	7.3	Radcliffe XV.: <i>very red</i> .
7 17 14	—25 29,7	7	Cape Obs.: <i>very intense fiery red</i> .
7 25 7	+ 8 36,8	var.	<i>S</i> Canis minoris. Hind 1856: <i>a fiery</i> 8.5 mag. Winnecke Astron. Nachr. 1224: <i>very red</i> .
7 34 33	+29 33,3	5	σ Gemin. d'Arrest: <i>reddish</i> .
7 34 38	+23 46,6	var.	<i>S</i> Gemin. Hind 1848: <i>bluish</i> , 1852: <i>reddish</i> . Winnecke Astron. Nachr. 1120: <i>deep orange</i> .
7 36 45	+28 21,6	1.5	β Geminorum.
7 40 54	+24 4,7	var.	<i>P</i> Geminorum. Hind 1848: <i>ruddy</i> , 1852: <i>bluish</i> . Auwers Astr. Nachr. 1238: <i>reddish or orange</i> . [<i>orange</i> .]
7 53 16	—49 36,7	8	Cape Obs.: <i>rich brick red, inclining to</i>
8 8 51	+12 9,2	var.	<i>R</i> Cancr. Auwers A. N. 1238: <i>bright</i>
8 14 54	+ 0 17,0	8	Bond p. 253: <i>red</i> . [<i>orange</i> .]
8 18 7	—37 50,2	6	Moesta Obs. p. 115: <i>reddish</i> .
8 27 45	+19 22,5	v	<i>U</i> Cancr. Winnecke A. N. 1224: <i>no</i> <i>colour</i> . Auwers A. N. 1238: <i>reddish</i> .
8 39 36	+ 0 9,3	8	Bond p. 245: <i>orange</i> : p. 255: <i>orange red</i> .
8 48 34	—10 50,4	8	Schj. 3282: <i>red</i> .
8 48 40	+20 23,0	var.	<i>T</i> Cancr. Bessel: <i>red</i> . Hind: <i>very</i> <i>red</i> . Winnecke Astr. Nachr. 1224: <i>blood red</i> .
9 1 54	—25 17,2	4.5	Argelander: <i>red</i> .
9 2 13	+31 32,1	6	Hist. Cél. p. 221: <i>red</i> .
9 28 42	—62 10,7	8	Cape Obs.: <i>very intense sanguine star,</i> <i>between scarlet and carmine red</i> .
9 37 10	+35 9,3	var.	<i>B</i> Leonis minoris. Schönfeld A. N. 1500: <i>yellow red</i> .
9 40 2	+12 4,6	var.	<i>R</i> Leonis. Greenw. Obs. 1861: <i>deep red</i> .
9 44 36	—22 21,8	6.5	Argelander: <i>red</i> .
9 49 44	—40 55,6	7.5	Cape Obs.: <i>scarlet</i> ; <i>remarkably full</i> <i>rich colour</i> . Three Obs.
10 3 59	— 7 43,7	6	Hist. Cél. p. 152: <i>red</i> .
10 5 46	—34 38,0	7	Cape Obs.: <i>Scarlet</i> . Three Obs.
10 29 1	—38 50,6	6.5	Cape Obs.: <i>extreme orange, almost</i> <i>scarlet</i> . Two Obs.
10 30 12	—56 50,0	5.5	Moesta Obs. p. 117: <i>reddish</i> .
10 30 39	—12 39,5	6.5	Hist. Cél. p. 329: <i>red</i> . Bessel: <i>red</i> . Lamont Z. 316: <i>orange</i> .
10 34 41	+69 30,5	var.	<i>B</i> Ursæ majoris. Auwers A. N. 1238: <i>pale red</i> .
10 44 49	—20 30,5	6.5	Hist. Cél. p. 284: <i>decidedly red</i> . Arge- lander: <i>very red</i> .
10 52 36	—15 36,2	6	Argelander: <i>red</i> .
10 53 40	—17 34,4	8	Cape Obs.: <i>most intense and curious</i> <i>colour</i> . <i>Scarlet, almost blood colour</i> .
11 4 59	—81 1,9	8	Cape Obs.: <i>ruby, almost sanguine</i> .
11 10 55	+33 51,5	4.5	Conn. d. T. XV.: <i>red</i> .
11 33 55	+25 34,9	8	d'Arrest: <i>red</i> .
12 15 10	—74 44,0	8.5	Cape Obs.: <i>sombre red</i> .
12 23 22	—56 19,4	2	γ Crucis. Rümker: <i>red</i> .
12 25 4	+ 5 26,8	9.5	Ross Phil. Trans. 1861: <i>scarlet</i> .

AE. 1860. h m s	Decl. 1860. ° ' "	Mag.	
12 37 48	+61 51,6	var.	<i>S Ursæ majoris</i> . Auwers A. N. 1238: <i>red or violet</i> .
12 38 32	+46 12,3	5.5	Hist. Cél. p. 385: <i>red</i> . d'Arrest: <i>red</i> .
12 45 24	+17 52,1	8	d'Arrest: <i>tauny (subfusca)</i> .
12 51 11	+18 31,5	8	d'Arrest: <i>red</i> .
13 11 18	-22 25,8	3	Conn. d. T. XV.: <i>red</i> .
13 19 20	-11 58,7	5.5	Conn. d. T. XV.: <i>red</i> .
13 22 4	-22 33,4	var.	<i>R Hydræ</i> . Piazz: <i>ruby</i> .
13 25 42	- 6 28,4	var.	<i>S Virginis</i> . Pogson, Radcliffe XV. p. 288: <i>vivid red</i> . Auwers A. N. 1238: <i>orange</i> .
13 42 44	+16 29,6	4	Argelander Abo Catalog: 1829 Maii 12, <i>noted as red</i> .
13 47 13	+41 1,8	7	d'Arrest: <i>tauny</i> .
13 57 40	+ 0 12,8	8	Bond p. 281: <i>reddish</i> . [brick red.
13 59 13	-59 3,5	8	Cape Obs.: <i>double equal</i> . Both stars
14 6 53	-59 15,6	7.5	Cape Obs.: <i>ruby, or high orange</i> .
14 9 17	+19 54,8	1	α Bootis.
14 17 25	+ 8 43,6	6	d'Arrest: <i>fulvous</i> .
14 17 53	+26 20,6	7.5	Cape Obs.: <i>vivid red; almost a bright ruby colour; fine</i> .
14 22 22	- 5 21,4	8	Schönfeld Neb. Cat. pp. 66 and 68:
14 25 48	+31 59,3	4	Conn. d. T. XV.: <i>red</i> . [reddish.
14 28 55	+37 14,6	6	Hist. Cél. p. 164: <i>red</i> .
15 0 58	-69 32,8	6	Cape Obs.: <i>almost scarlet</i> . Two Obs.
15 9 19	-29 37,8	4.7	δ Lupi. Greenw. Cat. of 1439 stars: <i>very red</i> .
15 10 37	-75 25,1	7	Cape Obs.: <i>very high red, or ruby</i> .
15 15 6	+14 49,2	var.	<i>S Serpentis</i> . Winnecke Petersh. Bull. III. p. 176: <i>red</i> .
15 29 59	+15 34,0	7.5	d'Arrest: <i>red</i> . [reddish.
15 42 49	+28 35,3	var.	<i>R Coronæ bor</i> . Auwers A. N. 1238:
15 44 15	+15 33,7	var.	<i>R Serpentis</i> . Winnecke A. N. 1224: <i>remarkably red</i> . Auwers A. N. 1238: <i>not very red</i> .
15 59 56	+18 45,1	var.	<i>R Herculis</i> . Auwers A. N. 1238: <i>red</i> .
16 1 19	+22 12,1	7.5	d'Arrest: <i>reddish yellow</i> .
16 18 57	-12 5,9	8	Cape Obs.: <i>dull brick red</i> .
16 19 37	+19 12,8	var.	<i>U Herculis</i> . Schönfeld A. N. 1523: <i>red</i> .
16 20 50	-26 7,1	1.5	α Scorpii.
16 31 39	-32 5,8	8	Cape Obs.: <i>deep red, like a drop of blood</i> .
16 43 57	- 5 56,0	8	Schj. 5990: <i>red</i> . [blood.
16 45 31	+15 10,8	var.	<i>S Herculis</i> . Auwers A. N. 1238: <i>red</i> .
16 52 26	- 4 0,4	8	Schj. 6046: <i>yellow red</i> .
17 8 16	+14 33,2	var.	α Herculis.
17 14 33	-28 0,2	6	Argelander: <i>reddish</i> .
17 30 31	-41 32,3	8	Cape Obs.: <i>beautiful ruby red</i> .
17 31 17	-57 39,0	8	Cape Obs.: <i>brilliant scarlet, or very high orange</i> .
17 36 43	-18 35,5	8	Cape Obs.: <i>remarkably red</i> .
17 51 2	+ 2 44,3	7.5	Cape Obs.: <i>a very fine orange star</i> .
17 59 7	+ 7 5,3	8	Schj. 6539: <i>red</i> .
18 1 41	-15 18,1	8	d'Arrest: <i>red</i> .
18 12 18	+ 0 47,3	8	Cape Obs.: <i>a very red star</i> .
18 21 59	+ 6 12,7	var.	<i>T Serpentis</i> . Baxendell Monthly Notices XXI. p. 68: <i>deep yellowish red colour</i> .

A.R. 1860. h m s	Decl. 1860. ° ' "	Mag.	
18 14 59	+ 0 5,7	7·5	Bond pp. 39 and 309: <i>red</i> .
18 24 44	—14 57,6	6·5	d'Arrest: <i>red</i> .
18 25 40	— 5 15,7	7·5	Schj. 6803: <i>red</i> .
18 30 58	—13 53,8	8	d'Arrest: <i>red</i> .
18 35 8	+ 0 1,5	8	Bond p. 41: <i>red</i> .
18 52 9	+14 10,2	8	Lamont Z. 199: <i>red</i> .
[18 56 55	— 5 53,4		Knott: <i>fine crimson</i> .]*
18 59 38	+ 8 1,2	var.	R Aquilæ. Auwers A. N. 1238: <i>red</i> .
19 2 47	+23 57,6	7	Conn. d. T. XV.: <i>red</i> .
19 8 29	—19 33,0	var.	R Sagittarii. Auwers A. N. 1238:
19 23 20	— 3 4,7	7	Lamont Z. 258: <i>red</i> . [reddish.
19 26 17	—16 40,4	7	Cape Obs.: <i>high scarlet or good ruby colour</i> . Two Obs.
19 26 30	+76 16,9	6·5	Argelander: <i>very red</i> .
[19 33 4	+49 53,2	var.	R Cyni. Knott: <i>colour remarkably fine</i>
19 37 35	+ 4 37,8	8	Schj. 7572: <i>red</i> . [at times.†
19 58 21	—27 37,3	7·5	Cape Obs.: <i>fine ruby coloured</i> . Two Obs.
20 3 27	—14 40,8	var.	R Capricorni. Hind: <i>reddish</i> .
20 8 55	—21 44,7	6	Hist. Cél. p. 174: <i>red</i> . Cape Obs.: <i>this is perhaps the finest of my ruby stars</i> .
20 19 0	+ 9 36,3	8·5	Lamont Z. 265: <i>red</i> .
20 19 23	—28 43,1	8	Conn. d. T.: <i>red</i> . Cape Obs.: <i>fine ruby coloured star</i> .
20 50 40	+15 42,9	8	Lamont Z. 204: <i>red</i> .
21 9 15	+59 32,2	8	Conn. d. T. XV.: <i>red</i> . Piazzzi 61: <i>ruby</i> . Argelander: <i>very red</i> .
21 11 31	—70 19,2	6	Cape Obs.: <i>ruby red, inclining to orange</i> .
21 36 54	+77 59,6	var.	S Cephei. Conn. d. T. XV.: <i>red</i> . Argelander: <i>very red</i> .
21 37 29	+37 22,6	8	Bessel: <i>red</i> .†
21 39 13	+58 8,4	var.	W. Herschel's <i>garnet star</i> . Argelander:
21 39 17	— 2 51,5	6·5	Hist. Cél. p. 183: <i>red</i> . [very red.
21 57 38	+27 40,4	8	Cape Obs.: <i>very ruddy orange</i> .
22 7 52	+39 1,3	4·5	Argelander Abo Cat. 511: <i>red</i> .
22 17 52	+55 15,4	6·5	Argelander: <i>very red</i> .
22 52 30	—25 54,6	6	Hist. Cél. p. 181: <i>red</i> .
22 59 37	+ 9 47,4	var.	R Pegasi. Hind: <i>red</i> .
22 59 57	+ 8 39,2	5·5	Conn. d. T. XV.: <i>red</i> .
23 11 16	+48 15,0	5·5	Argelander: <i>red</i> .
23 23 31	+ 0 6,4	8	Bond p. 107: <i>red</i> .
23 25 30	+23 4,4	8	Lamont Z. 223: <i>red</i> .
23 39 14	+ 2 42,6	6	T. Mayer, Piazzzi etc.: <i>sub-ruby</i> .
23 45 37	74 45,1	6·5	Radcliffe Vol. XIX.: <i>orange</i> .
23 49 55	—27 24,2	5·5	Hist. Cél. p. 570: <i>red</i> .
23 51 19	+50 36,5	var.	R Cassiopeiæ. Pogson Radcliffe XV. p. 294: <i>vividly red</i> . Auwers A. N. 1239: <i>bright red</i> .
23 54 9	+59 34,6	6	Argelander: <i>red</i> . A small bluish star following 7s55 on same parallel.

* Omitted by Schjellerup. In June, 1865, we saw it repeatedly as an orange star, flushed with intense crimson. It follows 12 Aquilæ by 2' 48", 2' 5" north of the parallel. Mr. Knott believes it slightly variable.

† We are indebted to Mr. Knott for pointing out Schjellerup's omission of this star.

‡ In September, 1865, Mr. Slack requested Mr. Knott's attention to the colour of this star, and he reported that on the 15th it was a fine coppery or orange red. On another night, at intervals, it was finely flushed with pale carmine, which was often seen by Mr. Slack.

HIGHLAND INSECTS.

BY E. C. RYE.

THE English Entomologist, confining himself for the most part to the productions of his native land, is at a great disadvantage, as regards mere variety and quantity of material, compared with continental workers; the late Dr. Schaum, when on a visit to this country, having indeed expressed astonishment that there should be *any* entomologists here, as there appeared such a "plentiful lack" of objects for investigation. Our insular position is, of course, in a great measure the reason of this comparative dearth of species; but, *en revanche*, it has the advantage of imposing upon our study a definite limit; and no one who has perused the works on the Atlantic fauna by our talented countryman, Mr. T. V. Wollaston, can deny the charm of working at island groups.

There are, however, more things in the British isles than are dreamed of in our philosophy, especially in the way of insects, and notably in the order *Coleoptera*, or beetles; and, strangely enough, it is from the more boreal parts of Great Britain that novelties are to be expected. The remote nooks and corners of the north are necessarily less investigated than the more easily accessible southern hunting-grounds; but the superficial observer would be inclined not to attach much weight to this point, as he would argue (and with apparent reason) that insects are most plentiful in the southern counties, and get gradually scarcer towards the midland and northern districts. Nevertheless, there are many parts of the south and west where beetles never abound, and from whence nothing entomologically good ever comes; and the geological formation and universal utilization of the soil of the midland counties account, in a great measure, for their want of insect-life,—the drainings of meres, and other "improvements," having especially exterminated many rarities. But when we get beyond the borders, and reach the mountainous districts of the Scottish highlands, a new insect-life, sub-alpine, and strange to southern eyes, greets us. Nor are the individual exponents of species rare, very many occurring in great profusion, and some of the forms being of considerable and unexpected size, curious development, and attractive colours.

Some years ago the little village of Kinloch-Rannoch, on the shores of Loch Rannoch, in Perthshire, about twenty-five miles west of Killiecrankie, was discovered (entomologically) by the late Mr. Weaver, a professional collector; and, subsequently to his time, has periodically been visited by many

pilgrims (including the writer of these notes), the result being evident in the addition of many species to our fauna, some of the most startling kind. About nine miles from Kinloch, on the south side of the loch, and stretching down to its shore, is a patch of thick pine-forest, about four miles square, known as the Black Wood, on account of the dark colour of the trees, some of which are of great age and size, being indeed occasionally so large, as to require the outstretched arms of two men to span their trunks. This forest must once have extended beyond the village of Camachgouran (*prononcez* "Camhouran," Gaëlicè), as the black soil is evidently composed of comparatively recent vegetable detritus, interspersed with knotted and gnarled stumps. Behind, is a wide-spreading flat of heather, *Sphagnum*, and pools, shut in by "Cross Craig," a mountain some three thousand feet high, its feet clothed with birch trees, and its top often snowy in summer, and nearly always wrapped in mist. To the west the view is closed in by more birch-scattered hills, at the foot of which a wide, steep, and rapid burn dashes along, with alternations of wavelets flashing over white boulders, black, sullen eddies, and leaping falls. This burn takes the drainage of the mountains on the flanks of Rannoch Moor, a vague, pathless tract, reaching to misty Glencoe, and is fed notably by a streamlet from "Gray-vel" (Gaëlic for "rough," and well deserving the epithet), a mica-capped and white marble studded peak, with precipitous crevasses, higher than and behind Cross Craig. On this mountain, in mid July, with cloudless skies and unbearable heat, I have seen patches of snow, five feet deep, and more than a hundred feet long, evidently destined to remain unmelted until increased by the next winter's fall. Here, also, ptarmigan are found among the peaks, on the lichen level. It will be noticed that in this district the conditions for the production of insect-life are extremely favourable; the heat being intense while it lasts, and alternated by a period of undisturbed rest (not the undecided winters of the south, which often allow insects to come to maturity prematurely, or tempt them from their torpid condition to an unseasonable and self-destructive activity),—the supply of vegetable pabulum unlimited, and in all stages, from soundness to decay,—and the atmosphere tempered by an almost constant dampness, in itself a necessary to most insects.

The Black Wood—however it and its neighbourhood may abound in insect-life—is nevertheless no place for drawing-room entomologists. There is a road along part of its skirts, certainly, but with that one road ends all approach to civilization. Once having left it, the collector must shift for himself—knee deep in wet *Sphagnum*, stumbling over vast decayed and

moss-grown logs, crashing through underwood, leaping from boulder to boulder, wading the numerous rapid streams, and always panting up, or slipping down-hill. Unfortunately, also, the inner man will find little indigenous food to sustain the over-taxed powers. Meat is a myth; milk scant and skim; eggs are small and few; so that oatmeal alone is left as a staple. Happy he whose primitive digestion can assimilate it with comfort. The Southron stomach does *not* take to it kindly as the sole staff of life. Of course, the luxurious traveller can take potted and savoury meats, curious drinks, and other vanities with him; but the road to Camachgouran is not favourable to much luggage. Once settled in that village, where some of the hospitable Gaëls will, for a nominal consideration, and to their own great personal discomfort, cede half of a two-roomed stone shanty to the visitor, he can, when on the verge of starvation, walk his sixteen miles to Kinloch and back for dinner—a meal to be obtained, in a surprisingly good style (apart from the oatmeal antithesis), at the fishing inn there, under the needle-peak of Schehallion.

Although my notice has been chiefly directed to the *Coleoptera* at Rannoch, there are a few conspicuous species of other orders occurring there, to which brief allusion must be made. In the *Lepidoptera*, butterflies appear to be scarce; the Alpine forms, in which the continent is so rich, being represented in this country by a very meagre list. Still, such mountain species as we possess are found here, and in abundance; *Erebia Cassiope*, a sight not often vouchsafed to southern eyes, flitting gaily on the mountain sides, high up, and retreating from observation directly the sun is obscured; *Blandina* being more common, and *Davus* swarming on the lower levels. The latter species occurs plentifully on Carrington moss, near Manchester, under similar conditions. The gap between the two localities is rather wide, but the subject of geographical distribution, as regards British insects, comprises harder problems than this; a recent puzzle having been afforded by the discovery, in one of the wet ravines at the back of Wimbledon Common, of *Stenus Kiesenwetteri*, a large and conspicuous species, and which had not long before been described as new to science from specimens found in Spain.

At Rannoch, also, among the birches, occurs plentifully, at times, the handsome moth known as "The Glory of Kent" (*Endromis versicolor*), formerly only taken in the extreme southern counties. This is one of the *Bombycidae* to which the practice of "sembling" is so fatal; a virgin female being bred and taken into the woods, where she attracts numerous males, who insist upon being caught, as it were; but by what

marvellous keenness of perception they are directed to their unseen attraction we cannot divine.

A permanent variety of the Oak-eggar moth (also easy to catch in the way indicated above), or a species closely allied to it (for it has been described as separate), is very common here on the heather, over which its large chocolate-banded male may be seen, winging his rapid flight in the hot sunshine in search of his bride—who, larger still, and of lighter hue, reposes sluggishly near her birth-place. This insect must be dear to a believer in the Darwinian theory, as it halts between the two opinions of a species and variety; its larva feeding on a different plant to that of the type form, and differing slightly, and the perfect moth also differing slightly in colour, and coming out at a different period of the year.

Another fine moth, *Petasia nubeculosa*, first discovered here as British, is found on the birch-trees, when the snow is on the ground; for insects in Alpine situations seem less affected than their southern brethren by climatic influences: as an instance of this I may remark that I have seen *Bombus lapponum* flying and working here in the cold rain at five o'clock in the morning. Concerning the *Petasia*, its original captor adhered to the statement that he was materially aided in finding the moths by certain tree-creepers, which flew from birch to birch, chattering, and directing his attention to the insects on the trunks.

Parasitic upon some of these large moths must be a large and handsomely banded species of *Metopius*, one of the *Ichneumonidæ*, which I took flying on Grayvel; probably its larva is nourished in that of the above-mentioned eggar (*Lasiocampa callunæ*), which would be sufficiently bulky to contain it. Another very large and thin black species, allied to *Pimpla*, with exceedingly long three-bladed ovipositor, was often observed by me flying round the felled trunks at the woodman's saw-pit, Dall; and it was most interesting to watch the prying ways of the creature, as it peered into holes and crannies, delicately gauging the many galleries made by the larvæ of *Longicorn* beetles, which its formidable weapon could scarcely fail to reach. A small species of *Spathius*, supposed also to be parasitic upon wood-beetles, used to occur plentifully in the wood work of my solitary bed-dining-and-drawing-room, which was riddled by *Ptinus* and *Anobium*, evidently its prey. The *Anobium* (a genus to which the well-known "Death-watch" belongs) kept me awake for some time by the frequency and persistency of its ticking, clicking call,—one beetle answering another by rapidly striking its hard mandibles against the sides of its gallery, and the result being very clear and distinct in the stillness of the night.

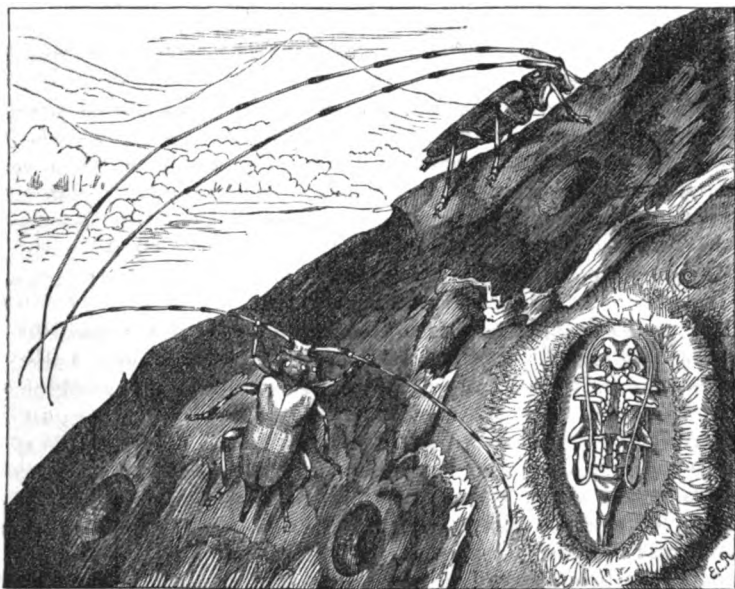
Of other *Hymenoptera*, our largest saw-fly, *Cimbex femorata*, and the large wood-ant, *Formica congerens*, were most conspicuous. The former, which flies sluggishly round the tops of young birches, could be taken by suddenly and violently hitting the trunk of the tree directly the insect was observed to settle on the top shoots, when it would often fall helplessly into the net; and the nests of the ants were to be seen, sometimes of huge dimensions, agglomerate masses of pine-droppings and sticks, swarming with their bellicose tenants. In these nests (not easy to examine, apart from the large size, great numbers, and sharp mandibles of their occupants, on account of their unusually copious and pungent exhalations of formic acid) lives a small species of *Tinea*—odd dwelling for a delicate moth,—also *Homalota parallela* and other myrmecophilous *Coleoptera*, and, notably, the larva of the Scotch rose-chaffer, *Cetonia cenea*, a species resembling, but duller than, our common rose-beetle.

Of the *Neuroptera*, some fine species of dragon-flies were not rare, *Cordulegaster annulatus* (found also in South Devon), being perhaps the most common, with the southern *Libellula A. maculata*, and the polar *Æschna borealis*, and *Cordulia arctica*. One cannot fail to be struck with the unusual circumstance (in England) of the large size of so many of these noteworthy insects, as, comparatively, but few of the southern forms are large; or, if so, are common species.

It is, however, to the *Coleoptera* that we must look for peculiarities of structure, novelties in appearance and habit, and additions to our lists. Here the wood-feeders, but seldom seen in the metropolitan district, play a conspicuous part, owing to the great abundance of their natural food. One of the most abundant at certain times is a *Longicorn* (*Astinomus ædilis*), which could scarcely fail to attract the attention of the most inveterate non-observer, owing to the extraordinary development of its antennæ, especially in the male. The accompanying wood-cut, in which the insects are life-size, will show to what a length horns can be carried, even in our temperate clime, unused to developments of frequent occurrence in more tropical regions. The female, readily distinguished by her long ovipositor (with which of course she lays her eggs in fitting chinks of the bark), has the antennæ much shorter than the male; a difference easily seen, even in the pupa condition, inasmuch as in that of the latter sex they are carried round in a complete circle, and again curved towards the front, whereas, in the female pupa (figured in the cut) each antenna is only just long enough to form a circle. The larvæ, which, like those of all wood-feeding insects, live for a long time in that condition, eat broad galleries on the surface of the solid

wood of the pine, beneath the bark, passing the winter in nests formed of chewed fibre, and eventually turning into pupa within a similar rampart. They seem to assume the perfect condition late in the summer or beginning of autumn, hibernating in their cell until the first hot days of the spring, when they gnaw a way to outer light with their powerful mandibles through the pine bark, which often looks as if it had served as a target for pistol practice, owing to the number, size, and neatly-cut edges of these escape holes.

Although lignivorous by nature, the males of this curious insect are excessively pugnacious; two of them settling on a tree-trunk being almost sure to fight, so that it becomes any-



thing but easy to find specimens with their fragile appendages quite perfect. It is a fine sight to the untravelled coleopterist to see a male of this exotic-looking creature flying across a glade of the forest, with his long antennæ streaming behind like the pennants of a ship. The inhabitants of the village are quite familiar with the *Astinomus*, on account of its frequenting the wood-huts, timber-cutting yards, and even the door-posts of the shanties, usually settling and gravely walking about with its horns extended laterally like an open pair of compasses, from which habit, indeed, it derives its fanciful specific name of "*Ædile*," as if a surveyor of buildings.

It appears to be common in Sweden, where, from its wood-frequenting habits, it is called "timberman" by the country-people, according to Linnæus; and it is exceedingly curious that several of the dwellers in Camachgouran also call it by the very same name. The insect is not known to be found in any other part of Great Britain (save accidentally; as, for instance, when a live specimen—a very Triton among the minnows of London beetles—was found in the courtyard of the British Museum, whither it had been conveyed under the bark of a stout larch pole, brought with others for scaffolding); so that the coincidence of name is very curious, for I imagine that the works of the learned Swede have not yet become household words amongst an isolated community whose sole literary wealth (*crede experto*) consisted of a Gaëlic Bible and a copy of Bunyan's "Pilgrim's Progress" (original edition).

It should be observed, however, that the parallel between the Swedish and Highland fauna is so marked that the student derives great assistance, when working in this district, from the works of Gyllenhal and Thomson; a clue to many of the species recorded by those authors, and already recognized as British, though very rare, being afforded by their notes as to habits and times of appearance, which also assist in the discovery of species new to our lists.

Another common insect at Rannoch, *Trichius fasciatus*, a *Lamellicorn* allied to the rose-beetle, is interesting, not only on account of its excessive rarity elsewhere, but also through its mimetic analogy to the common humble-bees, *Bombus muscorum* and *B. lapponum*, found in its company. It is bright yellow, with interrupted velvety black bands on the elytra, and covered with dense long yellow downy hairs, and delights to settle on thistle flowers; being, indeed, known to the villagers as the "bee-beetle." This unwonted appreciation by common people of the peculiarities of animals usually so despised as insects, is doubtless owing to their familiarity with collectors, and is possibly tinged with the suspicion of attachment of a pecuniary value, as the first visitants to Rannoch were dealers, who obtained a large price in London for insects then considered of great rarity, and therefore could afford to employ all the "young barbarians" to collect these really common things for "bawbees." Another conspicuous beetle, *Lamia textor* (which derives its specific name from a recorded habit of weaving osier-leaves together, after the manner of a tailor-bird, as a nidus) was formerly common here, but has been nearly exterminated by the "penny a-piece" system of collecting, the insect being easily seen on the willow-trees through its large size, cumbrous build, and deep black colour. It occurs also near Bristol. Very different from this is the deli-

cate, flattened, beautifully reticulated, bright red *Dictyopterus Aurora*, first discovered here, and not as yet found elsewhere in Britain, where it has long been considered as one of the arcana of science. It is very plentiful among rotten pine-chips under logs, accompanied by its larva, which much resembles that of the glow-worm, and, delicate as it is, is voracious enough, for I found one feeding on the carcase of a deceased "Shard-born" beetle (*Geotrupes*): the perfect insect may also be seen flying feebly, towards evening, in the depth of the forest. Its foreign brethren delight in settling on flowers; but we have only another species here, *D. minutus*, found very rarely in the south, mostly in rotten wood.

In consequence of the prevalence of fungoid growth under the decaying bark of felled trees and stumps, the family of *Anisotomidae* is well represented in the Black Wood by considerable numbers of *Liodes* and *Agathidium*, the species of which much affect such food. Three of our four species of the former genus (one of them occurring here only) are indeed to be taken in considerable numbers, gregariously haunting the black powdery residuum of certain fungoid excrescences on old bare pine stumps, in which they nestle, covering themselves as a sparrow does with road dust when water is not to be had. They are very little creatures, and, like the *Agathidia*, roll themselves up into balls, drop to the ground, and "scuttle" off when alarmed by the approach of the collector's fingers.

The *Agathidia* especially frequent a small dry, pink, puffy ball, growing on pine logs, and also damp, white layers of fungus under bark. Although small, they are of great interest, owing to their peculiarities of structure, not the least of which is the diversity in the number of joints of the tarsi between the two sexes. One species, *A. Rhinoceros* (Sharp), recently found here, and apparently new to science, is conspicuous from the great development of a sharp curved horn springing out of the left mandible of the full-grown males. In small examples of that sex the horn is much reduced, sometimes even entirely vanishing; and this reduction or absence of a strong sexual development is often found in the *Coleoptera*, where the most favourable conditions are required in many instances to produce the perfection of the type form, and especially in wood-feeding insects. So great, indeed, is the disparity frequently between the two extreme phases, that authors have been tempted to describe them as specifically distinct. The common stag-beetle exhibits a good instance of the possibility of increase of the sexual distinction of size of mandibles under favourable circumstances, in its earlier stages; as small male specimens often occur with very stunted jaws, when reared from willow, or stunted in proper food during the larval condi-

tion ; whilst a male from a full-fed oak-bred larva is of great bulk, and bears huge branching dentate mandibles. It is not, however, only the mandibles that are subject to this variation ; all sexual developments, such as cornuted processes on head or thorax, swelling of hind femora, dilatation of the head or front tarsi, spining and curving of the hinder tibiæ, etc., come under the same law.

A very marked instance of a frequently observed habit of insects—viz., that of their frequenting places similar in colour to themselves, was constantly forced upon my eye at Rannoch by *Rhagium indagator*, a Longicorn beetle apparently peculiar to this part of our country, and belonging to a genus very destructive to timber, the fat, flat-headed larvæ swarming under pine-bark in all directions, and committing great havoc. This insect is of a mottled grey colour, strikingly similar to the lichen-covered bark of the larch, on which tree (and never on the dark black pine) I constantly found it, beetle and bark being so precisely alike in hue and markings, that it was possible absolutely to sit on the log and yet not see the insect. On these logs, and under the bark, the very flat *Pytho depressus* (another species added to our catalogue from Rannoch) is occasionally to be found—a beetle which, although apparently bulky when viewed from the upper side, is most eminently adapted for slipping into the narrowest cracks. Its voracious, elongate larva, armed at the hinder apex of the upper side with two recurved hooks, for the purpose of obtaining a fulcrum, is found under bark, where it preys upon the larvæ of *Rhagium*, and other true wood-feeders.

Running about quickly, in company with *Pytho* and the fragile *Dircea*, *Clerus formicarius*, a curiously banded and variegated species, strongly suggestive of a large exotic ant, might often be seen ; its larva being of similar sub-cortical habits to that of the *Pytho*.

The freshly-cut stumps of fir-trees, fragrant with exuding turpentine, act as splendid traps for many beetles, *Astinomus* often settling on them, and a flattish, dull black Longicorn allied to it, *Asemum striatum*, called "the soft timber man" by the wood-cutters, being very plentiful. Ripping the bark off these and older stumps disclosed numerous colonies of Xylophagous *Coleoptera*, with their larvæ and attendants ; the species of *Hylastes* and *Hylurgus* being very abundant in deeply cut narrow channels worked in the underside of the bark, at the end of each of which the change to pupa takes place, the perfect insect drilling a neat round hole through which it escapes to the surface. Two species of *Ips* (one yellow, the other black, with red spots), and three or four of the linear *Rhizophagus*, abound also in these galleries ; syc-

phants of the true wood-feeders, among which they have hitherto been considered to rank (as far as selection of food goes), until M. Perris, a distinguished French entomologist, pointed out their true relations with regard to the *Xylophaga*. From his observations (which I have been enabled to corroborate in a great measure) it appears that the species of *Ips* and *Rhizophagus* enter the holes made in the fir-trees (either in chinks of the bark, where there is the thinnest space between the inner and outer coatings, or, in the case of felled stumps, at the junction of the bark and wood) by the *Hylastes*, and lay their eggs in the galleries made by the latter, on whose larvæ their larvæ feed. M. Perris has observed the larvæ of the common *R. depressus* with half their bodies plunged into the larvæ or pupæ of *Hylesinus* or *Hylastes*, devouring them; and I have myself seen the same species half immersed in a sickly specimen of a perfect *Hylurgus piniperda*.*

At the junction of the bark and solid wood in freshly-cut stumps, the female of *Pissodes pini*, a large and very prettily marked northern species of weevil, may be constantly seen, laboriously drilling round holes with its rostrum, in which to deposit eggs. Its fat, full-grown larva, or the pupa in a gnawed out cell, may often be found near the ground, to which it has eaten its way under the bark; where also its ally, the still larger *Hylobius abietis*—a clumsy, dull black, delicately yellow marked *Curculio*, of very clinging habits as to its tarsi—undergoes its changes, and may be found copiously. The latter insect has been imported in Scotch timber (in the larval state) to the south, where it is not uncommon.

These species, though constantly wood-feeders, exhibit a great difference in structure to certain other tree-frequenters; their heavy bulk being strongly contrasted by the thin, flat, elegant, long-limbed, *Dendrophagus crenatus*, a very rare sub-cortical species, which I found coursing rapidly, towards evening, over a bare stump; and by the cylindrical *Xyloterus lineatus*, which undergoes its changes deep in the solid wood, drilling a small, neat shot-hole through to the surface at right-angles from the centre, and lurking at the mouth of its burrow, into which it retreats backwards on the least alarm. A similar, but larger, hole is drilled in the very hardest pines by the larva of *Hylecætus dermestoides*, which nothing but a woodman's axe can circumvent. The exceedingly flimsy material of which this curious elongate *Malaco-*

* Certain species of *Epyrræa*—small flat testaceous beetles, often seen in flowers and fungi, or at the exuding sap of trees—are also attendants upon the larvæ of the small wood-feeders; one especially, *E. pusilla* (conspicuous through the arched middle tibia of its male), thronging the galleries. I imagine that they are attracted by the wet frass and sappy exudations caused by the operations of the *Xylophaga*.

derm is constructed causes its burrowing operations to appear the more wonderful. In the male, usually much darker than the other sex, the maxillary palpi are of great size, assuming the appearance of a fan, on account of the third joint (which is much developed) having numerous bronchial appendages.

The southern naturalist can hardly fail to be struck by the great prevalence of certain conspicuous species of *Elateridæ*, or "skip-jacks,"—a family with which he cannot make much acquaintance in his own district. Here many of them abound, and they are often of large size and bright colours, from the very rare banded and lovely *Athöus undulatus* to the shining black *Elater nigrinus*, beaten off birches; the very stones on the sandy shores of the loch covering little families of the jerking *Cryptohypnus*. Their long, vermiform larvæ abound in rotten wood; and some bright shining *Oteniceri*, with strongly-serrated antennæ in the male, fly about in the hot sunshine, often settling on timber with a metallic clang. The females of these are more sedentary and much rarer, occurring under stones, etc., and having the antennæ much smaller and more simple.

Of the *Phytophaga*, so abundant in the south, perhaps the most abundant of the few species to be seen is (at its proper season, and in its right locality) a most beautiful and variable species of *Cryptocephalus* (first discovered here in Great Britain in 1865), the *10-punctatus* of Linnæus; which, in its normal form, is clear yellow, with black spots—the male being darker and banded—and both sexes "sporting" into a deep black variety (*bothnicus*, Linn.). This elegant creature defies the net, and has to be absolutely "stalked" in its native dwarf sallow beds; it drops hopelessly into the wet moss if a shadow fall on it, and in the hot sunshine flies as readily as the common green Tiger-beetle (*Cicindela campestris*), which abounds in the hot paths. Of the latter a black form occurs, but exceedingly rarely; dark forms, also, are to be found of many bright insects (a circumstance often observed in marshy places), so glistening and coppery a species as *Anchomenus ericeti* being here taken of a dull, deep black colour.

Want of space prevents me from entering upon the numerous fungus-feeders abounding here, from the gregarious and minute species of *Cis* to the large Cassidiform *Thymalus*—also found in the New Forest; or upon the many Coprophagous Lamellicorns, or the very numerous species of *Brachelytra* or *Staphylinidæ* (of which Scotland is the metropolis), from the lustrous but rapacious bandit *Quædinus lævigatus* under bark (whose crooked yellow pupæ are often to be seen) to the many *Tachini*, living in *stercore*—insects of an apparently puzzling uniformity, but a close observation of whose diversely

sculptured anal plates has resulted already in the addition of two species from Scotland new to us. It is in the *Brachelytra* that the most numerous novelties have been, and will for some time continue to be, found. But a few words must be given to the beetles found upon the absolute mountain-tops and sides, which are of different habits and forms to those on the lower levels. On the topmost peaks, among the mist, the rare *Miscodera arctica*, a huge *Dyschirius* in show, occurs under stones; where, also, *Otiorynchus maurus* (oftener dead and fragmentary than alive) may be seen; and the Alpine *Nebria Gyllenhalii* (not seldom with lurid red elytra) replaces the closely allied *N. brevicollis* of the lowlands; the common *Patrobis rufipes* being in like manner superseded by *P. septentrionis* and *P. clavipes*. Here in moss, and under mica slabs, occur *Calathus nubigena* (apparently a mountain form of the common *C. melanocephalus*), *Anthophagus alpinus* (the males with strongly-cornuted heads, and long apical joint to the antennæ), *Arpedium*, *Geodromicus*, and hosts of other *Staphylinidæ*. This pure mountain work has great charms, apart from the adjuncts of scenery and the bracing results of the toil; for the species found are of strange aspect, the chances numerous of obtaining novelties or observing unrecorded facts, and the problems of arrested development (exemplified by apterous conditions, short elytra, etc.) and mutation of species appear to be undergoing solution under one's eyes.

In a paper of this limited length it is, of course, impossible to note more than the general features and most salient forms of so extensive a subject as the entomological productions of a rich district; indeed, a mere enumeration of all the new and rare species that have been found at or near Rannoch alone would occupy too much space—in spite of the fact that only two orders, the *Lepidoptera* and *Coleoptera*, have been as yet worked with any energy. Enough has been done to show that for many years the English naturalist need not travel out of his own country to find novelties.

PLANS FOR IMPROVING LONDON.

THE present year, A.D. 1866, marks a period of exactly two centuries since the great fire of London, an event at that time naturally considered as a great national calamity, but which might have tended to a great national good, if firmness and sound common sense had been allowed to prevail over prejudices and self-interests. The little mind and short-sightedness were unfortunately as common in those days as at the present time, and Sir Christopher Wren's noble plan for rebuilding the destroyed portions of the metropolis was rejected in the same obstinate manner as the proposed principal lines of our railways were in our own days, when first brought before the public. In 1766, exactly one hundred years after London's great conflagration, John Gwynn published his *London and Westminster Improved*, illustrated by some admirable plans, in which more than one hundred improvements are mapped and described. In the present year, after the lapse of another century, the Engineer and Surveyor to the Commissioners of Sewers for the City of London brings forward a most able and elaborate report on *The Traffic and Improvements in the Public Ways of the City of London*.

It may, perhaps, be interesting to take a glance at these centenary productions. John Gwynn was a bold man in his way; expense to him was a matter not to be thought of. The title of his work states that his illustrated plans were prefixed by "A Discourse on Publick Magnificence," and in 132 pages of letter-press he contended for his several suggested improvements with all the ardour and ability of the Préfet Haussmann. Gwynn proposed two royal palaces—one in Hyde Park, with a circular road of one mile in circumference to enclose it, and another to fill up the space from the Green Park to St. James's Street, with one end towards Piccadilly and the other on the site of the present St. James's Palace. The Houses of Parliament he proposed to rebuild; and not having the fear of the mediævalists before his eyes, he desired to make a clear sweep of Westminster Hall, in order that the site might be raised to a proper and higher level above the river. And although at the first sight we may be astounded at so audacious a proposal, yet, in so large an outlay as there has necessarily been in the construction of the Palace of Westminster, the additional amount in raising the ground floor—the *piano nobile*—of the whole structure some fifteen feet, and rebuilding Westminster Hall on its present site, raising the roof, and making every portion of it a strict restoration of the present venerable pile, would have been at a cost justified by the national importance

of the structure, and adding immensely to the grandeur and dignity of what ought to have been the most magnificent work of architecture in the metropolis.

Gwynn's veneration for Westminster Abbey stayed his hand of demolition in that sacred quarter; but the Dean and Chapter had no doubt smiled at his suggestion, that "*an elegant light Gothic dome*" be raised from the nave of the Church, and "the whole inside of the building *painted of an uniform clean stone colour*, in the manner that St. Paul's Church is, it would then become a most beautiful pile, and be deservedly esteemed one of the finest things of the kind perhaps in Europe." St. Paul's also was to come in for a share of suggested improvement, by the lead-work of the cupola "*being painted in stone colour.*"

We may smile at these well-intentioned suggestions, but in Gwynn's long list of improvements there are many which are entitled to great praise, and some have been since acted upon. We will just run through some of the most salient.

"Bedford Row is opened into Holborn, and the line continued to Lincoln's Inn Gardens."

"St. George's, Bloomsbury, is detached and disencumbered from the buildings, and streets opened north and south."

"An opening sixty feet wide is made through Leicester Square from Piccadilly, and continued into Long Acre. The west end of Queen Street, called the *Devil's Gap*, is here opened equal to the breadth of that street obliquely from Long Acre."

The opening into Leicester Square from Piccadilly has been done; the "*Devil's Gap*," it is feared, still remains.

"From the opening at the north-east corner of Leicester Fields before-mentioned, a street of fifty feet in width, making an acute angle with Long Acre, is carried through St. Martin's Lane into New Street." This improvement has also been effected, although not quite in the order described. Garrick Street is even better than Gwynn's line of street, and the Club House on the south side presents a striking façade.

"The Haymarket is continued to St. James's Park, where a triumphal arch may be erected as a termination to the view."

"A spacious opening is made at Spring Gardens from the Park, and continued to Charing Cross, opposite the Strand."

"A direct line from Northumberland House is drawn to Whitehall, and two considerable streets are formed which run down to the Thames, one of them directly fronts the Admiralty." It is to be hoped that the proposal for an opening from Charing Cross, which has of late been seriously entertained,

may still be accomplished, and that even the ducal Northumberland Palazzo may not be allowed "to stop the way."

"A new bridge is designed from the Savoy across the river Thames."

By referring to the plan it will be seen that three radiating straight lines of streets diverge from a crescent at the foot of the bridge, the centre one leading to Bow Street and Long Acre, the westward one to Southampton Street in the Strand, and that to the east to Catherine Street in the Strand. The situation thus marked out for St. George's Bridge by Gwynn one hundred years ago, has, in our times, been very nearly adopted in the construction of Waterloo Bridge by a public company, but unfortunately without the radiating streets Gwynn laid down. That this bridge, an important entrance to London, should be allowed to continue a toll bridge is most degrading to a great nation; indeed it ought to have been a national work in the first instance, and suitable approaches made at both ends of it, with buildings of character and importance, instead of the mean and wretched tenements in Wellington Street, and the abominable common lodging-houses on the Surrey side. With the successful completion of Somerset House, Wellington Street ought to be rendered worthy of the name it bears and of the bridge it leads to.

"Carey Street is continued into Vere Street, and widened at the end next Chancery Lane." This alteration has been effected, and there is hardly any part of the metropolis which of late years has been so much improved as the south end of Chancery Lane. The widening of Carey Street, the new Union Bank, and other commercial buildings, have all tended to make this an important thoroughfare; but with all the large outlay with which this has been effected by the City of London, the north approach from Holborn is only of sufficient width for *one* carriage, and the corner house was allowed to be rebuilt upon the old site only a few years since.

The above are only a few of the numerous improvements in Gwynn's first and second plates. The third map relates to the City proper, in which many alterations are suggested about the Mansion House, the Royal Exchange, and Moorfields, some of which have been adopted entirely, and others with modifications; but as it would occupy too much space in this paper to describe them fully, we will pass on to the present century, and take a rapid view of what has been done since Gwynn produced his *London and Westminster Improved*. The Houses of Parliament have been rebuilt, Victoria Street, Westminster, is in the course of completion, Buckingham Palace has been rebuilt, the new and extensive quarter of Belgravia formed upon swamps and open fields where snipes have been shot in the memory of living Londoners.

Kensington is now united to the metropolis by rows of splendid terraces overlooking Hyde Park, and has extended to the south, forming a new quarter, which will probably ere long be devoted to the fine arts. On the other side of Hyde Park, the humble Bayswater, and the culprits' spot of doom, now stand forth a district of palaces and villas, known as Tyburnia. Marylebone fields have been converted into a charming park, where the horticulturist spreads forth his treasures, and the professors of zoology find a home for natural history. The master-hand that originated the park also designed a noble street from Portland Place to Pall Mall, as well as Trafalgar Square, and widening the Strand. The Victoria Park and Battersea Park are also new creations; the latter, one of the happiest and most successful works of the able hand now attached to the Woods and Forests' department.

In the City of London a new street has been formed from Finsbury to the Mansion House, another from the Mansion House to London Bridge, and a third from London Bridge to St. Paul's; besides sundry widenings, lopping off of corners, setting back houses, and obtaining additional width to streets. These, for the most part, have been well done. A great portion of them were due to the energy of Mr. Lambert Jones, an influential member of the Corporation. He was for a time master of the situation; but he unfortunately was too careful of the City purse, and instead of forming a bold plan in making a good line of thoroughfare from Guildhall to the Post Office, made so tortuous a line, as to occasion the remark, that "Crooked Lane (close by London Bridge) was removed to Gresham Street." London Bridge and Westminster Bridge have both been rebuilt, and the Southwark, Waterloo, Hungerford, Lambeth, and Vauxhall bridges are all new erections. A noble street has been formed on the Surrey side, leading from London Bridge to Blackfriars; there are several fine piles of warehouses erected in this important thoroughfare—one in particular, on the south side, belonging to the Hop Planters' Company, which has a *portone* worthy of the old Italian architects. With this rapid notice of works *de facto*, we will take Mr. Haywood's plan, and see what he has *in petto* for us, premising that his report being an official one, connected with his appointment under the Corporation of London, is principally confined to the City proper. "But, in order," says Mr. Haywood, "to take the broad and comprehensive view which the subject demands, I must refer to the whole metropolis, for I shall be enabled to show that a large portion of its inhabitants have the most direct interest in the City of London, going to and from it daily, spending within its limits the largest portion of their active life, earning therein their livelihood, and forming the bulk of the traffic which encumbers its streets."

"The population of the metropolis was, in 1801, 958,863; in 1861, 2,803,989—thus having trebled itself in sixty years. In 1865 the population was computed to be, in round numbers, *three millions*; therefore, in forty years hence it may be expected to be *six millions*; and it is for the wants of this future, as well as for those of the present community, in respect of highways, that provision must now be made."

Mr. Haywood introduces in his report several most useful and valuable tables, showing the vehicular and pedestrian traffic, the areas of various thoroughfares, the number of persons entering into the City on certain days, and proves incontrovertibly how enormous the amount of the to-and-fro population is to the sleeping population. The following paragraph will no doubt astonish some of our old, retired City tradesmen of twenty-five years ago:—"As the traffic has increased since 1860, it may be computed that there now pass into the City of London daily three quarters of a million of human beings, and that the same number pass out at night, leaving but its residential, or sleeping population of 113,387; and this vast daily influx is equal to *one-fourth part of the whole metropolitan population*."

"This enormous amount of in-comers and out-goers comprises all classes of society, from the highest to the very humblest in the social scale. Thus, there are 68 Members of Parliament who have offices within the City, and of that large class who are directors of the commercial undertakings which must have a home in the commercial centre, there are 56 Peers of the realm, 132 Members of Parliament, and altogether as many as 589 titled and distinguished personages, whose directorial duties bring them frequently within its precincts."

Of the vehicular traffic, it would appear, that during twelve hours in June, 1865, 19,405 vehicles passed over London Bridge, and 11,972 through Fleet Street by Temple Bar, being about fifty-one per cent. above the traffic in 1850.

After an able exposition of the immense and daily-increasing amount of civic traffic, both pedestrian and vehicular, already producing the greatest inconvenience from the crowded state of the streets, Mr. Haywood boldly states, "*There is but one complete remedy for this, which is the formation of a new bridge, or a tunnel, with suitable approaches, lower down the river than London Bridge.*"

This is certainly a startling proposition at the first view, and Mr. Haywood really exceeds his rival, Mr. Gwynn, in the boldness of his projects; but a little calm consideration of the following paragraph may convince us that Mr. Haywood's boldness is the result of sound judgment. He says:—

"I am aware of the great interests which would be interfered with by the construction of this bridge; I am aware of the large sum of money which would be required, although I believe that the cost is exaggerated in the minds of most; but whatever the interests may be, and whatever the cost may be, sooner or later a bridge or a tunnel must be built lower down the river. Nothing else will effectually relieve London Bridge at the present day, and nothing else will satisfy the requirements of the vast population which will exist east of London Bridge; and it is to be hoped that this necessity will be boldly faced at once, and not be postponed until the period when it will cost double the outlay now needed, however great that outlay may be."

This is followed up by some very sensible remarks as to the width of streets and bridges, showing clearly that the author of the report is not led away by projects of grandeur or magnificence, but that the useful is what he has always in view. The following is the extract from the report to which we allude:—"It is, however, fundamentally an error to make streets and bridges of very great width; large streets are more costly; they are also in one respect inconvenient; they lead to concentration of traffic, and if stopped or impeded (as at times they must be) the public inconvenience is very great. *Diffusion*, and not *concentration* of traffic should be the object in devising the thoroughfares of large towns. Alternative lines give the most convenience; and, as a principle, it may be said that it is far better to have two bridges, each of fifty feet in width, than one of 100 feet in width, even if the cost were greater for the two than the one."

Our space will not permit us to cull any more of the wise saws and interesting statements abounding in this able report. We cannot, however, conclude without a view of the map in which Mr. Haywood lays down a projected new street leading from the east end of the Holborn viaduct to a point in Whitechapel, High Street, where the Metropolitan Board of Works propose a continuation of it to the Docks. This fine line of thoroughfare takes a gentle curve to the northward; it passes close in the rear of Christ's Hospital and crosses Aldersgate Street, Wood Street, Aldermanbury, Coleman Street, and Moorgate Street, Broad Street, and Bishopsgate Street, and debouches at Whitechapel, as above shown. This would afford an immense relief to the traffic of Newgate Street, Cheapside, the Poultry, Cornhill, Leadenhall Street, and Aldgate.

The curved line of the street is so gentle that it will scarcely be perceived in so long a distance; indeed, in some cases, such as the High Street, Oxford, curved lines are more

picturesque and beautiful than straight ones. We cannot conclude our notice upon this able report without one more quotation from it, and bestowing our sincerest congratulations to the Commissioners of Sewers for the City of London upon possessing so accomplished and efficient an officer in the Surveyor and Engineer :—

“That looking to the future as well as the present necessities, and having regard to the fact that the cost of present improvements will probably be in a degree cast upon a future generation, they should be planned and carried out upon the broadest and most comprehensive scale, that no obstacle should be allowed to interfere with this principle; and that such course is true economy.

“It should be held in mind that where the need for public improvements arises from the increase in the numbers, business, and wealth of the population, it may generally be inferred that the population is able to pay for them.”

THE PLANET SATURN.

(CONTINUED.)

BY THE REV. T. W. WEBB, A.M., F.R.A.S.

In our last No. attention was drawn to the insufficiency of the evidence by which the period of rotation of the ring has hitherto been considered to be determined. It will be at once understood, that no idea is entertained of throwing doubt upon the fact of rotation. The reader is in possession of the means of showing the insufficiency of the objections of Schröter, Schumacher, and Schwabe; and if such a motion is not a necessary condition of equilibrium, it would be entirely beyond the power of the writer to show it to be otherwise.* What has been said amounts merely to this, that the period must still be considered as unascertained, so far as observation is concerned: even its theoretical value is rather uncertain, for Secchi has given 14·238 hours as the period of a satellite revolving a little within the external ring, A. One thing is evident, that it must differ, theoreti-

* There are some curious observations by De-Vico which are worthy of mention. On several successive nights in 1840, an extremely minute point of light, like one of the smallest satellites, was seen in the E. ansa, immovably attached to the edge of the ring (B), then widely open. A similarly-situated pretty bright point was again seen 1842, Oct 17, Ball's alone among the divisions being visible, but that very distinct. It is difficult to explain this in connection with rotation.

cally, according to the 3rd law of Kepler, for every point in the breadth of the ring—and that it must differ, practically, for every zone of the ring that has a separate existence; the width of each zone being probably determined by the relative proportion of the forces of cohesion and gravity, or, in other words, by its power of resisting the strain to which it is subjected by a rotation, the uniformity of which must necessarily be too rapid for its outer, too slow for its inner edge. From this cause Laplace perceived that the ring must be multiple; and Pierce considers that it may be divided into at least twenty annuli, each having a period of its own.

The rotation of the dark ring, C, seems to be shown by the varying colour of its ansæ; but nothing definite has been ascertained with respect to it.

There are observations which seem to indicate that the general plane of the rings is not always coincident with that of the equator of the globe. We have already mentioned a want of parallelism between the belts and ring observed by H and De-Vico (INTELLECTUAL OBSERVER, ix. 254). The same was noticed by Schwabe, 1828–29–30, when the ring-shadow and the belts converged W., though not always equally.—1833, Dec., he saw the elliptic outline of the planet very obviously inclined to the ring.—1843, Sept. 30, shadow not exactly in direction of equatorial belt.—Schmidt, the same on several nights, Sept., proved by divided object-glass. 14, belts inclined to line of satellites.—1862, May 22, Secchi proved by measurement that the black shadow was not parallel to the belts. Nothing more, of course, could be inferred from a single observation of this kind, than the probability of an oblique current in the atmosphere of the ball; but a little consideration will show, that if the obliquity is maintained through a series of observations, when rotation has brought all parts of the ball successively under the eye, it can only be explained by a temporary deviation of the ring-plane from that of the equator—a very curious feature, if it can be established.

Another deviation from symmetry is implied in certain appearances, which, if not illusory, may be ascribed either to unequal curvature in the two hemispheres, or to an anomalous position of the ring-plane, not dividing the ball exactly in half. This construction might be put upon the observations of H and Gruithuisen, about to be cited under the head of refraction; and the following may be added: Valz at the disappearance in 1833 saw N. hemisphere much more considerable than S.—1848, July 11, Bond II. saw ball most flattened at N. Pole.—Aug. 29, it seems not symmetrical; flattest at N. Pole: Bond I.—Sept. 9, Busch and Luther thought centre of ball somewhat S. of that of ring.—Oct. 10, ring and shadow to

the eye nearer S. than N., Bond II: *by micrometer*, $8''.5$ and $9''.4$.—1852, Sept. 29, Bond II. found the ball projecting somewhat more over the edge of the ring in front (S.) than behind it. Dec. 1, distance between intersections of outer edge of A with ball greater to the eye S. than N.: *by micrometer*, $10''.68$ and $9''.11$ (exceedingly fine definition). It is conceivable that the two hemispheres may be unequal in density; and the singular irregularity in terrestrial attraction which has recently been discovered round Moscow furnishes an analogy which might possibly find its counterpart in Saturn on a much larger scale, so as to dissociate the centre of gravity from the centre of figure of the ball; but unfortunately such an explanation would only be applicable if the deviation were always in the same direction.

Whether the whole ring-system may be encompassed by any perceptible amount of atmosphere is an enquiry worthy of attention. *H* considered it probable, not only because even the smallest satellites appeared distinctly protuberant on either side of the thin ring-line, but because in June, 1807, when the ring crossed the S. hemisphere so as to leave only a segment of $1''.3$ or $1''.4$ in breadth visible, that portion seemed curved or bulged outwards, while the opposite N. pole retained its usual flattened appearance. This observation, which was frequently repeated, was confirmed by his son, as well as by Professor Wilson with another telescope. A refraction of $\frac{1}{2}''$ would, he thought, be adequate to the effect. The same appearance was remarked by Gruithuisen, 1817, and in the same direction. It may be questioned, however, whether this is anything more than an optical deception, the counterpart of the quadrilateral figure of the ball. Were it a reality, its effect would increase with the decrease of the outstanding segment, till the last visible portion of the latter would exhibit an unmistakable amount of distorted elevation. Nothing of the kind, however, is on record. On the contrary, Bond II. noted, 1853, Dec. 15, that the N. pole was invisible, when the S. limb just touched the outer edge of A: circumstances under which refraction round either ball or ring would surely have made itself known.

The idea, however, of an atmosphere is not without support from evidence of another nature. 1828, Jan. 22, Kater was led to the same conclusion, by noticing that during an observation of several hours, in a perfectly favourable evening, he could find no trace of the subdivisions upon A which had struck him so much on a former occasion.

Other phenomena also may be referred to the presence of such an envelope. But before describing them we must obtain some idea of the cause of the multiform aspect of the ring

where it crosses the globe. Various cases of projection and degrees of illumination arise from the changing, and sometimes opposite positions of the sun and earth with regard to the ring-plane. When this stands nearly edgewise to both, the ring and its shadow may be alike invisible (1848, Dawes, Sept. 1, 13. Schm: Sept. 6, 14, 17, 18). If the sun and earth are both on the same side, and equally elevated, the ring will hide the shadow, but may be itself perceptible as a grey stripe from the duskiess of C, and the greater part of B, to which possibly the enfeebling of the solar light through the "horizontal misty air" of its own atmosphere may contribute (see Schwabe's observation *infra* of the progressively fading ring, 1845). If the sun is higher than the earth above the ring-plane, the shadow will be visible beneath it, and A and B will be relieved upon the ball between two unequally dark borders,* C on the one side, and the true shadow on the other—a beautiful sight. If the earth be the higher, the shadow of A and B will be lost sight of behind C, the nearer part of which it ought to render deeper in shade. I do not know that it has been seen to do so; but in this position Dawes failed to distinguish the shadow of C from C itself across the ball. If the sun and earth are on opposite sides of the plane, and each sufficiently removed from it, the ring and its shadow will come out as two dark lines crossing the ball, with an extremely narrow bright streak, a portion of the ball's surface, between them. This extremely minute object, though repeatedly seen,† has not been always visible when we might have expected it; the difference might arise from a change in the position of the plane of C (we may here remark, by the way, that if C were materially thicker than the other rings, it is scarcely conceivable that this streak of light should be ever visible); or it might be referred to the presence of an atmosphere; some possible indications of which we shall now be better able to appreciate.

During the decrease of the ring in 1845, Schwabe found it gradually diminishing in reflective power, till from being in July always brighter than the ball, it had become equal in September, and by Oct. 11, a trifle fainter, and at the same time more of an orange-grey. This went on increasing, and he could only exceptionally note the colours alike, though the ring was always the fainter. After Nov. 21, it was always much the darker, especially on the W. side.—1848. June 30,

* 1851, Oct. 26. Dawes saw both equally black, but in consequence of their falling on very unequally reflective parts of the ball.

† INTELLECTUAL OBSERVER, ix. 381, where it is erroneously stated never to be mentioned by the American observers. See Bond I., 1948, Nov. 22. To the instances of visibility there given, should be added 1861, Dec. 4, Jacob.—1862, May 13, Talmage.

Aug. 9, Dawes found the unenlightened ansæ with $6\frac{1}{2}$ in. not quite invisible on the sky, of a deep coppery tinge like the eclipsed moon. On many other evenings the visibility of the dark side is noted, just as by Bond and others; but Dawes differs from them in thinking that what was seen was not the edge, or light through openings, but the whole surface feebly illuminated, more probably by atmospheric twilight than by reflection from the ball (an idea which had occurred to H.). The ring across the globe appeared less dark than its shadow when it was possible to distinguish them; a difference which was also noted by Schmidt, Sept. 19, with the addition that these details were much less distinct towards W. limb. 20, 21, nearly the same. Oct. 12, while ring invisible, he and Brunnov at Bilk saw shadow plainer and sharper E. Dec. 3, Schm. the same again.

During this season Bond II. found, July 10, the band across the ball not quite black; 18, it was darkest near *f* limb, B. I. II. 21, ditto, B. II. Aug. 29, growing less dark, B. I. II. [as the light fell more horizontally upon it]. Sept. 18, Oct. 6, not black, B. II. Nov. 13, perhaps a twilight illumination upon it, B. I. 22, not by any means black, B. II.—1849, Jan. 26, Schm. saw the re-appearing shadow faint, and in places very indistinct.—1852, Nov. Lassell at Malta saw on two nights the shadow not black, but like C., and not sharply defined. 1861, Nov. 8, Secchi found the ring decidedly reddish across the ball, though we were looking on the sunny side. 15, violet on ball, darker than he could have supposed possible, almost black, “truly surprising,” but not well defined, whence he inferred an atmosphere. 23, much the same; the earth not till now passing to the dark side. 1862, April 25, ansæ on sky ruddy. Hence, he says, encompassed by a strong atmosphere, if there is any solid part to encompass. May 13, Birt saw shadow darker than ring on ball. Carpenter, at Greenwich, found the ring of a dirty copper colour. June 3, fancied it very faintly illuminated. 1862, May 17, when the shadow of Titan, the largest satellite, was crossing the disc,—a very interesting sight, which I was permitted to witness,—Dawes could find no trace of the shadow, which he had expected to see with $8\frac{1}{2}$ inches in beautiful air; the ring was like a very dark pencil line, but not inky black like the shadow of Titan, and there was a very faint coppery gleam, much more plainly seen on several subsequent evenings, in the place of the ansæ on either side: these appearances he was disposed to refer to refraction through a pretty dense atmosphere producing a twilight on the dark side, and diluting the shadow on the ball. About the same time Huggins saw the ansæ of a deep bluish purple,—May 20, a beautiful dark blue, scarcely

distinguishable from that of the sky.—16, to June 10, he searched in vain, like Dawes, for the shadow of the ring, which ought to have become visible in consequence of the sun's passage to the side opposite to the earth about 17.—May 17, Σ II. considered the light of W. "of the colour of rose copper." (Edgewise that day to sun.)

The reader who has had the patience to examine and compare the mass of details which has been laid before him, in an accumulation which must have appeared more than ordinarily tedious to those not specially interested in the subject, will be disposed, we think, to view it in a two-fold light. Some part of it he will consider sufficiently intelligible on the principles of analogy and the known laws of the universe ; other portions he will find so puzzling, that he would take refuge in the supposition of instrumental or personal error, did it not seem precluded by the character of the testimony. But what shall we say when we find that a number of observations which remain, are still less capable of explanation upon known principles, and at the same time are so well established by the consent of astronomers, that they cannot fairly be got rid of by any supposition of illusion ? To explain them aright is most difficult ; to explain them away may suit the taste of those who choose to magnify the attainments of human knowledge, but they would scarcely have escaped the censure of Aristides of old, in thus adopting a course which, however expedient, would not be just. The true philosopher, on the contrary, deems such outstanding phænomena of peculiar interest and value. They have continually recurred during the extension of physical knowledge, and have furnished invaluable tests of the truth of theories, which, but for them, might have found unchallenged but erroneous acceptance. And though those to which we are now referring do not seem weighty enough to overthrow any received hypothesis, yet they are such as, steadily kept in sight and diligently pursued, may lead to interesting investigations and valuable conclusions.

We have indulged in very little speculation as to the possible materials of the ball and rings. Their nature is indeed involved in so much mystery that the reader will not be disappointed if we enter into no lengthened discussion upon the subject. The very slight density of the globe is well known. It has been given at only 0.132251 (the earth being 1), or $\frac{1}{8}$ that of water, so that it would float high out of a terrestrial ocean large enough to give it sea-room. And if, as may be expected from analogy, its density increases towards the centre, the value already specified being the average of the whole mass, the exterior shell must be considerably lighter still, and we can hardly form an idea of solid materials suf-

ficiently attenuated to take their place on its surface. If fluid existed there in any quantity, Beer and Mädler have supposed that it would be raised up in a gigantic and permanent equatorial tide by the attraction of the ring: of this, however, there is no appearance.* Mädler observes that the planet is far brighter than accords with its distance from the sun (whence Gruithuisen had previously inferred the existence of native light); but this, from the analogy of Jupiter, would be due to the highly reflective power of the vapours suspended in its atmosphere.† The density of the ring has been valued by Bessel at $\frac{1}{11}$ of that of Saturn. The aspect, at least of its brighter parts, is undoubtedly that of a solid, but at such a distance the mere evidence of sense is fallacious—a terrestrial thundercloud similarly situated would undoubtedly give as bright a reflection, as hard an outline, and as black a shadow. Secchi, in fact, has become convinced that the whole appendage is of a gaseous nature, and consists of opaque clouds suspended in an imperfectly transparent atmosphere, which renders itself visible in the dusky ring, and fills up Ball's division with feeble light. Theory, as has been stated, is entirely against its continuous solidity. Professor Maxwell (of Aberdeen) has investigated the question with great ability in an essay which gained the Adams Prize at Cambridge. He has shown that Laplace's result was imperfectly worked out, and that instead of concluding that the rings were irregular solids of unequal thickness, he should have inferred that since if solid and uniform their motion would be unstable and they would be destroyed, the fact that they are stable and permanent shows that they are either not uniform, or not solid. He then proves that so great a degree of irregularity as Laplace's theory would require, being equivalent to a *load* upon the ring, is not consistent with the observed structure,‡ and that therefore, though a rigid ring is not impossible, it is impossible that the rings of Saturn can be such. A continuous fluid ring would in theory suffer such perturbation as to break it up; and he therefore concludes that the rings are "composed of an indefinite number of unconnected particles, revolving round the planet with different velocities according to their respective distances," and that these are probably arranged in a series of

* B. and M. thought otherwise. They interpreted in this way, curiously enough, the aspect of ring C upon the ball, and imagined a corresponding determination of all the fluid in the ring to its inner edge, causing its more dusky light.

† 1848, Schmidt watched the gradual removal northward of the central zone, which is usually the most luminous part, till, Sept. 17, the whole of it had passed into N. latitude.

‡ Schr's 100 miles, in p. 379 of our June No. being German, should have stood as 460. Yet, had this been a real elevation, it seems that it would not have been large enough to ensure stability.

narrow rings, affected by waves of transversal displacement, as well as of condensation and rarefaction. To obtain ocular proof of the accuracy of this remarkable theory, to which so much publicity has recently been given by the ingenious and elaborate treatise of Mr. Proctor, may never perhaps be granted to us; we must not forget that even under the most favourable circumstances, we have to contend with 700 millions of miles of space! It remains to be seen what may be effected by persevering examination; hitherto it must be admitted that instead of removing, it has increased the difficulties of the subject. This will sufficiently appear from the ensuing part of our prolonged recital, in which we shall see whether any information as to the structure of the rings, or indeed of the ball, can be deduced from the appearance of their respective shadows. The reader has already met with some puzzling matter; he must now be prepared for statements still less intelligible.

So great is the variety presented to us in this marvellous planetary system, that we are again obliged to postpone our conclusion.

OCCULTATIONS.

Sept. 26, ξ Arietis, 5½ mag. 9h. 42m. to 10h. 37m., B.A.C. 755, 6 mag. 10h. 28m. to 11h. 31m.—28, γ Tauri, 4 mag. 8h. 17m. to 8h. 42m. (well worth looking for). 75 Tauri, 6 mag. 11h. 40m. to 12h. 41m.—29, 111 Tauri, 6 mag. 9h. 58m. to 10h. 43m. 117 Tauri, 6 mag. 11h. 20m. to 12h. 13m.

THE LAKE-DWELLERS OF SWITZERLAND.*

IN our fifth volume we published an interesting paper by Mr. Henry Woodward, *On the Ancient Lake Habitations of Switzerland*, and illustrated it by a plate containing a series of drawings of implements and ornaments obtained from the Swiss lake explorations, and now deposited in the British Museum. We must refer our readers to that paper for general views on the subject, and for sketches of objects belonging to various dates. Our present purpose is to call attention to a very valuable and beautiful work by Dr. Ferdinand Keller and Dr. J. E. Lee. Dr. Keller is the author of a series of papers on the lake dwellings, and Dr. Lee has, with his consent,

* *The Lake-Dwellings of Switzerland, and other parts of Europe.* By Dr. Ferdinand Keller, President of the Antiquarian Society at Zurich. Translated and arranged by John Edward Lee, F.S.A., F.G.S. Author of "Iros Silurium," etc. Longmans.

rearranged and translated them, with additions and alterations made by Dr. Keller, or with his approval, so as to make the book an invaluable treasury of facts known up to the present time. The illustrations are of a very high order of merit, and occupy no less than ninety-six plates, comprehending an amazing variety of objects, elucidating the mode of life and state of art amongst a most interesting set of men during the many generations that they adopted a sort of amphibious life.

To settle with tolerable approximation to accuracy the earliest period illustrated by the relics of the lake-dwellers is a difficult task for the geologist, but to the antiquarian belong the later periods in which the influence of Roman civilization is distinctly seen. That in Switzerland, in Ireland, and in various parts of the earth, tribes should have lived surrounded by water on artificial islands, is not in itself to be wondered at. Fishing must have been a source of subsistence almost as universal as the water in which the aquatic vertebrates dwell. Hence the vicinity of rivers, lakes, and seas must have been favourable to the multiplication of the human race, and to their aggregation into communities. Nor are we astonished that the water should be turned into a means of defence. An island, whether natural or artificial, is, by its position, more or less protected from the attacks which rude savages can carry on; and a tribe of people living in a village sustained upon piles, only accessible from the mainland by a single causeway, or rude bridge, supplied with fish from the adjacent water, and never lacking the fluid most essential for quenching thirst, might be regarded as in a condition of considerable security and comfort.

The researches which Dr. Lee has now rendered accessible to English readers, seem to show that the custom of living on pile-supported villages in lakes, was by no means confined to a peculiar race distinct from the inhabitants of the adjacent land, nor limited to such times of barbarism as might have been supposed. The earliest lake-dwellers must, if we consider them to have been the parents and progenitors of the later lake-dwellers, have already started on the road to civilization. Their implements may have been rude, their wants few, and their means of supplying them small; but they must have been in a very different state from those races of savages which remain stationary or die out, as circumstances change. In the earliest lake-dwelling period, rude huts, resting on piles, and made in a rough fashion, something like the "wattle and dab" construction of Australian settlers at the present day, with clay floors, and roofs of bark, straw, and rushes, seem to have been aggregated into villages of considerable size. Fishing nets, and hooks made of boars' tusks, have been found in some

of the earliest settlements, and organic remains likewise show that the lake-dweller was a hunter as well as a fisherman, and chased the land animals as well as caught the finny tribes. Any bone containing marrow seems to have been dexterously split lengthwise, to get at what Professor Rüttimeyer calls a "miserable pittance," but which the old lake-dwellers, agreeing with many moderns, may have considered a tit-bit. The work before us says: "The investigation of the bones which are found in such great numbers amongst the piles of all the lake-dwellings, has shown that, together with the remains of the beasts of the chase, those of domestic animals are met with, especially of the dog, which even in the oldest settlements is found as man's companion, and, moreover, of cows, sheep, goats, and pigs." If this was the state of things with the earliest lake-dwellers, they must have been considerably in advance of the mere hunter stage of existence; and it is, moreover, found that they were agriculturists as well as keepers of cows and other animals. A sort of scratching or tearing of the ground with tools of stags-horn, or wood, seems to have been an anticipation of ploughing, but their produce was of good quality, and considerable in amount.

Professor Heer divides the plants hitherto found in the lake dwellings into—1, cereals; 2, weeds of the corn-fields; 3, culinary vegetables; 4, fruit and berries; 5, nuts; 6, oil-producing plants; 7, aromatic plants; 8, bark and fibrous plants; 9, plants used for dying; 10, forest trees and shrubs; 11, mosses and ferns; 12, fungi for kindling fire; 13, water and marsh plants. The cereals comprehended the small-grained six-rowed barley, a small variety of wheat, a beardless compact wheat, and two kinds of millet. Masses of manure from domestic animals indicate that heaps of such materials were systematically collected. The fruits comprised crabs, apples, pears, strawberries, raspberries, cherries, plums, etc.; a cake of poppy seeds, pressed, probably for oil, was found at Robenhausen, and also carraways, which may have been a condiment. As lake-dwelling existed for many generations, the state of agriculture must have changed, and that of the earliest times may be presumed not to have comprised all the articles in the list. "The inhabitants of the lake-dwellings," do not, according to Professor Heer, "appear to have had any close connection with the people of eastern Europe, for they, at least in the bronze age, cultivated rye, with which the lake settlers must have been acquainted if there had been any extensive intercourse. On the contrary, all the cultivated plants show a connection with the countries of the Mediterranean." Thus, their agriculture seems to have come from the basin of the Mediterranean, and Professor Heer remarks concerning celts of

nephrite, found in the lake-dwellings, "The presence of what is called noble nephrite, which is only known in the east, is not more strange than the appearance of the Egyptian wheat, the Cretan cattle fly, the oil-yielding poppy, and the glass beads found at Wauwyl, which were either of Egyptian or Phœnician origin. Professor Heer does not assign a very high degree of antiquity to the lake-dwellings, but thinks it probable that they extended back to one or two thousand years before the Christian era. Professor Rüttimeyer, who has examined the remains of the animals that co-existed with the lake-dwellers, observes, "I cannot, however, refrain from expressing my conviction, that even the oldest lake-dwellings do not by any means exhibit to us the primitive population of our country. I must, indeed, regard them as 'autochthones,' or, at least, as very ancient inhabitants of these districts, for they possessed, as domestic animals, a number of those that undoubtedly were indigenous here, particularly the urus and the marsh swine; but the fact that from the beginning they had the sheep and the dog, the indigenous origin of which is, to say the least, highly improbable, indicates their having descended from a still earlier people. For my own part, therefore, I have little doubt of the existence at one time of a genuine primitive population throughout Europe. This appears to have been proved, as far as France is concerned, by the latest discovery at Aurignac." In another passage the Professor adds, "The discovery at Aurignac places the age of our lake-dwellings at a comparatively late period, although almost immediately under our peat-beds, with their rich treasures, similar antiquities are found: nay, still older remains are met with, only a little deeper, in the slaty, brown coal of Dürnten, perhaps forty feet under the bed of the Lake of Pfäffikon, than those of Aurignac, which have been gnawed by hyenas after having been despoiled of their marrow by human hands."

A very important part of the work before us refers to the settlements on the mainland, which corresponded with the lake-dwellings, and were contemporaneous with them. At Ebersberg, Burg, Uetliberg, and Windisch, settlements have been discovered in which "the stone celts, flint knives, what are called corn-crushers, tools of bone and bronze, as well as implements of bone and bronze, all appear perfectly identical with the antiquities of the lake-dwellings on both sides of the Alps. And in the presence of this fact, the correctness of the conclusion cannot be doubted in the slightest degree, that the settlements of the same people who erected the lake-dwellings were also spread over the mainland."

The manufactures of the lake-dwellers exhibit an advance from rude periods to the time when Roman civilization exerted

some influence upon them. "The whole of the pottery," say our authors, "may be divided into two classes, according to the nature of the material, one, a coarser sort, made of clay mixed with a large quantity of grains of stone; and a finer kind, made of washed loam, in some cases mixed with a small quantity of charcoal powder. The shape of the vessels in the older settlements does not vary to any great extent. Urns with a large bulge and thin sides are rare, very few flat vessels are found in the shape of plates; as a general rule, the form approaches that of a cylinder. With respect to ornamentation, . . . it consists only of bosses or impressions made either with the finger or a little stick. On some specimens, worked with greater care, a commencement of the zigzag ornaments may be seen; and some also are painted with graphite and ruddle. It is very certain that many of the large pots were used for cooking, for they are covered on the outside with soot."

The writers of this work very properly reject the theories which endeavour to mark out the "stone" and "bronze" ages as sharply defined. They see that improvements came gradually in old times as they do in new, and that transitions were gradual as they are now. But as the lake-dwellers learnt to cast bronze, and finally to work iron, they improved their various arts, and the pottery associated with bronze implements bears marks of augmented skill and increasing tact. "Still, at this period no vessels are found artificially formed with long narrow necks, like bottles, flasks, or jugs, which are so abundant in Roman times." The numerous plates with which this volume is illustrated contain a great many sketches of potter's vessels, wrought by hand, not by a wheel, and exhibiting the progress from rude shapes to elegant forms.

A very curious kind of pottery was ornamented with plates of tin, as thin as paper, which seem to have been pressed into the earthenware while it was soft, and contrasted with the black ground of the vessel so decorated. One of the plates gives a picture of a round dish of this sort found at Cortaillod. "The (tin) ornamentation consists of a rosette in the middle, formed of quadrangles, which is surrounded by a band of a pattern similar to that called the meander. . . . The material is dark grey, blackened by graphite."

In textile fabrics the lake-dwellers, evinced considerable skill, and they arrived at the art of working by means of some kind of loom. As the weaving together of twigs for basket work bears a close resemblance to the weaving of softer materials into cloth or net, we shall commence with the former, and we learn that ropes or basket handles of twisted willow twigs have been discovered. Mats have likewise been found of bark, varying in the complexity

of their manufacture. A simple cross pattern under and over making a square pattern is represented in one of the plates. In other patterns (also depicted) "the warp is made of twisted strips of bark, and the woof of flat bands." Other patterns are still more complicated. Many articles made of flax have been discovered, and in some of them the famous "weaver's knot" appears. Fishing nets were made of flax, and many specimens of linen cloth, which, though rude as compared with the productions of civilized races, yet evince considerable skill, and are pronounced by persons in the trade to have been made in some kind of loom.

When specimens of linen cloth of a complicated pattern were first obtained, it was thought that they might have become accidentally associated with earlier fabrics, but investigation convinced the Swiss antiquaries that "these questionable specimens are the actual relics of the lake-dwelling settlers, and belong to the same age as the implements of stone and bone."

The lake-dwellers were acquainted with some mode of dressing and preparing the skins of animals they killed, but the remains of their industry in leather have been very imperfectly preserved, and little more than the fact of its existence seems to have been ascertained.

Our plate in vol. v. gives illustrations of the bronze work of the lake-dwellers, and the volume before us contains an immense number of engravings fully illustrating this very interesting subject. From a chemical analysis made by Professor Fellenberg, of Berne, it appears that the bronze of many of the weapons and implements discovered in the western part of Switzerland, consists of pure tin mixed with copper, containing a little nickel, "while not a trace of this metal is to be found in bronze objects met with elsewhere." Copper of this kind is afforded by the ores of the Valais, and it is conjectured that the lake-dwellers worked these ores, and obtained their tin from the Cornish mines.

No definite line of demarcation separated the "stone age" from the bronze period, but as metal implements became more plentiful the stone ones gradually disappeared. Considerable skill was attained in the manufacture of bronze articles, and in many cases the form and the ornamentation is of a pleasing kind. The lake-dwelling of Nidau-Steinburg, lake of Bienne, has supplied very numerous illustrations of bronze manufacture, including sickles, knives, celts, spear-heads, pins, rings, hooks, etc. Many of the pins were of an ornamental character (see our plate, vol. v.), and it would appear that armlets of the same materials, engraved with elegant angular patterns, were also in vogue.

At Marin a great many objects of iron have been found, swords, lances, rings, brooches, etc., etc. Other localities have likewise afforded iron articles, but Marin has yielded the richest supply. Professor Keller says, "The following facts result from the investigation of the arms and implements of Marin, and their comparison with the specimens found in England, Alesia, and Berne:—The form of the swords and lance points, the ornamentation on the sword sheaths, the marks on the sword blades, the numerous Gallic coins found with them, and the wide-spread district where they occur, show that all the Marin antiquities have come from some of the workshops of Gaul, perhaps situated amongst the Belgæ." In another instructive passage Professor Keller observes that, "in looking over the specimens from Marin what strikes us most is the fact that the weapons, and other implements, differ so essentially, both in material and form, from the products of the older settlements; not only has iron taken the place of bronze, but the form and ornamentation are so different, that one is tempted at first sight to attribute their origin to another nationality and another district. But when we carefully consider this phenomenon it appears less striking. For if we compare the relics of a pure bronze station, such as Wangen or Mooseedorf, that is, of simple bronze implements, with those of stone, wood, and bone, the difference between them in whatever is necessary for sustaining life is found to be much greater. It is certain that these are passages or transitions from the stone to the bronze period. On the one hand, we find a number of stations in which stone or bronze objects are mixed together in different proportions, and which reveal to us the gradual diffusion of metal tools. On the other hand we can follow up the development of the art of bronze casting, and see how at first implements of this material took the form of those of the stone age."

When the Marin objects were made, iron had full possession of the field, and the forms of the object had undergone a change, partly from the peculiarities of the metal, and partly, no doubt, from a considerable alteration in wants and modes of thought.

That people should continue to occupy lake-dwellings after they had acquired possession of iron implements made with great skill, does not appear as surprising to us as it does to some other observers. In our own day the conservative element which resists progress, perpetuates practices and processes long after better ones are known, and we are usually driven to improvements by the force of competition. Amongst a barbarous people the conservative element dominates their entire lives, while a semi-civilized race retains enough of the

same spirit to resist innovations with a steady and powerful force. Besides, the lake-dwellings may have been favourite abodes for a fishing and semi-aquatic population, long after they ceased to be desirable on the score of defence. Possibly a diminution in the quantity of fish easily procurable had more to do with the abandonment of these villages than anything else. When fish abound, and a family can secure a dinner by the simple expedient of suspending a few hooks and strings in the water, the temptation to live close to, or on the water, must be very strong.

Many interesting questions concerning the lake-dwellers remain to be worked out, but enough is known to warrant the belief that in certain stages of human progress—not necessarily coincident in point of actual time—the same mode of living has been adopted by different races in various countries. The crannoge of Ireland bears some resemblance to the pile-dwellings of Switzerland, and our own fen districts will most likely show that we had our population of lake-dwellers, when much of the land, now artificially drained and dried, was permanently submerged.

PROGRESS OF INVENTION.

PHOTOGRAPHY WITH DRY PLATES.—Photographers have never ceased to look for a process by means of which dry instead of wet plates might be used. Many such processes have been proposed; but though some of them have answered tolerably well, the greater length of time required for exposure, and generally a want of delicate graduation, and therefore of truth, in the tints and shadows obtained, has prevented any of them from being generally adopted. A want of complete success is the more unfortunate as the necessity for using a wet plate involves a very large amount of trouble and annoyance; especially when mountainous and other places accessible with difficulty, are to be visited. This inconvenience which has so long been felt, is now overcome; at least so far as perhaps it is possible to overcome it; since a wet must ever be superior to a dry plate in sensitiveness. The improved process, which is due to Mr. W. England, consists in adding to each ounce of ordinary bromo-iodized collodion, two grains of bromide of cadmium and two grains and a-half of common resin, then shaking the bottle well and allowing it to rest for a couple of hours. After this it may be used for coating the plate, which is sensitized by being placed for a few minutes in a silver bath that contains forty grains to the ounce, and four drops of nitric acid to the pint. The development is effected, after running a little varnish round the edges of the plate to prevent the film from becoming loose, and slightly washing, by ordinary iron solu-

tion, to which when it is poured off the plate two or three drops of a thirty-grain solution of silver are to be added, after which it is to be poured on again. Should it be found that the exposure in the camera has been too short, the development may be continued by a gelatino-iron solution. The fixing is effected in the usual way. The resin is supposed to act mechanically; and employed in this manner, the developer need not be pyrogallic acid. Only double the time required for exposure with a wet plate is necessary when this process is employed, and the pictures obtained by means of it are quite satisfactory. It involves, however, one inconvenience: fogging begins to take place after a certain number of plates have passed through the bath. But the addition of a few drops of ammonia or solution of carbonate of soda, and a few drops of solution of cyanide of potassium, placing for a few moments in the sun, filtering, and slightly acidifying with nitric acid, not only renders the bath as good as before, but suits it admirably for use in the wet process.

NEW BLEACHING PROCESS.—Until a comparatively recent period the process of bleaching was extremely tedious; it is still both troublesome and expensive. As it is carried on to an enormous extent, any improvement in it is a matter of the highest importance. It has been greatly simplified by MM. Tessié du Mothay and Rousseau, without being rendered less effective or less generally applicable. The article to be bleached is immersed in a solution of permanganate of soda, which has been rendered slightly acid, and is stirred about in it for a few minutes with a glass rod. It is then plunged into a solution of sulphurous acid, which removes the violet brown oxide of manganese deposited upon it in the first bath. After the successive immersions in the two fluids have been repeated two or three times, it is found to be beautifully white, without its fibres being in the least impaired in strength. In this, as in all the processes which have been used for bleaching, oxygen is the agent which destroys the colouring matters; but it is here applied in the form of ozone, which is disengaged from the permanganate by the organic matters. Permanganate of soda, is at present, somewhat costly, but MM. Du Mothay and Rousseau have discovered a method of producing it that is extremely economical.

SUBSTITUTE FOR SODIUM AMALGAM, IN METALLURGICAL OPERATIONS.

—The gold set free in extremely minute particles from crushed quartz, etc., is covered with an impalpable powder which protects it from the action of the mercury intended for its separation, and thus a considerable amount of gold is lost. In addition to this, the mercury thrown into a state of minute division by the agitation employed, being covered by the same impalpable powder, is incapable of reuniting: a considerable portion therefore assumes the appearance of a fine powder, and is carried off with the refuse; and thus a large amount of mercury is wasted. These two sources of loss have caused a great diminution of profits. It was, however, fortunately ascertained that the brilliancy of the mercury is restored, so that it will run together freely, and unite with the gold with the greatest avidity, if a minute quantity of sodium amalgam

is added to it. Hence sodium amalgam is now an important article of commerce. It is considered highly explosive, and therefore very dangerous: but such is not the case, the explosive property of pure sodium on coming into contact with water is lost almost entirely when it is associated with mercury, so as to form an amalgam. But sodium amalgam is now likely to be superseded by a far less expensive, and it appears not less useful material. Caustic soda has not only been found quite as effective as sodium amalgam, but it is contested that the sodium in the amalgam actually assumes the form of caustic soda before producing its effect. A very simple experiment will show the efficiency of the soda. If a finely pulverized metallic powder is thrown into water, no amount of stirring will cause it to fall to the bottom of the vessel; it is rendered specifically lighter than the fluid by the coating of air which adheres to it. But if a very small quantity of caustic soda or potash is added it will soon descend from the surface to the bottom. It is supposed that the minute particles of mercury also, and of gold, are prevented from coming into contact by a coating of air, which the alkali removes in a way which has not yet been ascertained. This, if the real, is perhaps not the only effect produced by the alkali. The potash of soda must not be allowed to lose its causticity by exposure to the air during transport, etc., or it will be ineffective: it may have become a carbonate, without those who use it being aware of the fact.

NEW APPLICATION OF TUNING-FORKS.—An instrument has recently been constructed at Paris which possesses great power and sweetness. It somewhat resembles a piano, but is far more simple, as the strings are replaced by tuning-forks, one for each note. The sounds are produced by hammers, and are very persistent unless brought to an end by removing the fingers from the keys, and thus allowing the dampers to act.

DISSOCIATION OF GASES AT HIGH TEMPERATURES.—Some interesting researches on this subject have recently been made by M. L. Caillietet, in developing the discovery of M. Sainte-Claire Deville, that at a high temperature the constituents contained in a mixture of gases will separate. As it is necessary to cool the dissociated elements rapidly, it was necessary to devise an apparatus suited to the purpose. By means of this apparatus some important facts were observed. Thus, that oxygen has no action whatever on hydrogen, carbon, or carbonic oxide, placed within a mass which is at a temperature higher than the melting point of platinum; and the conclusion arrived at was that all bodies would most probably be dissociated by a temperature sufficiently high.

APPLICATION OF A NEW PRINCIPLE TO FIRE-ARMS.—The inertia of the projectile causes a certain time to elapse before it is set in motion. A certain amount, therefore, of the force of the gunpowder is wasted, and the more rapid the explosion the greater the loss, from this cause. M. Galant, of Liege, has invented a breech-loader which meets this difficulty. The force of the charge is first communicated to an elastic body which is easily set in motion, and the force which in ordinary cases is wasted, but in this is stored up, is gradually

communicated to the ball, after it has begun to move. The charge is ignited by a needle, the explosion commencing at the end next the ball, but between the latter and the powder, are placed five pads of felt, those next the ball having been for the sake of lubrication, moistened with a fatty matter. This arrangement altogether changes the nature of the explosion. A white smoke escapes from the muzzle, instead of flame, and the penetrative effect is so great that with a charge consisting of 6.5 grammes of powder and a cylindrical-spheric steel ball weighing fifteen grammes, a plate of steel twenty-nine millimetres thick was perforated at the distance of one hundred metres. Omitting any of the pads causes a proportionate increase in the recoil.

NOTES AND MEMORANDA.

THE WORM PHENACIA PULOHELLA.—We are indebted for the following remarks to Mr. Jonathan Couch, F.L.S.:—"The *INTELLECTUAL OBSERVER*, No. 55, informs us, in a note copied from the *Annals of Natural History*, No. 103, that this has been described as a new species, which it may be to the generality of naturalists, but it is far from new to myself or to Mr. W. Laughrin, A.L.S., who long since sent them to the British Museum, and who has lately dredged a considerable number from sandy ground off the coast of Cornwall, at a depth of about forty fathoms. They appear to be not attached to the bottom, or to any substance at that depth; and that they are even capable of rising high in the water by their own action, appears from a note that I made long since, of one which was obtained, in its case, high in the water over a considerable depth. From the thinness and transparency of the case with the marks of rings, I have supposed that it was formed from an exudation from the surface of its body. This worm readily quits its case, or shrinks into it when afraid."

SPECTRUM OF APATITE.—Mr. W. G. Lettsom writes to us from Monte Video (12th June, 1866): "With reference to the letter of Professor Church, contained in No. 52 of the *INTELLECTUAL OBSERVER*, I beg leave to remark that the apatite which occurs in Spain, I believe at Villa Rica, in nearly colourless transparent crystals, exhibits the absorption bands as distinctly as zircon does. Five of these bands are very clearly defined. One, the second from the red end of the spectrum, is nearly as dark as the black zircon band."

THE RAPID INCREASE OF THE STAR IN CORONA.—Mr. Lynn, of the Greenwich Observatory, noticing, in *Astr. Nachr.*, a letter from Herr Schmidt, of the Athens Observatory, stating that between half-past eight and half-past nine, Athens time, on the 12th May, he was surveying the heavens near Corona, and must have seen the so-called "new star," if it had been as large as 5 mag., applied, through Mr. Huggins, to Mr. Birmingham, of Tuam, to know at what hour on the same night he saw this remarkable variable as of the 2nd mag. The reply was, not later than 11.45 p.m., local time, whence Mr. Lynn draws the important conclusion, that at 8 p.m., Greenwich time, the star must have been less, and may have been much less, than 5 mag., and that it increased to the 2nd mag. in four hours, either suddenly or with great rapidity. This star was noticed, on the 4th May, by Mr. Barker, of London, Canada West, as brighter than ϵ Corona. He thinks he saw it one or two years ago.

NEW PLANETS.—Mr. Pogson discovered a new planet, 11.5 mag., on the 16th of May. Professor Peters, of Hamilton College, United States, also discovered one on the 20th of June of the same size. The numbers will be (57) and (58). They are named Sylvia and Thisbe.

NEW PARASITIC CRUSTACEAN.—*Annals of Natural History* contains a translation of a paper by M. Hesse on a parasitic crustacean living in a small tumour often noticed in young green wrasses,* not far from the eye and the bronchial aperture. This tumour is formed by the entrance of a young crustacean of the order Lernæida under the fish scales, which it displaces as it grows, and eats a hole in the flesh. The body is fusiform; head small, rounded at the apex, bearing above a median eye, a proboscisiform process with denticulated jaws, and three pairs of prehensile footjaws.

DIALYTIC ACTION OF INDIA RUBBER AND METALS ON GASES.—A paper by Mr. Graham will be found in *Proceedings of the Royal Society*, 86, on this subject, in which it is stated that a thin film of caoutchouc has no porosity, and is really impervious to air or gas; but the same film is capable of liquefying the individual gases of which air is composed, while oxygen and nitrogen, in the liquid form are capable of penetrating the substance of the membrane (as ether and naphtha, etc.), and may again evaporate into a vacuum, and appear as gases. When thus acting on air, oxygen is absorbed two and a-half times more abundantly than nitrogen. The penetration by hydrogen of platinum and iron tubes, discovered by M. M. St. Claire Deville and Troost, is supposed by Mr. Graham to be connected with "a power resident in these and other metals to absorb and liquefy hydrogen, possibly in its character as a metallic vapour." Palladium foil at 100° C. condenses 643 times its volume of hydrogen, but has no absorbent power for oxygen or nitrogen. Mr. Graham observes, "It is believed that metallic pores, and indeed all fine pores, are more accessible to liquids than to gases, and in particular to liquid hydrogen."

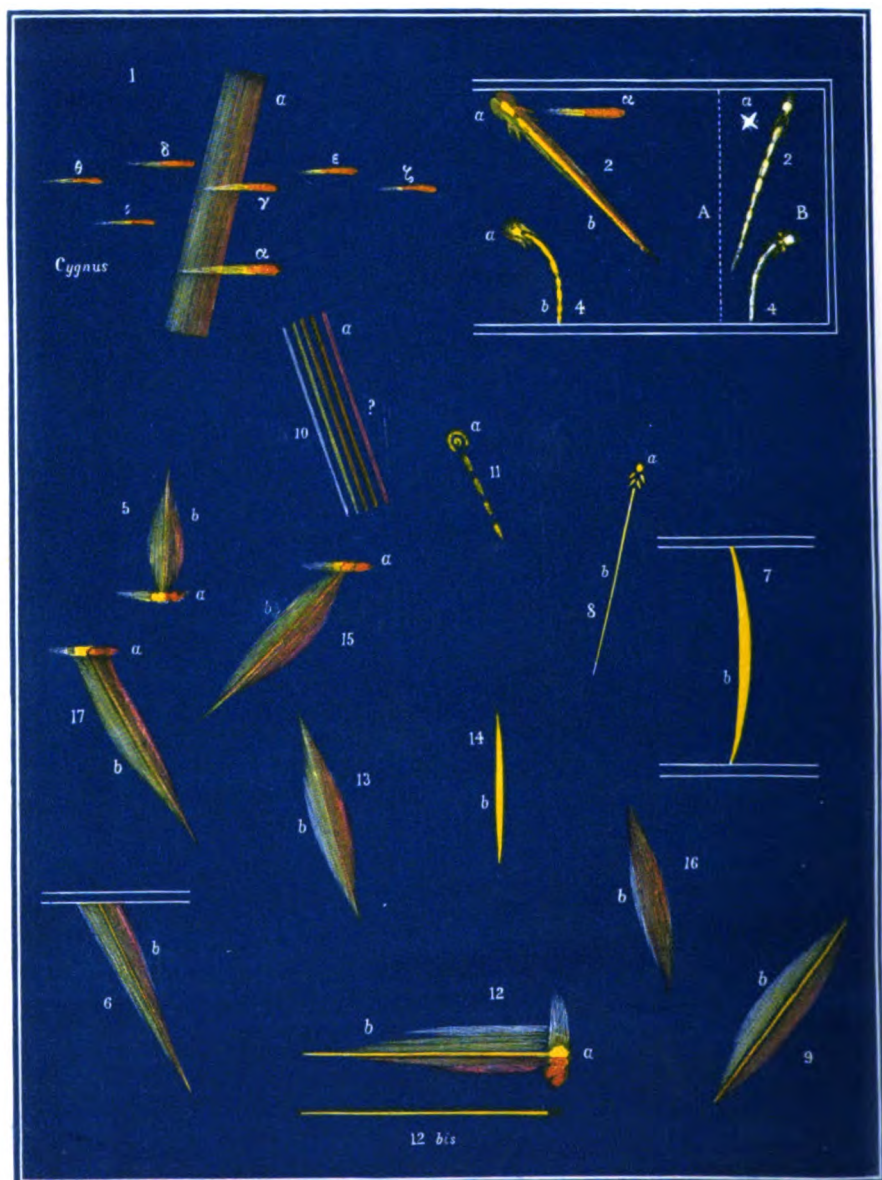
CONGELATION AND DEATH OF ANIMALS.—Dr. Davy, finding that a statement made by him many years ago, to the effect that a leech might be frozen without loss of life, was contradicted by more recent experiments of M. Puget, has repeated his investigations on leeches, frogs, etc., and he arrives at the conclusion that "the thorough congelation of an animal is incompatible with life." It is still, however, not certain to what extent congelation may be carried without death necessarily ensuing. What, for example, are we to make of the story of the frozen carp told by Sir J. Franklin, and cited by Mr. Couch. The amount of freezing in these cases may have been nearly complete. Dr. Davy's paper is in *Proceedings of the Royal Society*, 86.

MAGNETIC ACTION OF THE MOON.—*Proceedings of the Royal Society*, 86, contains a paper by Lieut.-General Sabine, F.R.S., on the lunar diurnal variation of the magnetic declination, and of the horizontal vertical components of the magnetic force, derived from seven years Kew observations, and from comparison with observations in other parts of the world. The paper states that "a magnetic variation shown to be thus obviously dependent upon the moon's position relatively to the terrestrial meridian, and agreeing in its principal features in such various localities, is urged by the author as being ascribable, with great probability, to the direct magnetic action of the moon."

CRYSTALLIZING CARBON.—M. Lionnet gives the following process in *Comptes Rendus*:—Take a long thin leaf of gold, or better of platina, and wind round it a helix formed of a similar tin leaf, so that the covered and uncovered portions of the platina shall be about equal. With the metallic couple thus formed a spiral is made, and plunged into sulphide of carbon. The sulphide is slowly decomposed, the sulphur combining with the tin, and the carbon being precipitated in crystals.

* For an account of the wrasses, see Couch's *Fishes of the British Islands*.





Drawn by A. Herschel.

PRISMATIC SPERMATOPHYTES. THE AUGUST MOLLUSC, 1861.

THE INTELLECTUAL OBSERVER.

OCTOBER, 1866.

PRISMATIC SPECTRA OF THE AUGUST METEORS, 1866.

BY A. S. HERSCHEL, B.A.

(*With Coloured Plate.*)

AN instrument for observing meteors was described in the August number of this journal, which had for its—certainly very unique, if not indeed for what must have appeared its impossible—object, to examine the colours, or other peculiarities of the prismatic spectrum produced by a ray of light emitted from the luminous streak, or from the nucleus of a shooting-star. A wide field of view; great facility of direction,—or in other words direct vision; the means of pressing two quick eyes into the service,—or, in other words, binocular arrangement; and, last of all, great power in the prisms, are the characters without which an instrument for viewing meteor spectra will be comparatively useless. A peculiar construction of prisms, described in a former volume, and a binocular arrangement of the same prisms, figured in the last-mentioned number of this journal, and answering all the above conditions, was invented as early as the year 1864 by the writer of these pages; and a meteor spectroscope, of the pattern now made by Mr. Browning, was presented by the writer to Mr. Babinet, at Paris, in August, 1864; without any attempt having hitherto been made, so far as the writer has been able to learn, to examine the peculiarities of meteor spectra, either by this or by any other means. If the problem of chemically analysing the substance of luminous meteors, by means of their light spectra, is not yet fairly solved, it is at all events pretty certain, from the following observations, that the metal *sodium* produces the most enduring light of the much-admired trains of the August meteors; and that at least one other mineral substance (either potassium, sulphur, or phosphorus) lends its aid, but in a much less remarkable degree, to produce the same luminous trains. Observations renewed

on the 13th of November will, doubtless, show a different result. The streaks of the November meteors are quite as enduring as those left by meteors on the 10th of August ; but their colour is white, verging to blue, while a glance at the brightest and most enduring meteor-streaks left on the 10th of August generally shows their *yellow* cast of colour. The first, or rudimentary colour of the August meteor-streaks is, like that of the November streaks, white or bluish ; and some few continue of this colour until they disappear. The effect is owing to the ignited vapour of the other mineral substance (potassium, sulphur, or phosphorus) to which allusion was just made, playing a principal part in the production of the streaks. Although glowing for a much shorter time, and with less intensity than the vapour of the metal sodium, it nevertheless in some instances forms the entire light of the meteor-streaks seen on the 10th of August. White, bluish, or "phosphorescent" streaks are most prevalent among the November meteors, and the light of this element, whatever it be, by which this bluish kind of phosphorescence of the streaks is produced, will probably appear more highly developed, and its spectrum will be more easily identified in the streaks of the meteors on the 13th of November, than it could be (from the brightness of the sodium-line) in the enduring streaks of the meteors of the 10th of August last. It extends between the red and the blue ; and is that portion of the visible train-spectrum which is called "diffuse" in the following observations :—

The meteor spectroscope, as already described, presents to the view a pretty considerable extent of the star-spangled surface of the sky. The spectra of the well-known "seven stars" of Ursa Major, may, for example, be seen together in the instrument at a glance. Each bright star is converted into a line of highly-coloured light, nearly three-quarters of a degree in length ; and horizontal, when the instrument is held in its natural position. Fifth magnitude stars are obliterated, and fourth magnitude stars appear only as a greyish line of light of no decided tint or colour. Prismatic hues are first perceptible in stars of the third magnitude and upwards. When the spectroscope is turned to a given part of the sky, the stars, through it, appear as if a gigantic wet brush had been applied to them in that part of the sky, and their light had been partially washed out in a particular direction. The effect is produced by the dispersion of the light of each star in passing through the prisms. Its single beam is spread out, as it were, into a fan of different coloured rays, called its "prismatic spectrum," and its light is proportionately enfeebled ; but the stars appear to occupy very nearly the same relative positions

in the field of view of the meteor spectroscope as that which they occupy in the sky to the unassisted eye. In this manner the instrument is well adapted for analysing the light of any bright object presenting itself for a moment in the part of the sky under examination, as, for example, the light of a shooting-star, or of its bright, fast-fading luminous train.

A flame of mono-chromatic light, or of light possessing only one degree of refrangibility presents, when viewed in the meteor spectroscope, a striking aspect. The flame of a common spirit-lamp, for example, possesses a faint and hardly distinguishable spectrum. Its light, when viewed through the instrument, is so dispersed, in a horizontal direction, as to be almost washed out, or obliterated; but if salt be introduced into the wick, the flame at once becomes conspicuous, and the homogenous character of its light is perceived by the sharpness of the definition, every flicker of its outline being visible, as perfectly and as brightly as it appears to the naked eye. The example of the spirit-lamp with a salted wick illustrates the streaks of some of the August meteors, which, when examined optically by the meteor spectroscope, reveal their chemical character from the composition of their light. Seventeen spectra were observed, in eight of which the sodium line, for the most part brilliant, and in some cases forming the entire spectrum of the streak, was plainly visible. Its position relatively to the rest of the spectrum, "on the side towards the red" (Nos. 9, 12, and 14), its golden yellow colour (Nos. 7, 8, 12, 14), its extreme brightness (Nos. 7, 14), and its single or isolated appearance (Nos. 8, 14) perfectly agree with the well-known appearance in the spectroscope of the yellow sodium flame; and at the same time with the spectrum of no other elementary substance, sodium only excepted, with which the spectroscope has made us acquainted. That the element sodium should be the first detected in the meteor spectra is by no means surprising, when the well-known brightness of this line of the spectrum is considered, wherever a trace of sodium exists in the outer luminous envelope of a flame. Nevertheless the fact, that the sodium line has been observed in the spectrum of lightning, is no proof that the meteor-streaks owe its presence in their light to the existence of the vapour of sodium in the atmosphere. No lines of nitrogen, or of any other known gas, accompany the sodium flame in the train spectra of the August meteors; but on the other hand the great intensity of the sodium streaks makes it almost certain that the meteors contain this element as a part and parcel of their chemical composition.

To obtain the spectra of meteors, a night must be chosen when they are more than ordinarily plentiful (such as, for