weight of 56lbs. The foreign Lepidoptera also figure largely, and are naturally attractive from their beauty, and in General Ramsay's cases from Nepaul, for their rarity. This portion of the series, however, is chiefly valuable for the illustrations of protective mimicry which it affords. Admirable specimens of the leaf butterfly, *Kallima inachis*, with the varying tints of their under surfaces, are in Gen. Ramsay's collection, and Mr. Swanzy has a grand series specially arranged of Diademas and Papiliones mimicking—some in the females and some in both sexes—the nauseous smelling members of the Danaidæ and Acraidæ. Similar series are shown by Rev. J. A. Walker and Mr. Weir. The extraordinary differences between male and female in some butterflies is well illustrated by Mr. Briggs' collection of Lycænas.

The remaining orders are in some instances admirably illustrated, but by far fewer exhibitors. Dr. Powers' nearly complete collections of British coleoptera and British hemiptera, are among the best ever made; and Mr. Frederick Smith's hymenoptera, which supplied much of the material for the British Museum Catalogue, and Mr. Stevens' exhaustive collection of weevils, both the results of forty years' work, are here exhibited. A most instructive series of Grecian hymenoptera, with their galleries bored in briars, and some magnificent coleoptera from Ashantee, containing beautiful examples of *Goliathus Drurii*, complete the list of the more noteworthy objects. Some important orders are thus without special illustration here, but no doubt this will not be the last as well as the first of such exhibitions; and when it comes round to the insects again we may hope to see as complete sets of diptera or neuroptera as of other orders. It would be a great advantage to students if such exhibitions of limited classes could be periodically instituted by loan, and Mr. Carrington certainly deserves our thanks for the idea and its successful realisation.

THE GOVERNMENT RESEARCH FUND

THE following list of grants to be paid from the Government Fund of 4,000*l.* on the recommendation of the Royal Society, during the present year, in aid of scientific research, has been sent us for publication:—

Not Personal.

David Gill, 93, Wimpole Street, W.—To defray Expenses connected with a Determination of the Solar Parallax by Observation of the Diurnal Parallax of Mars £250

Rev. Dr. Haughton, Trinity College Dublin.—For Aid in the Numerical Reductions of the Tidal Observations made on board the *Discovery* and *Alert* in the late Arctic Expedition £75

Prof. Fleeming Jenkin, 3, Great Stuart Street, Edinburgh.—For Experimental Investigations on Friction £50

W. Chandler Roberts, Royal Mint, Tower Hill, E.—For Researches on Metals and Alloys in a Molten State passing through Capillary Tubes £25

J. Kerr, Free Church Training College, Glasgow.—For Continuation of Electro-Optic and Magneto-Optic Researches £50

J. Norman Lockyer, 16, Penywern Road, South Kensington, S.W.—For Continuation of Spectroscopic Researches £200

Dr. O. J. Lodge, University College, Gower Street, W.C.—For Investigations into the Effect of Light on the residual Charge of Dielectrics; on the Conductivity of Hot Glass, and other Transparent Conductors, on Electrolytic Conduction, and other Subjects £100

Thomas Stevenson, Hon. Sec. Scottish Meteorological Society, General Post Office Buildings, Edinburgh.—For Aid in carrying on a Simultaneous Series of Anemometrical Observations at different heights, and in sheltered and unsheltered situations £50

W. Galloway, Cardiff.—For further Investigation of the Explosive Properties of Mixtures of Fire Damp and Coal Dust with Air £100

Sir William Thomson, University College, Glasgow.—For Tidal Investigations £100

For Experiments in Magnetisation of different Qualities of Iron, Nickel, and Cobalt under varying Stresses and Temperatures £100

J. E. H. Gordon, Pixholme, Dorking.—For Continuation of Experimental Measurements of the Specific Inductive Capacity of Dielectrics £100

H. Tomlinson, 36, Burghley Road, Highgate Road.—For Researches on the Alteration of Thermal and Electrical Conductivity produced by Magnetism, and on the Alteration of Electrical Resistance produced in Wires by Stretching £100

Prof. H. Alleyne Nicholson, University of St. Andrew's; R. Etheridge, jun., Geological Survey Office, Edinburgh.—For Aid in examining the Fauna of the Silurian Deposits of the Girvan District, Ayrshire, and in publishing a Descriptive List of the same £75

R. McLachlan, 39, Limes Grove, Lewisham.—For Aid towards the Expense of Publication of a Revision and Synopsis of European Trichoptera £50

C. Callaway, Wellington, Shropshire.—For Aid in working out the so-called Eruptive Rocks of Shropshire, and in verifying certain points in Local Geology £25

H. T. Stainton, Mountsfield, Lewisham.—In Aid of the Publication Fund of the Zoological Record Association... ... £150

Dr. J. W. Dawson, McGill College, Montreal.—For Aid in excavating Erect Trees in the Coal Formation of Nova Scotia, in Beds where they are known to contain Reptilian and other Remains £50

Dr. R. H. Traquair, Museum of Science and Art, Edinburgh.—For Aid in preparing and publishing a Monograph on the Carboniferous Ganoid Fishes of Great Britain £75

W. Saville Kent, St. Helier's, Jersey.—To pay for Microscopical Apparatus for the Further Prosecution of Investigations into the Structure and Life-History of certain Lower Protozoa £50

Dr. W. A. Brailey, 38, King's Road, Brownswood Park, Green Lanes, N.—For Researches on the Causes determining the Tension of the Globe of the Eye in Man and Animals, and on the Physiological Influence on this Tension of such Substances as Atropia, Daturin, Eserine, and Pilocarpine £25

E. A. Schäfer, University College, Gower Street.—For Payment of an Assistant in Continuing his Histological and Embryological Investigations £50

H. Woodward, 117, Beaufort Street, Chelsea.—For Continuation of Work on the Fossil Crustacea, especially with reference to the Trilobita and other Extinct Forms, and their Publication in the Volumes of the Palæontographical Society £75

Prof. H. G. Seeley, 61, Adelaide Road, N.W.—For an Examination of the Structure, Affinities, and Classification of the Extinct Reptilia and Allied Animals £75

Dr. C. R. A. Wright, St. Mary's Hospital, Paddington.—For Continuation of Researches on Certain Points in Chemical Dynamics; on the Determination of Chemical Affinity in Terms of Electrical Magnitudes; and on some of the lesser-known Alkaloids £100

Prof. C. Schorlemmer, Owens College, Manchester.—For Continuation of Researches into (1) The Normal Paraffins. (2) Suberone. (3) Aurin £100

Prof. E. J. Mills, 234, East George Street, Glasgow.—For a Research on Standard Industrial Curves £100

Personal.

J. Allan Broun, 9, Abercorn Place, St. John's Wood, N.W.,—For Continuation of Correction of the Errors in the published Observations of the Colonial Magnetic Observatories £150

Dr. J. P. Joule, 12, Wardle Road, Sale, near Manchester.—For an Exhaustive Inquiry into the Change which takes place in the Freezing and Boiling Points of Mercurial Thermometers by long Exposure to those Temperatures £200

Prof. W. K. Parker, 36, Claverton Street, S.W.—For Assistance in Continuation of Researches on the Morphology of the Vertebrate Skeleton and the Relations of the Nervous to the Skeletal Structures chiefly in the Head £300

Prof. A. H. Garrod, 10, Harley Street, W.—For Aid towards Publication of the Second Fasciculus of an Exhaustive Treatise on the Anatomy of Birds £100

Rev. J. F. Blake, 11, Gauden Road, Clapham, S.W.—For Aid in continuing the Publication of a Synopsis of British Fossil Cephalopoda £100

Dr. W. A. Brailey, 38, King's Road, Brownswood Park, Green Lanes, N.—For Researches on the Causes determining the

Tension of the Globe of the Eye in Man and Animals, and on the Physiological Influence on this Tension of such Substances as Atropia, Daturin, Eserine, and Pilocarpine £25

Dr. C. R. A. Wright, St. Mary's Hospital, Paddington.—For Continuation of Researches on certain Points in Chemical Dynamics; on the Determination of Chemical Affinity in Terms of Electrical Magnitudes; and on some of the lesser-known Alkaloids £200

Prof. Schorlemmer, Owens College, Manchester.—For Continuation of Researches into (1) the Normal Paraffins, (2) Suberone, (3) Aurin £150

W. N. Hartley, King's College, Strand.—For Investigation of the Fluid Contents of Mineral Cavities; of the Properties of the Phosphate of Cerium; of Methods of Estimating the Carbonic Acid in small Samples of Air; and of Photographic Spectra £150

Dr. Armstrong, Lewisham Village, S.E.—For Continuation of Researches into the Phenol Series... ... ... £250

THE SOURCES OF LIGHT[1]

WHEN the sun rises in the morning, the darkness of the night seems to fade away, and, wherever we look, without or within, all the air and space about us appears to be full of light. When evening comes again, the daylight disappears, and the moon and the stars give us another light. In the house we start the lamps, and they give us another light. Out-of-doors, in the dusky meadows, we see the fire-flies darting about, and giving out pale sparkles of yellow light as they fly. We look to the north in the night and see the aurora, or we watch the lightnings flash from cloud to cloud, and again we see more light.

This light from sun and moon, the stars, the fire, the clouds, the sky, is well worth studying. It will give us a number of the most beautiful and interesting experiments, and by the aid of a lamp, or the light of the sun, we can learn much that is both strange and curious, and perhaps exhibit to our friends a number of charming pictures, groups of colours, magical reflections, spectres, and shadows. All light comes from bodies on the earth or in the air, or from bodies outside of the atmosphere; and these bodies we call the sources of light. Light from sources outside of the atmosphere we call celestial light, and the sources of this light are stars, comets, and nebulæ. The nebulæ appear like flakes and clouds of light in the sky, and the comets appear only at rare intervals, as wandering stars that shine for a little while in the sky and then disappear. The stars are scattered widely apart through the vast spaces of the universe, and they give out their light both day and night. The brightest of these stars is the sun. When it shines upon us, the other stars appear to be lost in the brighter light of this greater star, and we cannot see them. At night, when the sun is hid, these other stars appear. We look up into the sky and see thousands of them, fixed points of light, each a sun, but so far away that they seem mere spots and points of light. Besides these stars are others, called the planets, that move round the sun. These give no light of their own, and we can only see them by the reflected light of the great star in the centre of our solar system. Among these stars are the Moon, Venus, Mars, Jupiter, and many others. We might call celestial light starlight; but the light from the great star, the sun, is so much brighter than the light of the others, that we call the light it gives us sunlight, and the light from the other suns we call starlight. For convenience, we also call the reflected light from the planets starlight, and the light from our nearest planet we call moonlight.

Terrestrial light includes all the light given out by things on the earth, or in the air that surrounds the earth. The most common light we call firelight, or the light that that comes from combustion. When we light a lamp or candle, we start a curious chemical action that gives out light and heat. The result of this action is fire, and the light that comes from the flame is firelight. When a thunder-storm rises, we see the lightning leap from the clouds, and give out flashes of intensely bright light. Sometimes, at night, the northern sky is full of red or yellow light, darting up in dancing streamers, or resting in pale clouds in the dark sky. You have seen the tiny sparkles of light that spring from the cat's back when you stroke her fur in the dark, or have seen the sparks that leap from an electrical-machine. All these—the aurora, the lightning, and the electric sparks—are the same, and we call such light electric light.

Sometimes, in the night, we see shooting-stars flash across the sky. These are not stars, but masses of matter that, flying through space about the earth, strike our atmosphere and suddenly blaze with light. The friction with the air as they dart through it is so great that these masses glow with white heat, and give out brilliant light. Two smooth white flint pebbles, or two lumps of white sugar, if rubbed quickly together, will give out light, and this light we call the light from mechanical action.

Sailors upon the ocean sometimes see, at night, pale-yellow gleams of light in the water. A fire-fly or glow-worm imprisoned under a glass will show, in the dark, bright spots of light on his body. A piece of salted fish or chip of decayed wood will sometimes give a pale, cold light in the night; and certain chemicals, like Bologna phosphorus and compounds of sulphur, lime, strontium, and barium, if placed in the sunlight in glass vessels and then taken into the dark, will give out dull-coloured lights. All these—the drops of fire in the sea, the glow-worm, the bit of decayed wood, and these chemicals—are sources of the light called phosphorescence.

These are the sources of light—the stars, the fire, electricity, friction, and phosphorescent substances. We can study the light from all of them, but the light from the sun or a lamp will be the most convenient. The light of the sun is the brightest and the cheapest light we can find, and is the best for our experiments. A good lamp is the next best thing, and in experimenting we will use either the sun or a lamp, as happens to be most easy and convenient.

The Heliostat.

In looking out of doors in the daytime we find that the sunlight fills all the air, and extends as far as we can see. It shines in at the window and fills the room. Even on a cloudy day, and in rooms where the sunshine cannot enter, the light fills everything, and is all about us on every side. Now, in studying light we do not wish a great quantity. We want only a slender beam, and we must bring it into a dark room, where we can see it and walk about it and examine it on every side, bend it, split it up into several beams, make it pass through glass or water, and do anything else that will illustrate the laws that govern it.

Choose a bright, sunny day, and go into a room having windows through which the sun shines. Close the shutters, curtains and blinds, at all the windows save one. At this window draw the curtain down till it nearly closes the window, and then cover this open space with a strip of thick wrapping-paper. Cut a hole in this paper about the size of a five-cent piece, and at once you will have a slender beam of sunlight entering the hole in the paper and falling on the floor. Close the upper part of the window with a thick shawl or blanket, and, when the room is perfectly dark, our slender beam of light will stand out clear, sharp, and bright.

As soon as we begin to study this beam of light, we find two little matters that may give us trouble. The sun does not stand still in the sky, and our beam of light

[1] From a forthcoming volume of the "Nature Series"—"Light: a Series of Simple, Entertaining, and Inexpensive Experiments in the Phenomena of Light, for the Use of Students of Every Age," by Alfred M. Mayer and Charles Barnard.