

boiler fall to a dangerous extent, the plug becomes hot, melts, and blows out, thus extinguishing the fire before overheating of the furnace plates can take place. It is well known that the behaviour of fusible plugs is somewhat erratic, and that they may be a source of danger on account of the false sense of security which they induce. It appears that there are two types of failures, those in which an oxide is formed as an interlocking network throughout the tin of the filling, and those in which the oxide forms as a solid hard mass at the fire end of the plug. In more than 1000 plugs examined, lead and zinc were found to be the principal impurities present, and an explanation of the formation of the network type of oxidation is found in the presence of zinc in amounts varying from 0.3 to 4 per cent. The use of pure tin of the quality of Banka (lead, traces up to 0.01 per cent.; zinc, traces) or of Straits (lead, up to 0.08 per cent.; zinc, traces up to 0.015 per cent.) would probably eliminate the danger of oxidation of these plugs in service.

A PAPER on the chemical and mechanical relations of iron, molybdenum, and carbon was read at the Institution of Mechanical Engineers on November 19 by Profs. J. O. Arnold and A. A. Read. Practical metallurgists estimate from lathe and drill experiences that, roughly, the steel-hardening power of molybdenum is from two to three times as great as that of tungsten. Theoretically, one atom of carbon is about 2.28 times as powerful in producing hardenite in true ferro-molybdenum steel as it is in forming the hardenite of true tungsten steel. Unfortunately, molybdenum is much more erratic in its behaviour than tungsten, and the latter, though the less powerful element, still sits unshaken on its throne, because of its trustworthy behaviour. The authors direct attention to the exceedingly poor mechanical properties of molybdenum steels compared with the corresponding steels containing tungsten. High molybdenum steel quenched out at a proper hardening temperature is very brittle, and it is clear that so powerful a steel-producing element should be used sparingly, avoiding large percentages. With low percentages it exerts a beneficial influence on certain classes of steel, when used cautiously either *per se*, or to replace about 2.5 times its percentage of tungsten.

THE annual report of the Board of Regents of the Smithsonian Institution for the year ending June 30, 1914, has been received from Washington. The first part of the volume, which runs to 729 pages, is devoted to the report of the secretary, which contains a summary of the researches and explorations carried out under the auspices of the institution, and eight appendices dealing with the year's work of the United States National Museum, the Bureau of American Ethnology, the National Zoological Park, the Astrophysical Observatory, and other organisations subsidised by the institution. But the most attractive section of the volume is the general appendix of nearly 600 pages containing thirty-two articles on recent advances and developments in science. These contributions are selected from scientific publications all over the world, and many are not easily accessible. The following translations of foreign scientific papers de-

serve special mention:—Modern theories of the sun, M. Jean Bosler, astronomer at the Meudon Observatory; Some remarks on logarithms apropos to their tercentenary, Prof. L'Ocagne, professor at the Ecole Polytechnique, Paris; The geology of the bottom of the seas, Prof. L. de Launay, professor at the Ecole supérieure des Mines, Paris; Recent oceanographic researches, Dr. Ch. Gravier; Homœotic regeneration of the antennæ in a plasmid or walking-stick, Mr. H. O. Schmit-Jensen, of Copenhagen; Latent life: its nature and its relations to certain theories of contemporary biology, Dr. Paul Becquerel; Excavations at Abydos, M. Edouard Naville; The rôle of depopulation, deforestation, and malaria in the decadence of certain nations, Dr. Felix Regnault; and a sketch of the life of Eduard Suess, by M. Pierre Termier, of the Paris Academy of Sciences. As usual, the volume is profusely and beautifully illustrated.

OUR ASTRONOMICAL COLUMN.

COMET 1915*d* (MELLISH).—The Copenhagen telegram announcing the discovery of this comet gave its position on September 19. According to the *Astronomische Nachrichten* (No. 4820), it was first seen by Mr. Mellish on the night of September 13, whilst on September 18 it was independently found by van Biesbroeck, Yerkes Observatory.

OCCULTATIONS BY THE MOON.—On the evening of December 10 the distant planet Uranus will be occulted by the moon. The disappearance of Uranus will occur at 6.2 p.m., and the reappearance at 6.10 p.m., so that the object will be hidden for a short period only by the limb of the moon in the apparent S.E. region of her disc. She will be four days old at the time, and visible as a narrow crescent with the opaque part perceptibly involved in earthshine. At the time of occurrence of the phenomenon the objects will be situated in the S.W. sky at a low altitude. Our satellite sets at 8.28 p.m.

On the night of December 18 some of the stars forming the Pleiades group will suffer occultation between 11h. 55m. and 13h. 51m. astronomical time. The occultation of these stars, and also that of Uranus on December 10, will require a fairly good telescope to be witnessed effectively, as the stars and planet are small, and will be partially overcome by the moon's light. This, however, refers more particularly to the occultation of the Pleiades, which takes place at a time when the moon is nearly full.

THE PERSEID METEORS IN 1915.—Meteoric astronomy is not only considerably alive in this country, but is also attracting increasing attention in the U.S.A., and we learn that there has recently been a very great increase in the membership of the American Meteor Society, from a report by Mr. Charles P. Olivier on the August meteor campaign (Monthly Reg. Soc. Pract. Astr., vol. vii., No. 6). Attention was mainly given to secure data for estimating the heights of the Perseid meteors. Observers situated at four stations arranged to maintain a watch on the same absolute section of the earth's atmosphere from 12h. to 14h. on each night from August 9–13 inclusive. Two nights (10 and 11) were totally cloudy. In the present report Mr. Olivier gives a summary of the observations made at one of the stations (Leander McCormick Observatory). The maximum of the shower occurred on August 12, whilst August 13 was notable for the brilliancy of the meteors seen. The publication of the complete results obtained will be awaited with considerable interest.

RADIAL VELOCITIES AND DISTANCES OF THE STARS.—The very puzzling relationship between the linear velocities of the stars and their spectral type has given rise to much speculation. Eddington's suggestion that the relationship is fundamentally between *distance* and velocity received support from the results obtained by Kapteyn for the K-type stars. Dr. W. S. Adams has recently extended the analysis to stars of the other main types (Proc. Nat. Acad. Sci., vol. i., p. 417; also *Astrophysical Journal*, November), with similar results—stars of types F, G, K, and M, having large proper motions, have also high linear velocities. For stars of types B and A the velocity difference is not so marked, but the range of proper motion is also considerably less.

The low average velocity of the distant stars of types F to M—stars of high absolute luminosity—together with the exceptionally great average radial velocity of the observed absolutely faint stars, stars of probably small mass, is held to favour Halm's hypothesis of the equipartition of energy among the stars.

A NEW ASTRONOMICAL PUBLICATION.—Under the ægis of the French Committee of Astronomy there has recently been launched a new periodical, entitled *Journal des Observateurs*. The editorial duties have been assigned to M. Henry Bourget, director of the Marseilles Observatory. The journal is to be strictly and exclusively devoted to the publication of observational matter concerning—for the present—planets and comets. The first number contains series of observations of comet Mellish (1915a), from Lyons, Algiers, and Marseilles, together with observations of minor planets. Numbers are to be published as occasion demands, and the terms of subscription are 25 francs per volume of twenty parts. We wish the new venture every success.

LANCASHIRE SEA-FISHERY INVESTIGATIONS.

NOTWITHSTANDING the fact that investigations at sea practically ceased with the outbreak of war, the report of the Lancashire Sea-Fisheries Laboratory for 1914 shows that much useful work was still carried on under the more restricted conditions which the war imposed. As Prof. Herdman points out in his introductory chapter, the present seems an opportunity to concentrate attention upon the cultivation of the shallower seas, and any increase of employment on the seashore or in shallow waters may be of direct and immediate advantage, both to the fishermen and to the country. "Such industries as shellfish cultivation, shrimping and prawning, whitebait and sprat fishing, if extended and exploited judiciously, will add to employment, will increase the food supplies of the country, and may lead to the establishment of permanent industries of a profitable nature."

One of the most useful sections of the report is the memoir by Dr. James Johnstone on the bacteriology of shellfish, which records the results of experimental work on the methods of cleansing mussels from ingested sewage bacteria. The self-cleansing of sewage-polluted mussels by placing them for some days in pure sea-water had previously been demonstrated. The experiments now described deal (1) with the periodic bacteriological examination of mussels from a polluted source, which were laid down either on the shore or in floating tanks in localities where pure sea-water is found; and (2) with similar bacteriological examination of mussels from a polluted source which were kept in sea-water sterilised by the addition of five parts in a million of chlorine. In both cases the number of organisms in the mussels was so far reduced that the shellfish might be safely used as food.

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In an appendix to the memoir, Dr. Johnstone gives a more minute and detailed examination of the scientific methods employed in his investigations and of the principles involved, which will be greatly valued by specialists in this line of work.

A second memoir by Dr. Johnstone deals with diseased and abnormal conditions of marine fishes, and forms a substantial addition to his previous work on this subject. The greater part of the memoir is devoted to the description of tumours found in fishes. Both benign and malignant tumours occur, the malignant being rare. All the malignant tumours the author has seen in fishes are sarcomata, due to an excessive growth of connective-tissue and almost always of the subintegumentary connective-tissues. Cases of hæmangioma in the eye of a stickleback and of papillary cystadenoma in a ling are also described.

A paper of high scientific value is that by Prof. B. Moore and Messrs. E. B. R. Pridaux and G. A. Herdman, entitled "Studies of Certain Photo-synthetic Phenomena in Sea-water." In this paper, seasonal variations in the reaction of sea-water in relation to the activities of vegetable and animal plankton are investigated and discussed. It is shown that the alkalinity of the water in the Irish Sea increases in the spring and summer months. This increase in alkalinity is not due to increasing temperature disturbing the equilibrium between the carbon dioxide of sea-water and atmosphere, for the rise in alkalinity clearly precedes in time the rise in temperature. It is caused, the authors state, by photo-synthesis, as is shown by its coincidence in its occurrence with the rapid lengthening of the day in March and the increasing sun's altitude, as also by the great changes in alkalinity which may be produced by exposure of sea-water containing algæ to sunlight.

Other subjects dealt with in the report are the plankton of the Irish Sea, the spawning period of the common shrimp, the whitebait fisheries of the Menai Strait, measurements of the Irish Sea race of herrings, and the variations in the amount of fat in these herrings at different seasons. The report as a whole shows that much valuable work is being carried out, and the Lancashire Sea-Fisheries Committee is to be congratulated upon it.

THE ACTION OF GASES ON IRON AND STEEL.

BY a curious coincidence, three out of the eight papers presented at the recent autumn meeting of the Iron and Steel Institute deal with the effects of a gas or its compounds when present in iron or steel. The gases dealt with are oxygen, by Mr. Wesley Austin; nitrogen, by Prof. N. Tschischewski, of Tomsk; and blast-furnace gases, by Mr. T. H. Byrom. The prominence thus given to the question of the action of gases reflects the increasing attention which this subject demands in practice. During most ordinary manufacturing processes our metals are exposed—often for prolonged periods—to the action of gases, and a knowledge of their action is thus of great importance. The subject is, however, beset with difficulties, since in many cases it is not at all easy to prepare alloys containing a given gaseous element in any desired proportion, while even the analytical determination of the nitrogen or oxygen contents of steel is by no means free from doubt and difficulty.

These difficulties are evident in the two papers named above, which deal with oxygen and nitrogen. Mr. Austin's specially prepared "oxygen alloys" contain relatively very large amounts of oxygen, and this makes it difficult to bridge the gap between his laboratory series and even the most highly oxygenated